LOUISIANA COASTAL AREA (LCA)
ECOSYSTEM RESTORATION STUDY

Volume IV of VI

Final Integrated Feasibility Study and
Supplemental Environmental Impact Statement

for the

Small Diversion at Convent/Blind River
St. James Parish, Louisiana

October 2010

U.S Army Corps of Engineers
New Orleans District

Coastal Protection and
Restoration Authority

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The responsible lead Federal agency for this study is the U. S. Army Corps of Engineers- Mississippi Valley, New Orleans District (CEMVN). The non-Federal sponsor for the study is Coastal Protection and Restoration Authority (CPRA). This report is a combined feasibility report and environmental impact statement complying with requirements of the U.S. Army Corps of Engineers (USACE) and the Council of Environmental Quality (CEQ), and is intended to reduce duplication and paperwork. An asterisk (*) in the table of contents notes paragraphs that are required for National Environmental Policy Act (NEPA) compliance.

October 2010

U.S Army Corps of Engineers
New Orleans District

Coastal Protection and
Restoration Authority

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This report contains six volumes.

You are at **Volume IV** which is the element-specific analysis for the **The Louisiana Coastal Area-Small Diversion at Convent/Blind RiverElement**.

Volume I:	Summary
Volume II:	Amite River Diversion Canal Modification
Volume III:	Atchafalaya Conveyance to N. Terrebonne Marshes
Volume IV:	**Small Diversion at Convent/Blind River Diversion**
Volume V:	Terrebonne Basin Barrier Shoreline Restoration
Volume VI:	White Ditch Diversion

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Final Integrated Feasibility Study and Supplemental Environmental Impact Statement
for the
LCA Small Diversion at Convent/Blind River

LEAD AGENCY: U.S. Army Corps of Engineers (USACE)– Mississippi Valley Division, New Orleans.

ABSTRACT: The USACE proposes to construct a freshwater diversion project from the Mississippi River in the vicinity of Romeville, Louisiana to provide freshwater, nutrients, and sediments to the southeast portion of the Maurepas Swamp to reverse the trend of deterioration in the swamp. The Mississippi River levee system has cut off the Maurepas Swamp (and Blind River) from the natural periodic, flooding by the Mississippi River and past construction of logging trails, drainage channels, pipelines and roads through the swamp has disrupted the natural flow and drainage patterns, and impacted the biological productivity of the swamp.

Without action, the swamp is predicted to continue to deteriorate at the same or accelerated rates, with approximately 21,369 acres (8,647 ha) of baldcypress-tupelo swamp projected to become marsh or open water over the 50-year period of analysis. Recent studies generally show that protecting wetlands has a net effect of lowering storm surge and wave heights compared to a future condition with extensive wetland loss. In addition to no action, twelve preliminary alternative plans to address the problems of swamp deterioration were developed and evaluated. After an iterative screening process, alternative plans were eliminated from further consideration because they did not adequately address the problems, planning goals or objectives. In addition to No Action, four alternatives were examined in detail as the final array. These four alternatives provide significant fish and wildlife habitat values and when compared to no action, contain elements that would work together to produce a greater overall benefit to restoring the swamp with limited detrimental environmental impacts to the study area.

Alternative 2, a 3,000 cfs diversion near Romeville is the Recommended Plan. It would improve and protect 21,369 acres (8,647 ha) of baldcypress-tupelo swamp, negatively impact 53 acres (21 ha) of forested wetland, and have a net value of 6,421 Average Annual Habitat Units (AAHUs) over the 50-year period of analysis. The Recommended Plan has a total estimated fully funded cost of $123,140,000. The Recommended Plan best meets the screening criteria; would accomplish the planning objectives and goals; would be consistent with the Environmental Operating Principles; and would best satisfy the Congressional mandate provided in Public Law 110-114 to reverse the trend of deterioration in the southeast part of the Maurepas Swamp.

COMMENTS: Please send comments or questions on this SEIS to the U.S. Army Corps of Engineers, New Orleans District, Attention: William P. Klein, Jr., P.O. Box 60267, New Orleans, Louisiana 70160-0267. Telephone: (504) 862-2540; FAX: (504) 862-2088. The official closing date for receipt of comments will be 30 days from the date on which the Notice of Availability of the SEIS appeared in the Federal Register.

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EXECUTIVE SUMMARY

ES-1 Summary Introduction and Study Information

This integrated feasibility study and supplemental environmental impact statement investigates alternatives to reverse the current decline of a portion of the Maurepas Swamp and to prevent the transition of the freshwater swamp into freshwater marsh and subsequently open water. Specifically, this feasibility study of the Small Diversion at Convent/Blind River evaluates a small hydraulic diversion (less than 5,000 cfs) from the Mississippi River into Maurepas Swamp and the the Blind River. Alternative locations for the proposed control structure in the vicinity of Convent, Louisiana, located at Mississippi River mile 159, were investigated. Reversing this decline will aid development of a more sustainable wetland ecosystem that will serve to protect the local environment, economy, and culture. In light of Louisiana's extreme vulnerability to intense storms this project may also provide some measure of flood damage protection.

The study identifies and evaluates management measures and alternatives that might contribute to reversing the current decline of the southeastern Maurepas Swamp. The purpose of this study is to identify reasonable alternatives and to screen the alternatives down to a recommended plan. The Blind River headwaters are located in St. James Parish approximately 2-3 miles north of the east bank of the Mississippi River at Convent. The Blind River flows then northeast through Ascension and St. John the Baptist Parishes before it empties into Lake Maurepas. The objective of this project is to introduce freshwater, sediment, and nutrients into the southeast portion of the Maurepas Swamp to improve biological productivity that will facilitate accretion in the swamp, and prevent further swamp deterioration.

The Study Area for this project included portions of the Mississippi River Deltaic Plain within coastal southeast Louisiana in the Lake Pontchartrain Basin. The Lake Pontchartrain Basin consists of four sub-basins—the Upper, the Middle, the Lower, and the Upland Sub-basins. The Study Area for this project is within the Upper Lake Pontchartrain Sub-basin. The Upper Lake Pontchartrain Sub-basin includes Lake Maurepas, Maurepas Swamp, Blind River, and portions of the Amite River.

Louisiana parishes in the Study Area include St. James and Ascension. The benefit area consists of the Maurepas Swamp and Blind River southwest of I-10. These boundaries define hydrologically distinct areas that can be individually addressed in the plan formulation process.

The Maurepas Swamp is one of the largest remaining tracts of coastal freshwater swamps in Louisiana. The Blind River flows from St. James Parish, through

Ascension Parish and St John the Baptist Parish, and then discharges into Lake Maurepas.

The Maurepas Swamp serves as a buffer between the open water areas of Lakes Maurepas and Pontchartrain and developed areas along the Interstate 10 (I-10)/Airline Highway corridor. Development along the I-10/Airline Highway corridor in this area includes residential, commercial, and industrial land use. The Maurepas Swamp is used for fishing, hunting, and other recreational activities and has considerable cultural significance since it is the largest contiguous tract of bald cypress-tupelo swamp near the New Orleans metropolitan area.

ES- 2 Need For and Objectives of Action

Study Area problems and opportunities were drawn from prior comprehensive planning studies and from public input and inter-agency information exchange. System-wide problems and opportunities were used to identify and define more geographically specific problems and opportunities throughout the Study Area. Through the NEPA public scoping process, the study team solicited input on problems and opportunities from members of the public, government resource agencies, and other stakeholders

Study Area Problems & Needs:

The Mississippi River and Tributaries (MR&T) levee system has isolated the Maurepas Swamp (and Blind River) from the natural, periodic, near-annual flooding by the Mississippi River. This has resulted in a degradation/deterioration process and reduced biological productivity in the swamp due to lack of freshwater, nutrients, and sediment input from the Mississippi River. The swamp is also subsiding due to natural causes and possibly due to man-made activities such as oil, gas, and groundwater withdrawals. The reduced biological productivity combined with the lack of sediment from the river has reduced soil formation (accretion) to a rate less than the subsidence. Consequently, the land surface is sinking.

Additional ecosystem problems are associated with past construction of logging trails, drainage channels, pipelines, other utilities, and roads through the swamp. These features disrupt the natural water flow and drainage patterns and impact the biological productivity of the swamp. Short circuiting of the natural drainage patterns has created ponding in some areas which inhibits bald cypress and tupelo propagation.

The Blind River project is being planned to address the problem of severe deterioration of the Maurepas Swamp. Subsidence, storm surge, saltwater intrusion, impoundment, lack of substrate accretion, tree regeneration and the absence of freshwater, sediments, and nutrients from the Mississippi River have all caused significant adverse impacts to the Maurepas Swamp and Blind River, resulting in swamp ecosystem degradation.

Specific problems identified in the Study Area are:

- Tree mortality and decline in the overall health of the swamp
- Exposure to stochastic risks, particularly increased salinities
- Potential impacts to populations of indigenous fish and wildlife species
- Vulnerability of the area to hurricane-related damage and conversion to open water areas

Study Area Opportunities: As management measures are developed opportunities within the Study Area will be identified and incorporated into the planning process. Opportunities identified in the 2004 LCA report and further developed for the Blind River study are listed below:

- Prevent future cypress swamp degradation and transition currently predicted to occur
- Restore the deltaic process impaired by levee and dredged material bank construction
- Enhance Blind River water quality by diverting freshwater from the Mississippi River to the Blind River
- Protect vital socioeconomic and public resources, such as the growing eco-tourism industry resident in the Maurepas Swamp and the Maurepas Wildlife Management Area.
- Enhance recreational opportunities in the Maurepas Swamp and Blind River

Planning Objectives

The goal of the Small Diversion at Convent/Blind River Project is to reverse the trend of degradation in the southeastern portion of the Maurepas Swamp, to help achieve and sustain a coastal ecosystem that can support and protect the environment, economy, and culture of southern Louisiana and thus contribute to the well-being of the Nation.

The overall objective of the Small Diversion at Convent/Blind River Project is to reverse the trend of deterioration of southeast Maurepas Swamp and Blind River.

Specific Project Objectives

Objective 1: Promote water distribution in the southeastern portion of Maurepas Swamp to move stagnant water out of the system.

Objective 2: Facilitate swamp building, at a rate greater than swamp loss due to subsidence and sea level rise, by increasing sediment input and swamp production to maintain or increase elevation in the swamp.

Objective 3: Establish hydro period fluctuation in the swamp to improve baldcypress and tupelo productivity and their seed germination and survival, by increasing the length of dry periods in the swamp.

Objective 4: Improve fish and wildlife habitat in the swamp and in the Blind River

ES-3 Existing and Future Without Project Condition

With no connectivity to the Mississippi River, the Blind River watershed has been cut-off from periodic Mississippi River flows resulting in much lower availability of freshwater, nutrients, and sediment. Without freshwater, nutrients, and sediment reintroduction into the Blind River watershed, observed conditions of deterioration are expected to continue into the future.

Without action, the swamp is predicted to continue to deteriorate at the same or accelerated rates, with approximately 21,400 acres (8,600 ha) of baldcypress-tupelo swamp projected to be lost over the 50-year period of analysis, including 3,300 acres (1,300 ha) of baldcypress-tupelo swamp that would become marsh in 20 to 30 years, 7,900 acres (3,200 ha) of baldcypress-tupelo swamp that would become marsh in 30 to 50 years, and 10,140 acres (4,100 ha) of baldcypress-tupelo swamp that would become marsh in greater than 50 years.

A more complete and detailed description of the existing and future without project conditions can be found in Sections 4 and 5 of this report.

ES-4 Plan Formulation and Alternative Screening

The following paragraphs summarize the alternative plan formulation process, alternative evaluation criteria, selected alternatives for detailed analysis and plan implementation and management.

Management Measures

Management measures were developed to address Study Area problems and to capitalize upon Study Area opportunities. A total of 99 measures were considered and evaluated. Management measures were derived from a variety of sources including prior studies, the NEPA public scoping process, and the multidisciplinary, interagency PDT. Management measures identified were organized into structural and nonstructural measures.

Structural Measures (Features)

- **Water Management Modifications in Maurepas Swamp:** Various water management measures were identified to apply diverted freshwater to the swamp to beneficially allow transfer of freshwater and release of nutrients and sediments to the swamp. This category of management measures included the inflow of the water from a distribution system, sheet flow across the swamp through existing and proposed berm gaps, and then release and, if required, control of flow and final routing to the Blind River.
- **Distribution System within the Maurepas Swamp:** After being delivered to the fringes of the distribution area, the freshwater will have to

be transported and distributed throughout the swamp to avoid short-circuiting into existing pipeline and drainage channels and into the Blind River.

- **Separate Distribution System:** This measure would keep the freshwater conveyance separate from the existing drainage systems. The initial concept is to provide the distribution system, consisting of either canals or underground conduits, to transport the freshwater to the upstream ends of sub-basins (hydrologic units), where it will be released. Outlet controls may be required to prevent channelization and to control the hydroperiod in the swamp
- **Transmission (Transfer) System:** The transmission or transfer system includes the facilities necessary to transfer the freshwater from the diversion point and deliver it to the distribution system at the edge of the swamp.
- **Diversion System:** The diversion for the Blind River project will be located on the east bank of the Mississippi River at a point with available alignments into the Maurepas Swamp.
- **Diversion Point:** Seven potential diversion point locations were identified. In addition to a single diversion point, multiple diversion points were considered as the project progressed.
- **Water Quality Management:** Water quality management measures are required for two broad purposes:
  - Provide the desired water quality and parameters in the freshwater delivered to, and applied in, the swamp.
  - Protect and possibly improve the water quality in the streams and water bodies downstream of the targeted service area.

  The swamp has specific needs to promote revitalized growth, including the freshwater, suspended sediment, and nutrients in the water. The Mississippi River water may have pollutants that can be assimilated in the swamp, such as mercury, pesticides, and nutrients.
- **Sediment Management:** The existing ground surface in the swamp has had a net loss of elevation relative to sea level due to ground subsidence trends and sea level rise. Several measures were identified to introduce sediment directly into the swamp. Sediment can assist with vertical accretion and will be supplemented by vegetation and litter fall that will also add to the soil base in the swamp.

Non-Structural Management Measures (Activities)

- **Water Quality Management.**
  - **Extended diversion duration to freshen Blind River.** The anticipated diversion period will be in the spring. During the dry season, the Blind River becomes stagnant, due to lack of local rainfall and runoff. The diversion period could be extended into the dry seasons to freshen the Blind River and downstream water courses. This management measure would require a corresponding measure at

the diversion point, such as pumps, to allow diversion during low water levels in the Mississippi River.
    - **Extended diversion duration to counter salinity intrusion.** The Study Area is subject to high levels of salinity backing up from the Gulf of Mexico due to stochastic events. These include extended droughts and tropical storm surges. Providing capabilities for extended diversion periods, as discussed above, could assist in flushing out the system after the salinity intrusion events.
- **Vegetation Management:** A major objective of the diversion project is to improve conditions for bald cypress and tupelo germination and seedling recruitment to promote regeneration. Measures can be taken to assist in regeneration and to protect against loss of seedlings and saplings, including:
    - Plant seedlings in targeted areas. This could be a one-time planting, or routine plantings in different areas over the design life of the project;
    - Identify areas and control the water levels to mimic the natural wet – dry cycle; and
    - Control herbivore grazing of the seedlings with fences or other means.
- **Recreational Access and Enhancements:** The swamp and the existing wildlife management area is a recreational destination for the general public. A diversion will enhance nutrient assimilation and thereby improve water quality and in turn fish and wildlife habitat which will enhance recreational activities.
- **Real Estate:** Real estate acquisition will be required for all elements of the project, including the diversion structure, the transmission system, and all elements within the targeted project service area in the swamp.

There were a total of 75 management features included in the initial screening and 24 management activities. As an initial step the screened list of management measures was evaluated based on benefits, constraints, and relative costs. Based on that initial screening of the management measures, 48 features and 3 activities were retained for further analysis.

The retained management measures were then grouped into a preliminary array of 12 alternatives and the no action alternative for further evaluation to achieve the overall project goals and objectives. The 12 alternatives were formulated to consider 11 different options for the diversion point, different diversion methods, the transmission system, the distribution system, and the benefit area. Through iterative screening of the alternatives with respect to their viability to meet project goals, a final array of five alternatives was considered for further detailed analysis.

Identification of the Final Array of Alternatives

The following five alternatives were identified for further consideration and inclusion in the Final Array are:

- No Action (required to establish baseline conditions and the need for a diversion)
- Alternative 2 – 3,000 cfs Diversion at Romeville (Gated Culvert System)
- Alternative 4 – 3,000 cfs Diversion at South Bridge (Gated Culvert System)
- Alternative 4B – 3,000 cfs Diversion at South Bridge with split flows (Gated Culvert System)
- Alternative 6 – Two 1,500 cfs Diversions at Romeville and South Bridge (Gated Culvert Systems)

No Action (Future without Project Conditions)
The No Action Alternative will lead to the eventual degradation of the swamp in the distribution area. Local drainage occurs in episodic events and sends large quantities of water to the Blind River and the swamp. This local drainage can contain significant pollutants in terms of sediment, nutrients, pesticides, and herbicides. Without the natural assimilation capacity of the swamp, these pollutants can cause stresses on the aquatic life in the Blind River.

Without adequate flow of water through the swamp and with issues relating to subsidence, and relative sea level rise as well as ponding and drainage from pipeline channels, the hydro period of the swamp is not conducive to the health and regeneration of several native tree species, including baldcypress and water tupelo. The swamp has been traversed with many man-made features, including railroad embankments and channels, which have disrupted the natural hydro period of the swamp and limited the vertical accretion that would occur from sediment input and prolific vegetation growth from the nutrient input from the Mississippi River.

Alternative 2 – A 3,000 cfs Diversion at Romeville
This alternative adds a gated culvert system and transfer canal along the Romeville alignment, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp, and adds 4 new culverts under U.S. HWY 61. The purpose of the diversion is to bring freshwater, sediment, and nutrients to the swamp at strategic times during the year.

Alternative 4 – A 3,000 cfs Diversion at South Bridge
This alternative adds a gated culvert system and transfer canal along the Cox alignment south of the U.S. HWY 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp, and adds 4 new culverts under U.S. HWY 61. The purpose of the diversion is to bring freshwater, sediment, and nutrients to the swamp at strategic times during the year.

Alternative 4B – A 3,000 cfs Split Diversion at South Bridge

This alternative adds a gated culvert system and transfer canal along the Cox alignment south of the U.S. HWY 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp, and adds 4 new culverts under U.S. HWY 61. This alternative includes a modification to the distribution of the diversion provided by Alternative 4 by sending 1,500 cfs to the south through the St. James Parish Canal in order to achieve a similar distribution to Alternative 6. The purpose of the diversion is to bring freshwater, sediment, and nutrients to the swamp at strategic times during the year.

Alternative 6 – A 3,000 cfs Dual Diversion at Romeville and South Bridge

This alternative adds a gated culvert system- and a transfer canal- along the Romeville alignment and a gated culvert system- and transfer canals along the Cox alignment south of the U.S. HWY 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp, and adds 4 new culverts under U.S. HWY 61. The purpose of the diversion is to bring freshwater, sediment, and nutrients to the swamp at strategic times during the year.

Comparison of Alternative Plans

The four alternatives in the final array were compared to each other and to no action based on benefits, costs, and impacts. The first cost and annual costs for the final four alternatives are below.

Alternative 2 is the least expensive with a first cost of about $102 million with Alternative 6 being the most expensive at over $155 million. Alternatives 4 and 4B are slightly less expensive than Alternative 6 at $152.2 million and $146.9 million, respectively. A cost summary comparison of the final array of alternatives is provided in Table ES-1.

ES-1: Cost (millions of dollars) of Final Array Alternatives[1,2]

Item	Cost (millions of dollars)			
	Alt. 2	Alt. 4	Alt. 4B	Alt 6
Construction Subtotal	$73.5	$110.7	$106.8	$111.2
Engineering & Design (E&D)	$3.7	$5.5	$5.3	$5.6
Supervision & Administration (S&A)	$2.2	$3.3	$3.2	$3.3
Real Estate	$2.2	$2.2	$2.2	$4.4
Subtotal	$81.6	$121.8	$117.5	$124.5
Contingencies @ 25%	$20.4	$30.4	$29.4	$31.1
Total First Cost	$102.0	$152.2	$146.9	$155.6

Annualized First Cost	$5.06	$7.55	$7.28	$7.72
Annual O&M Costs	$0.59	$0.59	$0.67	$0.74
Total Annual Cost	$5.65	$8.14	$7.95	$8.46

* Costs for Adaptive Management are not included in Table ES-1.

Table ES-2 summarizes the results of the Wetlands Value Assement (WVA) benefit analysis and of the IWR-PLAN incremental cost analysis. Although Alternative 6 provides the greatest number of environmental benefits in terms of AAHUs estimated using the WVA process. Alternative 2 provides over 90% of the benefits for about 67% of the cost of Alternative 6. As can be seen from Table ES-2 below, the cost per AAHU is much lower for Alternative 2 that for the other three alternatives and the incremental cost per habitat unit in going from Alternative 2 to Alternative 4B and/or Alternative 6 is quite high. Another factor to consider is that Alternative 2 impacts the smallest number of wetland acres. Accordingly, Alternative 2 is the alternative that reasonably maximizes ecosystem restoration benefits compared to costs and is designated as the National Ecosystem Restoration Plan (NER).

Table ES-2: Summary of WVA Analysis AAHUs, IWR-PLAN benefits, and Wetland Impacts (acres) for Final Array Alternatives[3],[4]

	Alt. 2	Alt. 4	Alt. 4B	Alt. 6
AAHUs	6,421	6,124	7,103	7,114
Cost ($1,000s)	$5,646	$8,135	$7,954	$8,455
Cost-effective	Yes	No	Yes	Yes
Best Buy	Yes	No	Yes	Yes
Cost/HU	$879	$1,328	$1,120	$1,189
Incremental Cost/HU		negative	$3,385	$4,054
Wetland Acres Impacted*	53	271	306	287

*Wetlands impacted during project construction.

ES-5 NER Plan

The NER Plan reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective. Based on the comparison of alternatives above, Alternative 2, a 3,000 cfs diversion at Romeville is designated as the NER Plan.

ES-6 Plan Selection – Tentatively Selected Plan

After comparing the four alternative plans carried over for detailed analysis and the No Action Alternative, Plan 2, a 3,000 cfs diversion at Romeville was selected, as the Tentatively Selected Plan (TSP) and later confirmed as the Recommended Plan. Plan 2 best meets the screening criteria; would accomplish the planning objectives and goals; would be consistent with the Environmental Operating Principles; and would contribute to reversing the trend of deterioration in the southeast part of the

[3] All costs are in October 2009 prices

[4] First costs were annualized using a discount rate of 4-3/8% over a 50-year period

Maurepas Swamp. The Recommended Plan would improve a total of 21,369 acres (8,648 ha) of baldcypress-tupelo swamp that are in various stages of deterioration. The Recommended Plan would improve 3,295 acres (1,333 ha) of baldcypress-tupelo swamp that would become marsh in 20 to 30 years without project implementation, 7,934 acres (3,211 ha) of baldcypress-tupelo swamp that would become marsh in 30 to 50 years without project implementation, and 10,140 acres (4,104 ha) of baldcypress-tupelo swamp that would become marsh in greater than 50 years without project implementation.

Components

Alternative 2, a 3,000 cfs diversion at Romeville, has six major components: a diversion structure, a transmission canal, control structures of various sizes, approximately 30 berm gaps, cross culverts at four locations along the U.S 61, and instrumentation. The Recommended Plan components are summarized in the following table.

Table ES-3: Recommended Plan Components

Item	Description
Diversion Culvert	3,000 cfs
Box Culverts[5]	3 – 10' x 10' reinforced concrete, multi-cell box culvert
Sluice Gates	3 – 10' x 10' cast iron gates with motor operators
Trash Racks	Coarse grid
Inlet Canal	Earthen channel – 40' bottom width, 4:1 SS, 27' deep
Transmission Canal	3,750 cfs (1.25x diversion flow rate)
Earthen Canal	155' bottom width, 4:1 SS, 12' deep
Berms	Earthen embankments, 12' top width, 3:1 SS (exterior)
Culverts at CN RR	8 – 12'x8' reinforced concrete multi-cell box culverts
Culverts at LA 3125	8 – 12'x8' reinforced concrete multi-cell box culverts
Control Structures	
Control Structure	Large concrete structure in existing channel
Control Building	Housing for instrumentation, HPU, generator
Berm Gaps	
500-foot Wide Gaps	Excavate gaps at 2,500-foot spacing in spoil banks
Cross Culverts at Hwy 61	
Box Culverts	3 – 3'x4' Box Culverts at 4 locations
Instrumentation	
Local instrumentation	Monitoring and control at diversion and control structures
Stream Stage Monitors	Monitoring in Blind River and drainage channels
Communication	Remote satellites for communication to control building

[5] Box culvert dimensions are horizontal x vertical inside dimensions.

ES-7 Monitoring Plan and Adaptive Management

A feasibility level monitoring and adaptive management (AM) plan was developed for the LCA Small Diversion at Convent/Blind River project. The monitoring and AM plan for this project was developed with assistance from the LCA AM Formulation Team. The feasibility level monitoring and AM plan was developed to include a sufficient description of the proposed monitoring and AM activities to identify the nature of proposed AM activities and to estimate the costs and duration of the monitoring and AM plan.

The project monitoring and AM plan describes and justifies AM in relation to the proposed project management alternatives identified in the Feasibility Study. The plan also identifies how AM will be conducted for the diversion at Convent/Blind River and who will be responsible for this specific AM program. The results of this project-specific AM program will be used to adaptively manage the project, including specification of conditions that will qualify project success and terminate the AM program.

ES-8 Effectiveness of Recommended Plan in Meeting Goals and Objectives

The Overall Small Diversion at Convent/Blind River project objective is to reverse the trend of deterioration of Maurepas Swamp and Blind River.

The Recommended Plan would meet the overall and the specific project objectives. The diversion will bring nutrients, sediment, and water to the swamp to increase productivity and accretion (swamp building). The construction of new gaps in berms, maintenance of existing gaps in the berms, and strategically placed control structures in the major conveyance channels, along with the diversion, will promote water distribution to increase productivity and accretion (swamp building). The operational flexibility provided in the Recommended Plan will allow establishment of hydroperiod fluctuations in the swamp to improve seedling germination and survival. Nutrient assimilation in the swamp of water diverted from the Mississippi River will improve water quality and thereby the fish and wildlife habitat in the swamp and in Blind River. These activities would reverse the trend of deterioration of Maurepas Swamp (west) and Blind River.

ES-9 Effectiveness of Recommended Plan in Meeting Environmental Operating Principles

The Recommended Plan is effective in meeting the environmental operating principles developed by the U.S. Army Corps of Engineers to apply to all its decision-making and programs and to reaffirm its commitment to the environment. The Recommended Plan is environmentally sustainable as it minimizes operational activities to the extent possible while maintaining operational flexibility to restore a viable natural system. The Recommended Plan was developed to reverse deterioration of the swamp and Blind River by utilizing the natural swamp building and assimilation processes balanced with appropriate management activities while minimizing environmental consequences. The improvement of bald cypress-tupelo swamp provided by the Recommended Plan will mitigate for the unavoidable wetland impacts resulting from project implementation. Monitoring and adaptive management will provide knowledge on how to effectively implement small diversion projects to maintain and protect valuable swamp ecosystems. In addition, the Recommended Plan was developed with the inclusion of important stakeholder input.

ES-10 Compensatory Mitigation Measures

Compensatory mitigation is not needed for this project. Wetland impacts were avoided and minimized to the extent possible in the preliminary design of the Recommended Plan. The Recommended Plan will impact 53 acres (21ha) of wetlands with construction of the Romeville diversion canal. The wetlands that will be impacted are not part of Maurepas Swamp that will be improved (as described above). The improvement of 21,369 acres (8,648 ha) of bald cypress-tupelo swamp will mitigate for the wetland impacts resulting from construction of the Romeville diversion canal.

ES-11 Risk and Uncertainty

The study addresses risk and uncertainty as related to the ability of the proposed system to meet the project objectives. Areas of risk and uncertainty analyzed include hydrologic, environmental, engineering design, operational performance and maintenance needs, construction, and economics. In summary the Recommended Plan is a robust solution to the identified problems and considered likely to be successful in meeting and/or exceeding the planning objectives. See **Section 3.8** for a more complete discussion of the risk and uncertainty analysis.

ES-12 Implementation Responsibilities and Cost Sharing

The State of Louisiana, acting through the Coastal Protection and Restoration Authority of Louisiana (CPRA), will be the non-Federal sponsor for the LCA Small Diversion at Convent/Blind River project. In November 2008, the USACE and CPRA executed a single Feasibility Cost-Share Agreement covering six Louisiana Coastal Area near-term plan elements listed in Section 7006(e) of the Water Resources Development Act of 2007. The six features each underwent a separate feasibility analysis and environmental compliance analysis culminating in a single master feasibility document. The cost-share during the feasibility phase was 50% Federal and 50% non-Federal. However, the individual elements have been divided so that each entity had lead responsibility for preparing three of the six report components. At the end of the feasibility phase the total cost for all elements will have been shared on a 50/50 basis, yet for work on each individual element during the feasibility phase the ratio of funds expended by either the Federal or non-Federal sponsor will be higher depending upon their level of responsibility. CPRA had the technical planning lead for this particular LCA project element.

Following the feasibility phase, the cost share for the planning, design and construction of the project will be 65% Federal and 35% non-Federal. The CPRA must provide all lands, easements, rights-of-way, utility or public facility relocations, and disposal areas (LERRDs) required for the project. Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) of the project would be a 100% CPRA responsibility.

Table ES-4 below provides the distribution of cost for the fully funded project cost estimated. The estimate includes contingencies based on a risk and uncertainty analysis using the Crystal Ball computer program, price escalation to October 2011, and inflation to the midpoint of construction. According to the MCACES cost estimate developed, the total fully funded cost of constructing the Recommended Plan is $123,140,000. The Federal cost-share for construction of the Recommended Plan would be $80,041,000 and the non-Federal cost share would be $43,099,000. Operation and maintenance costs will be $462,000 annually and the cost to dredge sediments from the transfer canal will be $2,200,000 annually. The State of Louisiana is in full support of the LCA Small Diversion at Convent/Blind River project at the current cost share ratio of 65 percent Federal, 35 percent non-Federal, with operations, maintenance, repair, replacement and rehabilitation being a 100 percent non-Federal responsibility, as required in WRDA 2007. Additionally, project monitoring and any Adaptive Management deemed necessary will be cost shared at 65/35 for the first ten years of the project life.

Table ES-4: Cost Sharing

ITEM	**FEDERAL**	**NON-FEDERAL**	**TOTAL** (Rounded)
LERRDs to be acquired		$4,040,000	$4,040,000
Facility/Utility Relocation		$14,060,000	$14,060,000
Highway modifications/Relocations		$1,820,000	$1,820,000
Railroad modifications/Relocations		$2,090,000	$2,090,000
Subtotal Real Estate		$22,010,000	$22,010,000
Construction	$77,610,000		$77,610,000
Planning, Engineering, & Design	$5,812,500	$1,937,500	$7,750,000
Construction Management	$9,150,000		$9,150,000
Subtotal Construction	$94,510,000		$94,510,000
Adaptive Management	$6,620,000		$6,620,000
Subtotal 65/35 Cost Share	$101,130,000	$22,010,000	$123,140,000
Adjustment for 65/35 Cost Share	($19,151,500)	$19,151,500	
TOTAL FIRST COST*	$80,041,000	$43,099,000	$123,140,000
PERCENT OF FIRST COST	65%	35%	
Annual Operation & Maintenance		$462,000	
Annual maintenance dredging		$2,200,000	

**Represents fully funded costs including insterest during construction*

ES-13 Environmental Commitments

A summary of the environmental and related commitments made during the planning process and incorporated into the proposed project plan is as follows.

Management practices would be employed during construction activities to minimize environmental effects and would be included in construction specifications. Many of these measures are required in order to comply with Federal, State, or local laws and regulations, regardless of whether they are specifically identified in this document. Project implementation will comply with all relevant Federal, State, and local laws, ordinances, regulations, and standards during the implementation of the preferred alternative. Implementation of the environmental commitments for the proposed project will be documented to track the completion of the environmental commitments.

Environmental Commitments:

- Ensure that construction contractors limit ground disturbance to the smallest feasible areas.
- Use accepted erosion control measures during construction.
- To minimize disturbance to bald eagles and other raptors nest searches will be conducted up to three-quarters of a mile of proposed activities prior to construction to avoid active nests. Appropriate protective measures will be implemented to avoid or minimize nest disturbance if active nests are found.
- Contact pipeline and gas well companies prior to construction activities to identify and avoid existing hazards.
- Construction contractors will use and implement measures contained in erosion control guidelines and BMPs to control soil erosion from construction areas.
- Construction contractors will implement measures to control fugitive dust during construction.
- Implement a program to compensate for losses of archaeological sites (if any) that would occur as a result of construction and operation of the proposed project.

ES-14 Views of Non-Federal Sponsor

CPRA has expressed the desire to implement and sponsor the LCA Small Diversion at Convent/Blind River project in accordance with the items of local cooperation that are set forth in Section 3.9.2 and subject to the discussion provided in Sections 3.9.3 and 3.9.5 in the main report. In addition, CPRA supports the NER plan (Alternative 2) since this plan best meets the screening criteria; would accomplish the planning objectives and goals; is cost-effective and is a best-buy, and would reverse the trend of deterioration in the southeast part of the Maurepas Swamp. Specifically, Alternative 2 would improve over 21,000 acres of baldcypress-tupelo swamp that are in various stages of deterioration.

ES-15 Public Involvement

NEPA Scoping

A Notice of Intent to prepare a SEIS for the Small Diversion at Convent / Blind River, Louisiana, was published on December 22, 2008, in the Federal Register (Volume 73, Number 246, Pages 78339-78340). A public scoping meeting was organized and hosted in accordance with NEPA on February 12, 2009.

A total of 83 comments were received during the comment period; 12 multi-part comments were expressed at the scoping meetings and 10 multi-part written (letter, fax, and email) and verbal comments were received during the comment period. Commenters were generally supportive of the project and stressed a need for urgency.

Two additional meetings were conducted with groups associated with recreational use of the Study Area. Based on comments received from attendees of the meetings, it is very apparent that the main recreational feature(s) associated with the swamp include fishing and hunting. Comments were supportive of the project.

For the DSEIS, two additional public meetings were held in April and June of 2010 to describe the plan formulation process and obtain feedback on the Tenatively Selected Plan. Comments received during these meetings also were supportive of the project.

Other Public Comments, Areas of Controversy, Unresolved Issues

Meetings and discussions with the public and local, State, and Federal agencies indicated support for the project and did not identify any areas of controversy or unresolved issues.

The impacts of the Deepwater Horizon oil spill on coastal Louisiana are uncertain at this time. The impacts of the oil spill as well as the various emergency actions taken to address oil spill impacts (e.g., use of oil dispersants, creation of sand berms, use of Hesco baskets, rip-rap, sheet piling, and other actions) could potentially impact USACE water resources projects and studies within the Louisiana coastal area. Potential impacts could include factors such as changes to existing, future-without, and future-with-project conditions, as well as increased project costs and implementation delays. The USACE will continue to monitor and closely coordinate with other Federal and State resource agencies and local sponsors in determining how to best address any potential problems associated with the oil spill that may adversely impact project implementation. Supplemental planning and environmental documentation may be required as information becomes available.

ES-16 Coordination and Compliance

USACE Principles and Guidelines

The guidance for conducting Civil Works planning studies (ER 1105-2-100) requires the systematic formulation of alternative plans that contribute to the Federal objective. In order to ensure that sound decisions are made with respect to development of alternatives and ultimately plan selection, the plan formulation process requires a systematic and repeatable approach. The Economic and Environmental Principles and Guidelines for Water and Related Land Implementation Studies (Principles and Guidelines) describe the USACE study process and requirements.

Planning for this feasibility study has been conducted in accordance with ER 1105-2-100. This report is a summary of the integrated feasibility study and SEIS conducted for this project. Policy reviews have been conducted to ensure compliance with applicable USACE policies.

Environmental Coordination and Compliance

Coordination and compliance efforts were conducted pursuant to statutory authorities. These include environmental laws, regulations, executive orders, policies, rules, and guidance applicable to this project.

Full compliance with statutory authorities will be accomplished upon review of the integrated feasibility study and supplemental environmental impact statement by appropriate agencies and the public and the signing of a ROD.

ES-17 Conclusions and Recommendations

The LCA Small Diversion at Convent/Blind River project recommended in this report is in the overall public interest and would work to restore the natural ecology within Maurepas Swamp. The estimated fully funded cost of the recommended plan is $123,140,000.

1.0 STUDY INFORMATION

1.1 Study Authority

Title VII of the Water Resources Development Act (WRDA) (Public Law 110-114, 121 STAT. 1270) of 2007 authorizes the Louisiana Coastal Area Near-term Restoration Plan. The authority includes requirements for comprehensive coastal restoration planning, program governance, project modification investigations, a Science and Technology (S&T) program, restoration project construction, a program for beneficial use of dredged material, feasibility studies for restoration plan components, and other program elements.

In total the LCA Near-term Restoration Plan has authority for 25 elements falling into various components including investigations, research, demonstrations, and construction. This report outlines the study elements requiring Congressional reporting that will be undertaken in partnership between the USACE and the State of Louisiana.

Specifically, Section 7006(e)(3) requires the Secretary of the Army to submit feasibility reports to Congress on six projects by December 31, 2008 and a Chief's Report by December 31, 2010. Due to delays in executing a Feasibility Cost Sharing Agreement for the projects the requested feasibility reports were not submitted to the Congress by the December 31, 2008 deadline. The contingent authorization provided in Section 7006(e)(3)(B) for the six projects however remains subject to the December 31, 2010 deadline for a Chief's report. The six elements are:

1 LCA Multipurpose Operation of Houma Navigation Lock

2 LCA Terrebonne Basin Barrier Shoreline Restoration

3 LCA Small Diversion at Convent/Blind River

4 LCA Amite River Diversion Canal Modification

5 LCA Medium Diversion at White Ditch

6 LCA Convey Atchafalaya River Water to Northern Terrebonne Marshes

The Convent/Blind River Diversion Project is proposed to be a small freshwater diversion from the Mississippi River to the Maurepas Swamp. A small diversion as defined in the 2004 Louisiana Coastal Area (LCA) Ecosystem Restoration Study is a diversion between: 1000 cubic feet per second and 5000 cubic feet per second. The purpose of the project is to reintroduce freshwater, sediment, and nutrients to the swamp, approximating the natural historic flooding cycle, to rebuild wetlands at a rate greater than the subsidence rate. This is to improve biological productivity and reverse the current trend of degradation and restore the swamp.

An excerpt from WRDA 07 outlining the project authority is listed below:

SEC. 7003. LOUISIANA COASTAL AREA.

(a) IN GENERAL.—The Secretary may carry out a program for ecosystem restoration, Louisiana Coastal Area, Louisiana, substantially in accordance with the report of the Chief of Engineers, dated January 31, 2005.

(b) PRIORITIES.—

(1) IN GENERAL.—In carrying out the program under subsection a), the Secretary shall give priority to—

(A) any portion of the program identified in the report described in subsection (a) as a critical restoration feature;

(B) any Mississippi River diversion project that—

(i) will protect a major population area of the Pontchartrain, Pearl, Breton Sound, Barataria, or Terrebonne basins; and

(ii) will produce an environmental benefit to the coastal Louisiana ecosystem;

(C) any barrier island, or barrier shoreline, project that—

(i) will be carried out in conjunction with a Mississippi River diversion project; and

(ii) will protect a major population area;

(D) any project that will reduce storm surge and prevent or reduce the risk of loss of human life and the risk to public safety; and

(E) a project to physically modify the Mississippi River-Gulf Outlet and to restore the areas affected by the Mississippi River-Gulf Outlet in accordance with the comprehensive plan to be developed under section 7002(a) and consistent with sections 7006(c)(1)(A) and 7013.

SEC 7006. CONSTRUCTION

(e) Additional Projects

(3) PROJECTS SUBJECT TO REPORTS.—

(A) FEASIBILITY REPORTS.—Not later than December 31, 2008, the Secretary shall submit to Congress feasibility reports on the following projects referred to in the restoration plan:

(i) Multipurpose Operation of Houma Navigation Lock at a total cost of
$18,100,000.

(ii) Terrebonne Basin Barrier Shoreline Restoration at a total cost of
$124,600,000.

(iii) Small Diversion at Convent/Blind River at a total cost of
$88,000,000.

(iv) Amite River Diversion Canal Modification at a total cost of
$5,600,000.

(v) Medium Diversion at White's Ditch at a total cost of
$86,100,000.

(vi)Convey Atchafalaya River Water to Northern Terrebonne Marshes at a total cost of $221,200,000.

(B) CONSTRUCTION.—The Secretary may carry out the projects under subparagraph (A) substantially in accordance with the plans and subject to the conditions, recommended in a final report of the Chief of Engineers if a favorable report of the Chief is completed by not later than December 31, 2010.

(4) CONSTRUCTION. – No appropriations shall be made to construct any project under this subsection if the report under paragraph (2) or paragraph (3), as the case may be, has not been approved by resolutions adopted by the Committee on Transportation and Infrastructure of the House of Representatives and the Committee on Environment and Public Works of the Senate.

1.2 Purpose and Scope*

The study investigates alternatives to reverse the current decline of a portion of the Maurepas Swamp and to prevent the transition of the freshwater swamp into freshwater marsh and subsequently open water. Reversing this decline will aid development of a more sustainable wetland ecosystem that will serve to protect the local environment, economy and culture. In light of Louisiana's extreme vulnerability to intense storms this project may also provide some measure of flood damage protection.

The study identifies and evaluates management measures and alternatives that might contribute to reversing the current decline of the southeastern Maurepas Swamp. The purpose of this study is to identify reasonable alternatives and to screen the alternatives down to a recommended plan. The Blind River headwaters are located in St. James Parish approximately 2-3 miles north of the east bank of the Mississippi River at Convent. The Blind River flows north then east through Ascension and St. John the Baptist Parishes before emptying into Lake Maurepas. The objective of the project is to introduce freshwater, sediment, and nutrients into the southeast portion of the Maurepas Swamp to improve biological productivity and facilitate swamp accretion, and prevent further swamp deterioration.

The environmental consequences of the proposed project are evaluated in the Feasibility Study/ Supplemental Environmental Impact Statement (FS/SEIS). This FS/SEIS is a supplement of the *Final Programmatic Environmental Impact Statement, Louisiana Coastal Area (LCA), Louisiana, Ecosystem Restoration Study (FPEIS)*.

1.3 Study Area*

This feasibility study of the Small Diversion at Convent/Blind River evaluates a small hydraulic diversion (less than 5,000 cfs) from the Mississippi River into Maurepas Swamp via the Blind River. Alternative locations for the proposed control structure in the vicinity of Convent, Louisiana, located at Mississippi River mile 159, were investigated.

The Study Area for this project included portions of the Mississippi River Deltaic Plain within coastal southeast Louisiana in the Lake Pontchartrain Basin. The Lake Pontchartrain Basin and its four sub-basins—the Upper, the Middle, the Lower, and the Upland Sub-basins—are shown in **Figure 1-1**. The Study Area for this project is within the Upper Lake Pontchartrain Sub-basin (**Figure 1-2**). The Upper Lake Pontchartrain Sub-basin includes Lake Maurepas, Maurepas Swamp, Blind River, and portions of the Amite River.

Louisiana parishes in the Study Area include St. James and Ascension. The benefit area consists of the Maurepas Swamp and Blind River southwest of (I-10). **Figure 1-3** shows the boundary for the benefit area and the hydrologic boundaries within the benefit area. These boundaries define hydrologically distinct areas that can be individually addressed in the plan formulation process.

The Maurepas Swamp is one of the largest remaining tracts of coastal freshwater swamp in Louisiana. The Blind River flows from St. James Parish, through Ascension Parish and St John the Baptist Parish, and then discharges into Lake Maurepas.

The Maurepas Swamp serves as a buffer between the open water areas of Lakes Maurepas and Pontchartrain and developed areas along the I-10/Airline Highway corridor. Development along the I-10/Airline Highway corridor in this area includes residential, commercial, and industrial land use. Being the largest contiguous tract of bald cypress-tupelo swamp near the New Orleans metropolitan area this area has considerable cultural significance and is used for fishing, hunting, and other recreational activities.

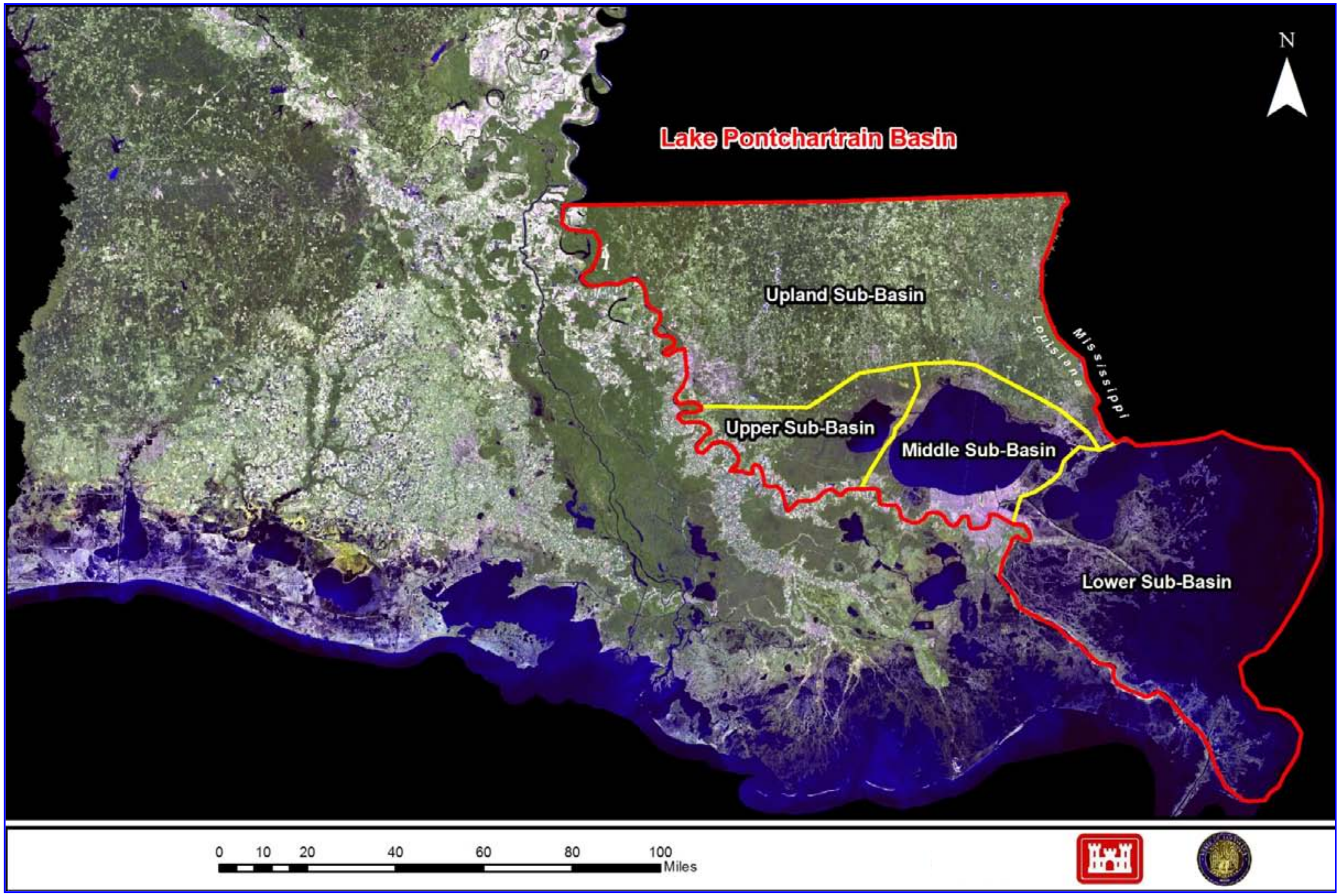

Figure 1-1: Lake Pontchartrain Basin and Sub-Basins, including the Upland, Upper, Middle, and Lower from northeast to southwest, respectively.

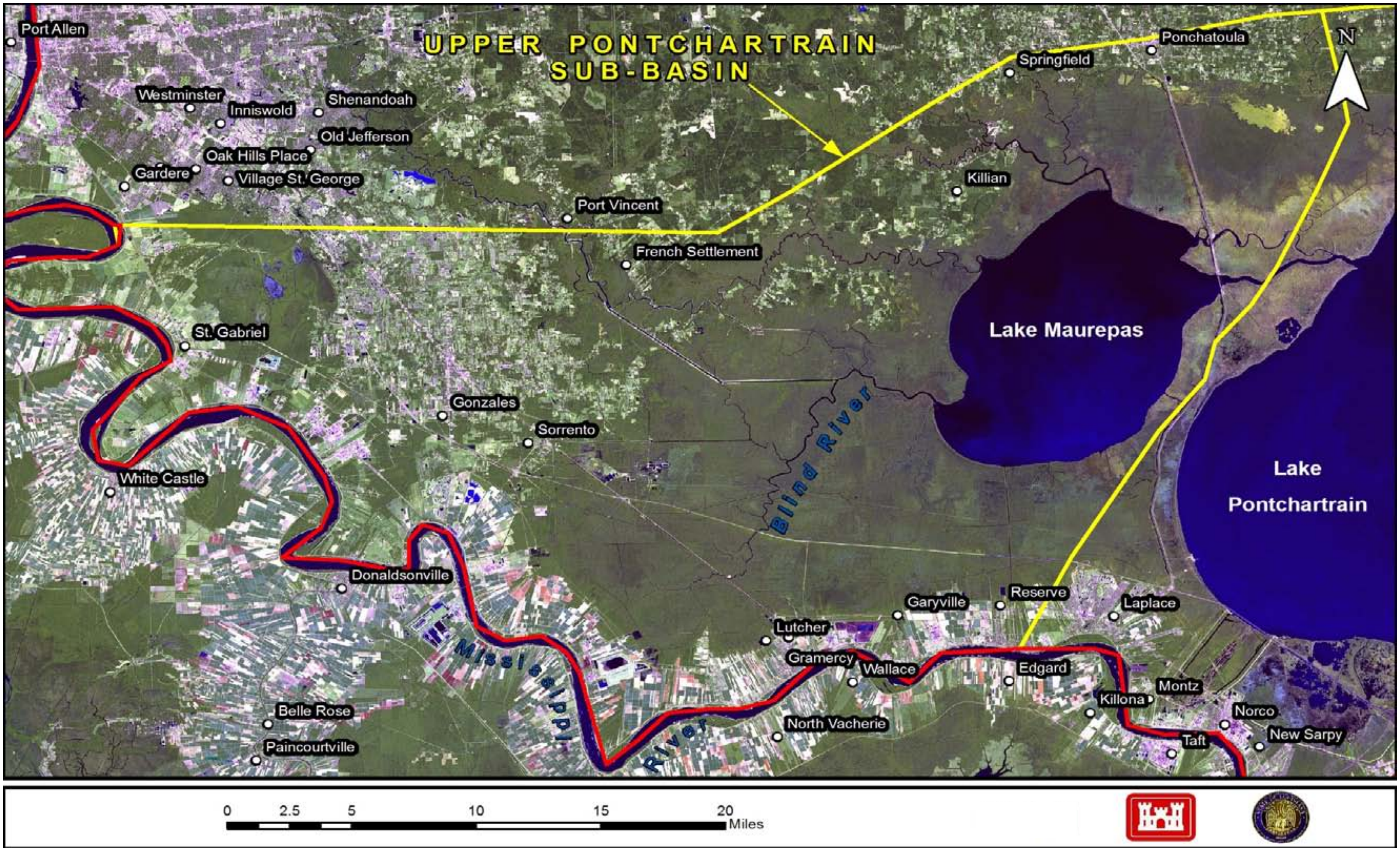

Figure 1-2: Upper Pontchartrain Sub-Basin

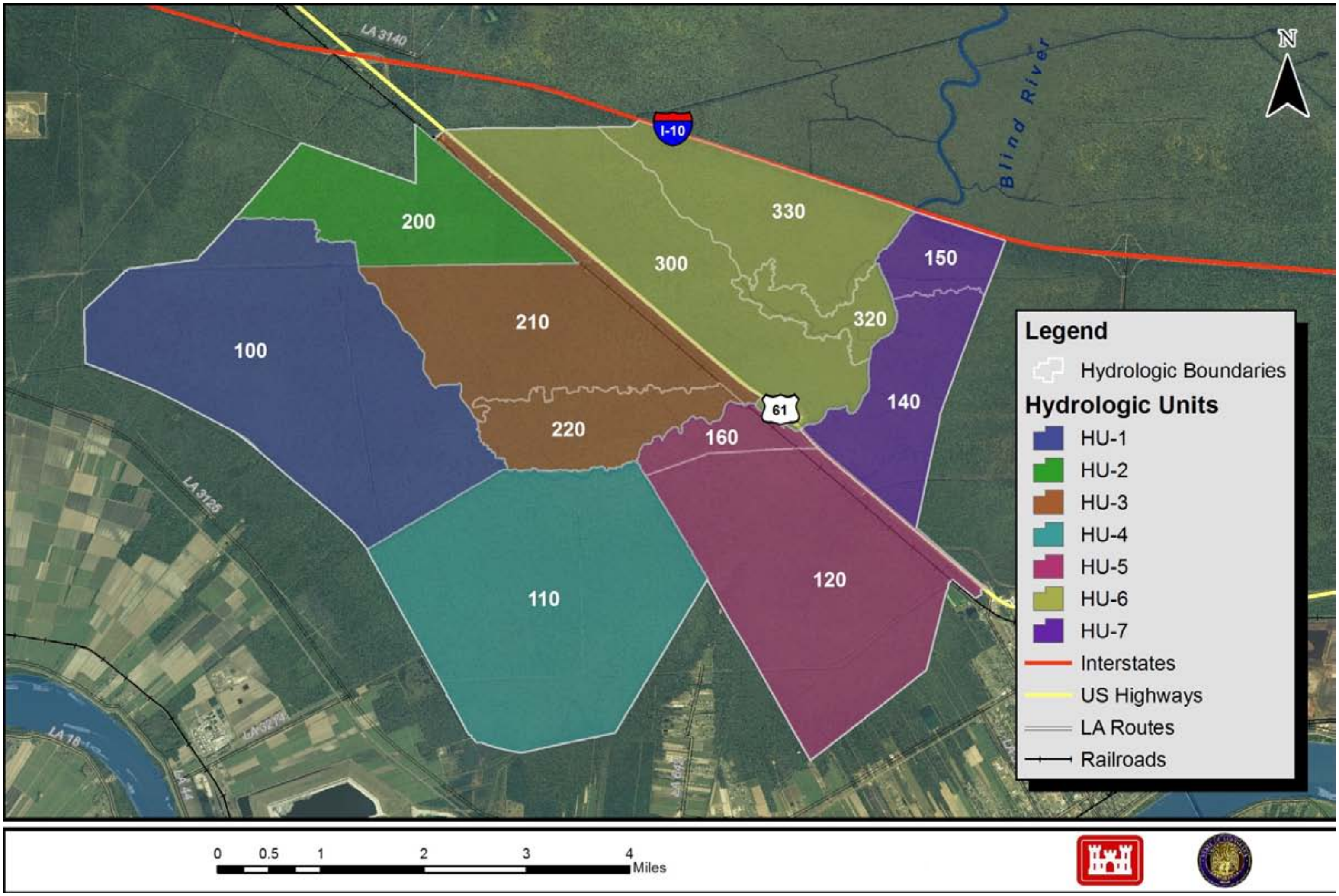

Figure 1-3: Study Area - Small Diversion at Convent / Blind River

1.4 History of Investigation

This study was designed to address general ecosystem restoration problems and opportunities in the Study Area. These have been documented since 1998 through numerous comprehensive planning studies. Specifically this study builds upon the following comprehensive planning efforts for the Louisiana coastal areas:

- 1998 Coast 2050 Plan
- 2004 Louisiana Coastal Area (LCA) Report
- 2006 Louisiana Coastal Protection and Restoration (LACPR) Preliminary Technical Report
- 2007 Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast
- 2009 Louisiana Coastal Protection and Restoration (LACPR) Final Technical Report

Planning for this project utilizes data from these reports and other studies. Alternative plans were formulated based upon the 2004 LCA Report.

1.5 Prior Reports and Existing Projects

A number of prior water resources development efforts are relevant to the LCA Near-term Restoration Plan. **Table 1-1** lists these efforts and denotes how each is relevant to the Small Diversion at Convent/Blind River, Louisiana study followed by a discussion of each report or project.

1.5.1 Comprehensive Planning Studies

Several comprehensive planning efforts have covered the Blind River swamp, including the Coast 2050 Plan; the LCA Near-term Restoration Plan, the Louisiana's Comprehensive Master Plan for a Sustainable Coast; and the Louisiana Coastal Protection and Restoration (LACPR) Technical Reports. These comprehensive planning efforts are described below.

Table 1-1: Relevance of prior studies, reports, programs, and water projects to the Small Diversion at Convent/Blind River, Louisiana Feasibility Study

Prior Studies, Reports, Programs, and Water Projects	**Relevance to Convent/Blind River Diversion**				
	Data Source	**Consistency**	**Structural Measures**	**Non-Structural Measures**	**Future Without Project Condition**
Comprehensive Planning Studies					
Coast 2050 Report, 1999	x	x		x	x
Louisiana's Comprehensive Master Plan for a Sustainable Coast, 2007	x	x	x	x	x
Louisiana Coastal Protection and Restoration (LACPR), 2009	x	x	x	x	
Louisiana Coastal Area (LCA) Near-term Restoration Plan Critical Restoration Features 2004 LCA Small diversion at Hope Canal (1,000 – 5,000 cfs) LCA Small diversion at Convent/Blind River (1,000 – 5,000 cfs) LCA River Diversion Canal Modification	x	x	x	x	x
Mississippi River Sediment, Nutrient, and Freshwater Redistribution Study, 2000	x	x		x	x
Prior Studies, Reports and Water Projects					
LCA Small Diversion at Hope Canal					
2001 Diversion into Maurepas Swamp	x	x	x	x	x
2003 Potential Nitrate Removal from a Diversion into Wetlands	x	x		x	
2003 Ecosystem Health of the Maurepas Swamp	x	x		x	x
2006 Impacts of Freshwater Diversion on Wildlife and Fisheries	x	x		x	x
2007 Mississippi River Reintroduction into Maurepas Swamp	x	x	x	x	x
2007 Evaluation of Potential Impact of Diversion on Gulf and Pallid Sturgeon	x	x		x	
2007 Cultural Resources Survey of River Reintroduction Corridor	x	x		x	
LCA Amite River Diversion Canal Modification					
2002 Amite Gapping	x	x		x	
2010 Amite Feasibility Study	x	x	x	x	x
Other reports					
1996 Diversion and Feasibility of Bonnet Carré Spillway	x	x	x	x	x
2001 Water Quality Analysis	x	x		x	x
2008 Swamp Ecology in a Dynamic Coastal Landscape	x	x		x	
2006 Pontchartrain Basin Research Program	x	x		x	x
2007 Pontchartrain Basin Research Program	x	x		x	x

Prior Studies, Reports, Programs, and Water Projects	Relevance to Convent/Blind River Diversion				
	Data Source	Consistency	Structural Measures	Non-Structural Measures	Future Without Project Condition
2002 Hydrologic Modeling to Evaluate MR Diversion into Maurepas Swamps	x	x		x	x
(n.d) Growth and Development of Bald cypress-Tupelo	x	x		x	
1992Effects of Flooding on Bald cypress	x	x		x	
1972 Effects of Aeration, Water Supply, and Nitrogen on Tupelo and Bald cypress	x	x		x	
2004 Through Droughts and Hurricanes: Survival and Productivity of a Coastal swamp	x	x		x	
1995 Interaction of Flooding and Salinity Stress on Bald cypress	x	x		x	
2005 Comprehensive Habitat Management Plan	x	x		x	x
2008 Interim Feasibility Report: Convent/Blind River Freshwater Diversion	x	x	x	x	x
Laws and Programs					
The Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) 1990	x	x		x	x
Act 8 of the First Extraordinary Session of 2005	x	x		x	
Louisiana Coastal Zone Management Program, 1980	x	x		x	
Coastal Impact Assistance Program	x	x	x	x	x

Coast 2050 Report, 1998: Federal and state agencies, local governments, academia, numerous non-governmental groups, and private citizens participated in developing the Coast 2050 Plan. The Plan built upon lessons learned through the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) and other programs. It reflected a growing recognition that a more comprehensive "systemic" approach to restoring coastal wetlands was needed. The Plan formed the basis for the May 1999 905(b) reconnaissance report for the LCA Ecosystem Restoration Study.

Louisiana Coastal Area (LCA) Near-term Restoration Plan, 2004: In 2000, the USACE and State of Louisiana initiated the LCA Ecosystem Restoration Study to address Louisiana's severe coastal land loss problem. The LCA study used the best available science to develop a plan addressing the most critical coastal ecological needs. An FPEIS entitled *Final Programmatic Environmental Impact Statement, Louisiana Coastal Area (LCA), Louisiana, Ecosystem Restoration Study* was prepared for this study. The FPEIS is hereby incorporated by reference. The small diversion at Convent Blind River Project is one of the elements included in the LCA Near-term Plan:

> ***Description of Small Diversion at Convent/Blind River Project in 2004 LCA Report-*** *This restoration feature involves a small diversion from the Mississippi River into Blind River through a new control structure. The objective of this feature is to introduce sediment and nutrients into the southeast portion of Maurepas Swamp. This feature is intended to operate in conjunction with the Hope Canal diversion to facilitate organic deposition in the swamp, improve biological productivity, and prevent further swamp deterioration.*

Louisiana's Comprehensive Master Plan for a Sustainable Coast, 2007: Act 8 of the First Extraordinary Session of the 2005 Louisiana Legislature established the Coastal Protection and Restoration Authority (CPRA). The CPRA developed a comprehensive coastal protection master plan and annual coastal protection plans. The master plan discusses diverting Mississippi River water into areas of deteriorated wetland and swamp habitat, including the Maurepas Swamp.

Louisiana Coastal Protection and Restoration (LACPR), 2009: In 2006, Congress authorized development of a Technical Report for coastal restoration and "Category 5" hurricane risk reduction in south Louisiana. The USACE submitted a Preliminary Technical Report to Congress in July 2006. A Final Technical Report completed in 2009 includes different structural alignments and measures such as floodgates, floodwalls, and levees. The report includes nonstructural measures such as elevating homes. In addition, the report reviews various wetland restoration measures and highlights the role of wetlands in coastal risk reduction. Although the potential for LaCPR measures affecting the LCA Small Diversion at Convent/Blind River is recognized, no specific impacts have been identified.

Mississippi River Sediment, Nutrient and Freshwater Redistribution Study, 2000: This report presents the technical background and rationale for developing Mississippi River diversions to redistribute freshwater and nutrients to parts of the coastal floodplain that have been cut off by levees and manmade structures. Each floodplain area is evaluated with respect to current conditions, conditions that will prevail if no action is taken, and future conditions with project implementation. The report provides a conceptual implementation plan for river diversions as they relate to coastal restoration, wetland maintenance, and land building. The Maurepas Swamp is specifically described as a feature within the Lake Pontchartrain Basin that needs freshwater.

Prior Studies, Reports, and Projects

In addition to the comprehensive planning efforts described above, the studies, reports, and projects listed in **Table 1-1** are relevant to the Small Diversion at

Convent/Blind River, Louisiana Feasibility Study as noted. A brief description of relevant prior studies and reports is provided.

1.5.2 Related Laws and Programs: Over the past three decades, the Federal government and the State of Louisiana have established policies and programs that are intended to halt and reverse the loss of coastal wetlands and to restore and enhance ecosystem function.

1.5.2.1 Federal

Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA), 1990: The Coastal Wetlands Planning, Protection and Restoration Act 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: U.S. Environmental Protection Agency (USEPA), U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers (USACE), National Marine Fisheries Service (NMFS), and Natural Resources Conservation Service (NRCS), and the State of Louisiana. The Task Force prepared a comprehensive restoration plan in 1993 to coordinate and integrate coastal wetlands restoration projects to ensure the long-term conservation of coastal wetlands of Louisiana. The Task Force prepares annual Project Priority Lists and funds coastal restoration planning and the project construction. As of July 2008, 145 active CWPPRA projects have been approved, 74 have been constructed, 17 are under construction, and 26 have been de-authorized or transferred to other programs.

Coastal Impact Assistance Program (CIAP). The Energy Policy Act of 2005 (Public Law 109-58) was signed into law by President Bush on August 8, 2005. Section 384 of the Act establishes the Coastal Impact Assistance Program (CIAP) which authorizes funds to be distributed to Outer Continental Shelf (OCS) oil and gas producing States to mitigate the impacts of OCS oil and gas activities.

Under the CIAP, the Secretary of the Interior is authorized to distribute to producing States and coastal political subdivisions (CPSs) $250 million for each of the fiscal years 2007 through 2010. This money is shared among Alabama, Alaska, California, Louisiana, Mississippi, and Texas and is allocated to each producing State and eligible CPS based upon allocation formulas prescribed by the Act.

Pursuant to the Act, a producing State or CPS shall use all amounts received under this section for one or more of the following purposes:

- Projects and activities for the conservation, protection, or restoration of coastal areas, including wetland
- Mitigation of damage to fish, wildlife, or natural resources
- Planning assistance and the administrative costs of complying with this section

- Implementation of a federally-approved marine, coastal, or comprehensive conservation management plan
- Mitigation of the impact of OCS activities through funding of onshore infrastructure projects and public service needs

Each eligible State is allocated their share based on the State's Qualified Outer Continental Shelf Revenue (QOCSR) generated off of its coast in proportion to the total QOCSR generated off the coasts of all eligible States.

1.5.2.2 State Laws

Louisiana Coastal Zone Management: Louisiana began participating in the Federal Coastal Zone Management program in 1978. Shortly thereafter, the State developed a coastal zone management plan. The Louisiana Coastal Resources Program, approved by NOAA in 1980, is administered by the Department of Natural Resources through the Coastal Management Division (CMD). The State and Local Coastal Resources Management Act of 1978 required the state to develop Coastal Use Guidelines, a set of comprehensive coastal policies governing various activities. The Louisiana coastal zone is a 5.3 million-acre area that includes 40 percent of the nation's coastal wetlands. One of the primary objectives of this plan was to ensure that future coastal development activities would be accomplished with the greatest benefit and the least amount of environmental damage.

Act 8 of the First Extraordinary Session of 2005: Act 8 of the First Extraordinary Session of 2005 created the Coastal Protection and Restoration Authority (CPRA) and charged it with coordinating the efforts of local, State, and Federal agencies to achieve long-term and comprehensive coastal protection and restoration. The CPRA created a Master Plan to integrate flood control and wetland restoration activities.

1.5.2.3 Local

Non-governmental organizations have also participated in various coastal restoration projects. In particular, the Lake Pontchartrain Basin Foundation (LPBF) has supported a multitude of studies and reports that include ecological interest and restorative issues associated with the Maurepas Swamp. Coordination of LPBF with other public and private parties involved in wetlands preservation or restoration activities in coastal Louisiana include Coastal America, Corporate Wetlands Restoration Partnership, Audubon Society, National Fish and Wildlife Foundation, the Nature Conservancy, and the Louisiana Wildlife Federation. These efforts are primarily concerned with preservation. The restoration activities of these organizations will support the overall goals of the Small Diversion at Convent/Blind River, Louisiana; however, these efforts are small in scale and will not appreciably influence plan formulation.

1.5.3 Existing Water Projects

Several existing and authorized navigation, river flood control, and coastal restoration, projects are related to the Small Diversion at Convent/Blind River, Louisiana Feasibility Study. These projects are briefly described below.

1.5.3.1 Navigation Projects

Mississippi River, Baton Rouge to the Gulf of Mexico: The Mississippi River, Baton Rouge to the Gulf of Mexico project currently provides a 45-foot deep draft channel between Baton Rouge and the Gulf of Mexico. This project includes points on the river near Convent investigated for the Blind River diversion.

1.5.3.2 River Flood Control Projects

Mississippi River and Tributaries Project (MR&T): The Mississippi River and Tributaries (MR&T) Project is a comprehensive project for flood control on the Lower Mississippi River below Cape Girardeau, Missouri. The project was authorized by the Flood Control Act of 1928 in response to the 1927 Lower Mississippi River flood. The 1927 flood resulted in levee failures and extensive flooding of populated areas. The four major elements of the MR&T Project are: 1) levees for containing flood flows; 2) floodways for the passage of excess flows past critical reaches of the Mississippi River; 3) channel improvement and stabilization to provide an efficient navigation alignment, increase the flood carrying capacity of the river, and protect the levee system; and 4) tributary basin improvements for major drainage and for flood control, such as dams and reservoirs, pumping plants, and auxiliary channels. The MR&T system controls and confines the river system before it reaches the coastal area.

1.5.3.3 Coastal Restoration Projects

LCA Small Diversion at Hope Canal: The LCA Small Diversion at Hope Canal project is located northeast of the Convent/Blind River project. This project is included in the Louisiana Coastal Area, Louisiana Report of the Chief of Engineers, dated 31 January 2005 in a list of five priority projects for implementation approval. The project is being investigated under the CWPPRA program described above.

The LCA Small Diversion at Hope Canal consists of diverting approximately 0-5,000 cfs from the Mississippi River into the Hope Canal. The objective is to introduce sediment and nutrients into Maurepas Swamp south of Lake Maurepas. The introduction of additional freshwater via the diversion would facilitate organic deposition, improve biological productivity, and prevent further deterioration of the swamp.

The LCA Small Diversion at Hope Canal has a significant number of project-specific biological, environmental, and hydrology/hydraulic studies. The hydrodynamic analysis includes an Advanced Circulation (ADCIRC) model with overlap onto the potential Convent/Blind River service area.

Mississippi River Hydrodynamic Study (and other studies): The LCA Near-term Restoration Plan recommended authorization of a hydrodynamic study of the Mississippi River (and Atchafalaya River) covering the reaches of both rivers from the Old River Control Structure (ORCS) to their mouths. This comprehensive modeling and study effort will provide reliable estimates of water and sediment resources in the Mississippi River for future restoration projects and for maintenance of navigation and water supplies. The USACE and the LDNR have combined the Mississippi River Hydrodynamic Study with the Mississippi River Delta Management Plan (which was also recommended for authorization under the LCA Near-term Restoration Plan). These studies are currently in the strategic development and data collection stages and output data and results are not yet available.

1.5.4 Planned Projects

LCA Amite River Diversion Canal Modification, 2010: This project is located north of the LCA Small Diversion at Convent/Blind River study area. This restoration feature involves the construction of gaps in the existing dredged material banks of the Amite River Diversion Canal. The objective of this project is to allow floodwaters to introduce additional nutrients and sediment into western Maurepas Swamp. The exchange of flow would occur during flood events on the river and from the runoff of localized rainfall events. This project would provide nutrients and sediment to facilitate organic deposition in the swamp, improve biological productivity, and prevent further swamp deterioration. The project is being studied concurrently with and under the same authority as the LCA Small Diversion at Convent/Blind River project.

This project will restore a different portion of the Maurepas swamp than the Small Diversion at Convent/ Blind River project. **Figure 1-4**. The ARDC project is independent of but will be additive to the restoration benefits of the LCA Small Diversion at Convent/Blind River and Small Diversion at Hope Canal projects. All projects will aid in restoring the second largest stand of continuous swamp in Louisiana.

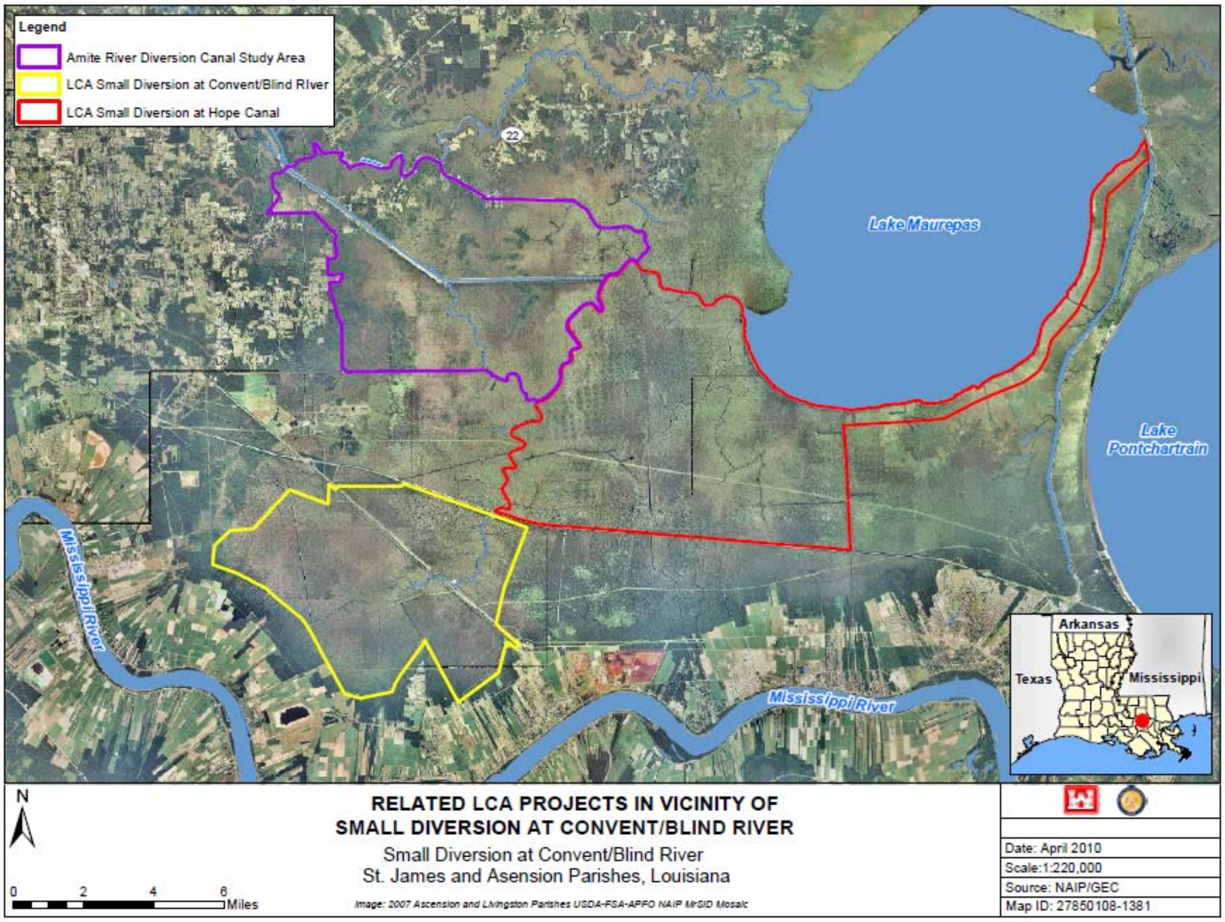

Figure 1-4. Location of study area in relation to other proposed restoration projects in southeastern Maurepas Swamp

1.6 Planning Process and Report Organization

This study followed the 6-step planning process prescribed in the Water Resources Council's "Principles and Guidelines" (See **Section 7.1** for additional information on the "Principles and Guidelines"). The following paragraphs describe that process.

The first step of the planning process defines study area problems and opportunities, as well as study constraints, goals, and objectives. Because this is an ecosystem restoration study, problems and opportunities are developed to address the Federal objective of National Ecosystem Restoration (NER). Goals, objectives, and constraints are identified to aid in the development of solutions to problems and to aide in the achievement of opportunities within the confines of legislative authority, policies, and other restrictions.

The second planning step consists of the inventory and forecast of resources within the study area. This evaluation, or inventory step, accounts for the level or amount of a particular resource that currently exists within the study area, i.e., identification of existing conditions. This step also involves forecasting to predict what changes will likely occur throughout the 50-year period of analysis, assuming no actions are taken to address reveal problems in the study area. Comparison of existing conditions to the forecast conditions assists with the identification of potential problems arising from the change in resources that could occur during the period of analysis. Study area problems are quantified based on predicted changes in resources. This second step is the delineation of opportunities that fully or partially address the problems in the study area. An opportunity is a resource, action, or policy that, if acted upon, may alter the conditions related to an identified problem.

The third step in the planning process is to generate alternative solutions. Alternative plans are formulated across a range of potential scales to demonstrate the relative effectiveness of various approaches at varying scales.

In the fourth step, alternative plans are evaluated for their potential effectiveness in addressing the specific problems, needs, and objectives of the study. The measure of output is expressed by the difference in amount or effect of a resource between the "No Action Alternative" conditions and those predicted to occur with each "Action Alternative" in place. This difference is referred to as the benefits of the action alternative. The evaluation focuses on ecosystem benefits, which are measured in metrics that reflect the area, productivity, and value of habitats that are restored or maintained.

The planning process continues with the fifth step, which is devoted to the comparison of alternative plans according to the expected benefit outputs and costs of the alternative. A relationship between costs and varying levels of ecosystem restoration outputs across a full range of scales is compared.

The sixth and final step in the process is the selection of the plan that best meets the study objectives and the four criteria in the Principles and Guidelines: completeness, effectiveness, efficiency, and acceptability. Using the six-step planning process, a Tentatively Selected Plan is identified.

This report is organized into nine sections with supporting appendices. The nine sections in the main report are described below:

1 Study Information – This section provides basic background on the study, including such information as study authority, study purpose and scope, study area delineation, and related reports and authorities.

2 Need for, and Objective of Action – This section describes the need for the action and the objectives of the study. Additional information in the section

includes Project goals and identified problems, opportunities, and constraints.

3 Alternatives – This section describes the plan formulation process.

4 Affected Environment – This section paints a picture of the historic and existing condition of the environmental, social, and economic resources in the vicinity of the project.

5 Environmental Consequences – This section describes the affect or impact of each of the alternatives in the final array of alternatives on the resources identified in Section 4.

6 Public Involvement – This section describes the public involvement process and the results of that process.

7 Coordination and Compliances – This section describes the coordination that took place during the study and documents the compliance of the process and the study recommendations with applicable laws and regulations.

8 Conclusions and Determinations – This sections documents and supports the study recommendations.

9 Distribution Lists and Other – This section includes the list of individuals and organizations receiving copies of study documents, the list of prepares, literature cited, Acronyms list, the Glossary, and the index.

1.7 USACE Campaign Plan

The U.S. Army Corps of Engineers is marching forward with a new Campaign Plan to transform the way it does business. The "Campaign Plan" has informed this study process from its inception, and will continue to influence planning decisions and methods utilized throughout the study.

The study is being planned in an open cooperative framework designed to lead to a sustainable solution to the problem of degradation of the Maurepas Swamp and ultimately contributing to the long-term recovery of the Gulf Coast of Louisiana.

2.0 NEED FOR, AND OBJECTIVES OF ACTION

2.1 National Objectives

The Federal objective of water and related land resources planning is to contribute to national economic development (NED) consistent with protecting the Nation's environment, in accordance with national environmental statutes, applicable executive orders, and other Federal planning requirements. Contributions to national economic development (NED outputs) are increases in the net value of the national output of goods and services, expressed in monetary units, and are the direct net benefits that accrue in the planning area and the rest of the Nation. Contributions to NED include increases in the net value of those goods and services that are marketed and also of those that may not be marketed. Protection of the Nation's environment is achieved when damage to the environment is eliminated or avoided and important cultural and natural aspects of our nation's heritage are preserved. Various environmental statutes and executive orders assist in ensuring that water resources planning are consistent with protection. The objectives and requirements of applicable laws and executive orders are being considered throughout the planning process in order to meet the Federal objective.

The National objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER). Contributions to national ecosystem restoration (NER outputs) are increases in the net quantity and/or quality of desired ecosystem resources. Measurement of NER is based on changes in ecological resource quality as a function of improvement in habitat quality and/or quantity and expressed quantitatively in physical units or indexes (but not monetary units). These net changes are measured in the planning area and in the rest of the Nation. Single purpose ecosystem restoration plans shall be formulated and evaluated in terms of their net contributions to increases in ecosystem value (NER outputs), expressed in non-monetary units. Multipurpose plans that include ecosystem restoration shall contribute to both NED outputs and NER outputs. In this latter case, a plan that trades off NED and NER benefits to maximize the sum of net contributions to NED and NER is usually recommended.

2.2 Public Concerns

Study Area problems and opportunities were drawn from prior comprehensive planning studies and from public input and inter-agency information exchange. System-wide problems and opportunities were used to identify and define more geographically specific problems and opportunities in the study area. Through the NEPA public scoping process, the study team solicited input on problems and opportunities from members of the public, government resource agencies, and other stakeholders.

2.3 Problems, Needs, and Opportunities*

The first step in the planning process is the identification of problems and opportunities. Problems are undesirable, negative conditions that the study will address. Opportunities are desirable conditions that could be achieved in the future. Study area problems and opportunities were drawn from prior comprehensive planning studies and from public input and inter-agency information exchange. System-wide problems and opportunities were used to identify and define more geographically specific problems and opportunities throughout the study area. Throughout the NEPA public scoping process, the study team solicited input on problems and opportunities from members of the public, government resource agencies, and other stakeholders.

Following an extensive literature review and NEPA scoping the PDT met to consider all the available information in order to identify specific problems and opportunities as well as develop a general problem statement, goal statement and an initial list of project specific objectives and constraints. The results of the PDT deliberations are provided in the following paragraphs.

2.3.1 Study Area Problems and Needs

The Mississippi River and Tributaries (MR&T) levee system has isolated the Maurepas Swamp (and Blind River) from the natural, periodic, near-annual flooding by the Mississippi River. This has resulted in a degradation/deterioration process and reduced biological productivity in the swamp due to lack of freshwater, nutrients, and sediment input from the Mississippi River. The swamp is also subsiding due to natural causes and possibly due to man-made activities such as oil, gas, and groundwater withdrawals. The reduced biological productivity combined with the lack of sediment from the river has reduced soil formation (accretion) to a rate less than the subsidence. Consequently, the land surface is sinking.

Additional ecosystem problems are associated with past construction of logging trails, drainage channels, pipelines, other utilities, and roads through the swamp. These features disrupt the natural water flow and drainage patterns, and impact the biological productivity of the swamp. Short circuiting of the natural drainage patterns has created ponding in some areas which inhibits bald cypress and tupelo propagation.

With no connectivity to the Mississippi River, the Blind River watershed has been cut-off from periodic Mississippi River flows resulting in much lower availability of freshwater. A higher quantity of freshwater if properly distributed throughout the watershed, would help restore natural hydrologic conditions and allow for increased vegetative growth and nutrient uptake. These processes would result in water filtration prior to the Blind River discharging into Lake Maurepas. Without freshwater reintroduction into the Blind River watershed, observed conditions of deterioration are expected to continue into the future.

The lack of freshwater input into the Blind River results in oxygen depletion because of low water flow and inadequate mixing that would otherwise flush out algae and other biological growth that result from agricultural runoff. Freshwater inputs will increase flow and reduce the excessive biological growth causing oxygen depletion in Blind River. Reintroduction of Mississippi River freshwater will also provide additional nutrients which can be used to increase vegetative productivity in the Blind River watershed, including bald cypress and tupelo trees. Without additional nutrients, vegetative growth will continue to be restricted. Restricted vegetative growth will also reduce soil building processes (vertical accretion) which are vital in reversing current trends of subsidence and degradation. Lack of seasonal flushing by the river can also impacts the swamp following storm surge events which force higher salinity water into the swamp. Without seasonal flushing to force higher salinity water out of the system, vegetation becomes stressed.

With subsidence, the lack of substrate accretion, and reduced organic productivity, this area is at high risk for the type of die-off that is already occurring in lake-rim areas in western Lake Pontchartrain. The combination of little to no tree regeneration and more frequent incidence of higher than tolerable salinities result in a higher risk of conversion to open water in the Maurepas Swamp. With the increasing water depth and year-round wet conditions in these areas, it is highly likely that swamp habitat will be converted to intermediate marsh and eventually open water.

The Blind River project is being planned to address the problem of severe deterioration of the Maurepas Swamp. Subsidence, storm surge, and saltwater intrusion, impoundment, lack of substrate accretion and tree regeneration and the absence of freshwater, sediments, and nutrients from the Mississippi River have all caused significant adverse impacts to the Maurepas Swamp and Blind River, resulting in swamp ecosystem degradation.

Specific problems identified by the PDT in the Study Area that need attention are:

- Tree mortality and decline in the overall health of the swamp
- Exposure to stochastic risks, particularly increased salinities
- Potential impacts to populations of indigenous fish and wildlife species
- Vulnerability of the area to hurricane-related damage and conversion to open water areas

2.3.2 Study Area Opportunities

Opportunities identified in the 2004 LCA report and further developed for the Blind River study area are listed below:

- Prevent future cypress swamp degradation and transition currently predicted to occur
- Restore the deltaic process impaired by levee and dredged material bank construction
- Enhance Blind River water quality by diverting freshwater from the Mississippi River to the Blind River
- Protect vital socioeconomic and public resources, such as the growing eco-tourism industry resident in the Maurepas Swamp and the Maurepas Wildlife Management Area.
- Enhance recreational opportunities in the Maurepas Swamp and Blind River

2.4 Planning Objectives

The project goal of the Small Diversion at Convent/Blind River Project is to reverse the trend of degradation in the southeastern portion of the Maurepas Swamp, to help achieve and sustain a coastal ecosystem that can support and protect the environment, economy, and culture of southern Louisiana and thus contribute to the well-being of the Nation.

The overall objective of the Small Diversion at Convent/Blind River Project was to reverse the trend of deterioration of southeast Maurepas Swamp and Blind River.

Specific Project Objectives

Objective 1: Promote water distribution in the swamp

Target for Objective 1: Increase the area of freshwater inundation for low to average flood events by 10 to 25 percent from existing conditions in order to increase swamp productivity and wetland assimilation. Increase nutrient input to the swamp in order to increase swamp productivity as measured by a 5 to 10 percent annual increase in the diameter at breast height (dbh) of baldcypress and tupelo from existing conditions, and increase wetland assimilation as measured by a 10 to 25 percent decrease in the average TN and TP in Blind River and a 5 to 10 percent increase in the average dissolved oxygen in Blind River from existing conditions.

Objective 2: Facilitate swamp building, at a rate greater than swamp loss due to subsidence and sea level rise.

Target for Objective 2: Increasing swamp productivity, as described above and by increasing sediment input by up to 1,000 grams per square meter per year in order to decrease the annual subsidence rate 50 to 100 percent in the swamp.

Objective 3: Establish hydro period fluctuation in the swamp to improve baldcypress and tupelo productivity and their seeding germination and survival.

Target for Objective 3: Decreased flood duration in the swamp by 10 to 25 percent for high flood events, increasing the length of dry periods in the swamp (no standing water) by 10 to 25 percent, and by increasing the number of baldcypress and tupelo saplings per acre by 25 to 50 percent from existing conditions.

Objective 4: Improve fish and wildlife habitat in the swamp and in Blind River

Target for Objective 4: Increase the existing Wetland Value Assessment (WVA) Habitat Suitability Index (HSI) value in the swamp by 10 to 25 percent five years after project implementation and by a 5 to 10 percent increase in the average dissolved oxygen in Blind River from existing conditions.

2.5 Planning Constraints

Planning constraints in general include legal and policy constraints that are applicable to all Federal water resources planning efforts and project-specific constraints. The implementation and operation of the project will be constrained by the following identified project-specific constraints:

<u>Institutional Constraints</u>

- Minimize impact for the ability of the Mississippi River & Tributaries flood control project to continue to fulfill its authorized purposes.
- Minimize impact for the ability of authorized navigation projects to continue to fulfill their purpose.
- Do not violate limitations imposed by the designation of the Blind River as a scenic river by the LDWF. (e.g. do not include structures in the Blind River).
- The project will have to be constructed and operated so it would not conflict with the Wildlife Management Area in the study area.

<u>Technical Constraints</u>

- The operation of the project is constrained by the availability of freshwater, nutrients, and sediments from the Mississippi River. The Mississippi River annual high water (spring) and low water (summer) cycle will impact the hydraulic design of the diversion structure, transmission channel and swamp distribution system. The annual cycle could also reduce the ability to intercept a significant sediment load and to control the nutrient level received by the swamp.

- The operation of the project will be constrained by Lake Maurepas tail water conditions (i.e. The Lake Maurepas tailwater is of the higher than the water level in Maurepas Swamp).

Environmental Constraints

- Do not violate water quality standards as administered by the Louisiana regulatory agency.

2.6 Existing and Future Without Project Condition

The Mississippi River levee system has cut off the Maurepas Swamp (and Blind River) from the natural periodic, near annual flooding by the Mississippi River. This has resulted in a degradation/deterioration process and reduced biological productivity in the swamp due to lack of freshwater, nutrients, and sediment input from the Mississippi River. In addition, the swamp is subsiding due to natural causes and possibly due to man-made activities such as oil and gas, and groundwater withdrawals. The reduced biological productivity and lack of inorganic sediment has reduced soil build-up (accretion).

Additional ecosystem problems are associated with past construction of logging trails, drainage channels, pipelines and other utilities, and roads through the swamp. These facilities disrupt the natural flow and drainage patterns, and impact the biological productivity of the swamp. Short circuiting of the natural drainage patterns has created ponding in some areas which inhibits baldcypress and tupelo propagation.

Without freshwater, nutrient and sediment reintroduction into the Blind River watershed, observed conditions of deterioration are expected to continue into the future.

Without action, the swamp is predicted to continue to deteriorate at the same or accelerated rates, with approximately 21,400 acres (8,600 ha) of baldcypress-tupelo swamp projected to be lost over the 50-year period of analysis, including 3,300 acres (1,300 ha) of baldcypress-tupelo swamp that would become marsh in 20 to 30 years, 7,900 acres (3,200 ha) of baldcypress-tupelo swamp that would become marsh in 30 to 50 years, and 10,140 acres (4,100 ha) of baldcypress-tupelo swamp that would become marsh in greater than 50 years.

A more complete and detailed description of the existing and future without project conditions can be found in Sections 4 and 5 of this report.

The impacts of the Deepwater Horizon oil spill on coastal Louisiana are uncertain at this time. This spill could potentially adversely impact USACE water resources projects and studies within the Louisiana coastal area. Potential impacts could include factors such as changes to existing or baseline conditions, as well as changes to future-without and future with project conditions. The USACE will continue to monitor and closely coordinate with other Federal and state resource agencies and local sponsors in determining how to best address any potential problems associated with the oil spill that may adversely impact USACE water resources development projects/studies. Supplemental planning and environmental documentation may be required as information becomes available.

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3.0 ALTERNATIVES

This chapter presents the alternative plan formulation process, alternative evaluation criteria, selected alternatives for detailed analysis and plan implementation. In order to ensure that sound decisions are made with respect to development of alternatives and plan selection, the plan formulation and selection process requires a systematic approach. This chapter documents this approach and ultimately the plan implementation and management.

3.1 Plan Formulation Rationale

The guidance for conducting Civil Works planning studies (ER 1105-2-100) requires the systematic formulation of alternative plans that contribute to the Federal objective. In order to ensure that sound decisions are made with respect to development of alternatives and ultimately plan selection, the plan formulation process requires a systematic and repeatable approach. The Economic and Environmental Principles and Guidelines for Water and Related Land Implementation Studies (Principles and Guidelines) describe the USACE study process and requirements.

See http://www.usace.army.mil/CECW/PlanningCOP/Pages/planlib.aspx for additional information on the plan formulation rationale, ER 1105-2-100 and the Principles and Guidelines.

3.1.1 Plan Formulation Rational

This section presents an overview of the plan formulation process for the study. Specifically, management measures are presented, screening criteria are discussed, and preliminary and intermediate alternative arrays are presented along with the screening process to obtain the final array of alternatives. The preliminary alternative plans identified through the plan formulation process were first screened based on the diversion locations, flow rates, and the diversion method. The remaining alternatives were then evaluated, based on study area problems and opportunities, as well as study goals, objectives and constraints. As specified in ER 1105-2-100, four criteria were considered during alternative plan screening: completeness, effectiveness, efficiency, and acceptability further described below in Section 3.1.2. Additionally, ecosystem benefits, cost-effectiveness, and environmental impacts were considered to ensure that the Recommended Plan best meets the project objectives. This chapter also describes the TSP which was later confirmed as the Recommended Plan and its implementation requirements.

3.1.2 Plan Formulation Criteria

3.1.2.1 Completeness

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects.

3.1.2.2 Effectiveness

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

3.1.2.3 Efficiency

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

3.1.2.4 Acceptability

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

3.1.3 Environmental Operating Principles

In 2002, the USACE reaffirmed its long-standing commitment to environmental conservation by formalizing a set of Environmental Operating Principles applicable to decision-making in all programs. The principles are consistent with NEPA; the Department of the Army's Environmental Strategy and its four pillars of prevention, compliance, restoration, and conservation; WRDA; and other environmental statutes that govern USACE activities. The Environmental Operating Principles inform the plan formulation process and are integrated into all proposed program and project management processes. The Environmental Operating Principles are:

- Strive to achieve environmental sustainability and recognize that an environment maintained in a healthy, diverse, and sustainable condition is necessary to support life;
- Recognize the interdependence of life and the physical environment, and proactively consider environmental consequences of USACE programs and act accordingly in all appropriate circumstances;
- Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another;
- Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems;
- Seek ways and means to assess and mitigate cumulative impacts to the environment and bring systems approaches to the full life cycle of our processes and work;

- Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work; and
- Respect the views of individuals and groups interested in USACE activities, listen to them actively, and learn from their perspective in the search to find innovative win-win solutions to the Nation's problems that also protect and enhance the environment.

3.2 Management Measures

A management measure is a feature (a structural element that requires construction or assembly on-site) or an activity (a nonstructural action) that can either work alone or be combined with other management measures to form alternative plans. Management measures were developed to address study area problems and to capitalize upon study area opportunities. Management measures were derived from a variety of sources including prior studies, the NEPA public scoping process, and the multidisciplinary, interagency project delivery team (PDT).

3.2.1 Development of Management Measures

To restore the swamp and promote its long-term perpetuation, conditions must be reestablished that contribute to survival of existing baldcypress and tupelo trees and allow at least periodic reproduction and recruitment of seedlings. Within the Maurepas Swamp and Blind River system, non-stagnant water, accretion of soil, nutrients, and freshening are all needed to achieve these goals. From the perspective of sustainable ecosystem management, it is believed that implementation of a freshwater reintroduction project of appropriate size into the Maurepas Swamp is essential for bringing the area back toward environmental sustainability. Implementation of the proposed diversion and flow reintroduction will greatly increase flow through the study area, which will provide periodic renewal of oxygen- and nutrient-rich waters to the swamps. In addition to the diversion alternatives one or more alternatives may be considered which redirects local hydrology to improve the hydro period of the swamp so as to accomplish the ecosystem restoration similar to the water obtained through diversion. In either case, it is important to understand that management measures for properly distributing and controlling the hydro period of the swamp are as important as those management measures designed to divert the water from the Mississippi River. It is also important to note that a proposed alternative would be operated such that reintroductions are reduced or stopped when climate and soil conditions are conducive to tree regeneration.

Based on a review and analysis of prior studies, initial site visits, and input received through the scoping process, an initial list of management measures was developed. Management measures identified are organized into structural and nonstructural measures and then into nine categories as described below. In addition to the management measures identified below the no action alternative will be carried forward in the plan formulation process.

3.2.2 Description of Management Measures

3.2.2.1 Structural Management Measures (Features)

A feature is a "structural" element that requires construction or assembly on-site. A total of 75 features were developed for consideration in this study.

Water Management Modifications in Maurepas Swamp. Various water management measures have been identified to apply diverted freshwater to the swamp to beneficially allow transfer of freshwater and release of nutrients and sediments to the swamp. This category of management measures include the inflow of the water from a distribution system, sheet flow across the swamp which is facilitated by existing and proposed berm gaps, and then release and, if required, control of flow and final routing to the Blind River. Swamp building is slow because the sediment load and freshwater that historically created the swamps are no longer available. The flow rate will need to be controlled at both the inlets and outlets to the swamp in order to control the depth and detention time of the water directed into the benefit area. A fluctuating hydroperiod characterized by occasional dry periods is critical to the germination and sapling survival of baldcypress and tupelo because seedlings can only withstand complete submergence over short intervals, up to 45 days (Souther and Shaffer, 2000), and increased mortality occurs when seedlings are inundated for greater than two weeks (Brandt and Ewel. 1989). Such conditions will also enhance assimilation and improve the quality of water exchanged with the Blind River.

> **Flow controls.** Flow control devices, such as weirs, flow control gates, and control valves, with and without features such as rock filters can be used to manage flow rates and depth of flow. Additionally, the water will have to be transported across existing topographic and man-made features that interfere with the natural flow gradients, such as existing drainage courses and pipelines.
>
> **Crossings at existing drainage and infrastructure.** There are existing features in the swamp, such as pipelines and drainage courses, which will have to be crossed. Inverted siphons can be used to convey the water under the conflict. These structural management measures will be included in alternatives as needed.

Distribution System within the Maurepas Swamp. After being delivered to the fringes of the distribution area, the freshwater will have to be transported and distributed throughout the swamp to avoid short-circuiting into existing pipeline and drainage channels and into the Blind River. Alternate measures and approaches to distributing freshwater throughout the distribution area were identified, including conveyance channels (canals) and conveyance conduits.

Specific approaches and measures are discussed below. The distribution is a critical component in each alternative because there are more than a dozen distinct hydrologic units that are separated by existing channels. These channels have disconnected the hydrology of the individual drainage units, and therefore, the hydro period of each unit must be addressed individually.

St. James Parish drainage canals. There is an interconnected network of existing man-made drainage channels along the south and west boundary of the distribution area, with several outfall channels discharging to the Blind River. The drainage channels are maintained by St. James Parish. These channels are large, varying in size from approximately 30 to 100 feet (9 to 30 meters) wide at the top, and 6 to 12 feet (1.8 to 3.7 meters) deep.

- **Pumps.** Pump the freshwater from the drainage channels into the swamp. Multiple pump stations will be required along the drainage channels to accomplish complete distribution of the water into the swamp. Power would likely be electrical, and would require a significant extension of the electrical grid into the swamp. Solar power was considered, but the power requirement would be on the upper range to use solar cells. Maintaining a large solar grid is not practical for the remote locations due to limited vehicular access. Strategic location of the pumping stations and the use of low cost piping may be an economical option. The pump stations would need security (fences) and scheduled monitoring and maintenance.
- **Control structures.** The drainage channels could be isolated from the Blind River by blocking the downstream ends of the drainage channels. This would allow an increase in the water surface level, providing a hydraulic gradient to force the freshwater into the swamp. The channels currently serve drainage and flood control purposes and measures would be incorporated into the design to accommodate these needs. Active monitoring and management would be required for this management measure to avoid negative flood impacts to the developed areas adjacent to the swamp.

Separate Distribution System. This alternative keeps the freshwater conveyance separate from the existing drainage systems. The initial concept is to provide the distribution system, consisting of either canals or underground conduits, to transport the freshwater to the upstream ends of sub-basins (hydrologic units), where it will be released. The freshwater will then flow through the swamp uniformly and slowly drain to the existing natural and man-made drainage channels. Additional earthwork may be necessary to rectify man-made disturbances to the terrain and to direct overland flow to desired routes and locations as discussed under the section for Water Management in the swamp. Outlet controls may be required to prevent channelization and to control the hydro period in the swamp.

- **Earthen Trapezoidal Channels**. The first alternative for distribution into the swamp is to use earthen trapezoidal channels. The earthen channels will transition to inverted siphons of significant size to cross under infrastructure conflicts and avoid connection to existing drainage channels. The open channels will use raised berms to keep the water elevation in the channels sufficiently higher than the swamp's natural ground elevations to be able to distribute freshwater at numerous discharge points throughout the swamp. The channels will be excavated approximately 3 to 5 feet (0.9 to 1.5 meters) below grade on average with berm heights of approximately 4 to 8 feet (1.2 to 2.4 meters). This would allow sufficient water surface elevation for distribution. The channels will incorporate side slopes of 3:1 both inside and outside of the channels. Easement widths for the channels will be up to 200 feet (61 meters).
- **Concrete-lined Channels**. Concrete lining the channels will improve the hydraulic efficiency of the section, and allow design of smaller channels. However, concrete liners are expensive and normally used only where land is limited, or land acquisition is expensive.
- **Low-head Pressure System Conduits**. This alternative was developed to allow distribution of freshwater without disrupting wildlife migration paths. The conduits would be large pressure-rated pipes or concrete box culverts that would be installed slightly below grade. Inverted siphons will be required at the Blind River, drainage channels, and other obstacles.
- **Pressure Conduits**. This alternative is similar to the low head pressure system in that it uses underground conduits, but the head pressure is provided by a pumping system which allows for higher heads, higher velocities, and smaller diameter conduits. The operation of the system using flow release valves and discharge control gates is similar to the low-head system discussed above.
- **Crossings at Existing Channels and Infrastructure.** Obstacles to the distribution system in the swamp include the Blind River, man-made drainage channels, natural drainage courses, pipelines, abandoned railroad embankments, and other features. All of these can be crossed with inverted siphons; however, due to the costs, other options need to be reviewed. Smaller pipelines could be adjusted or relocated to eliminate the conflict. Other locations my allow flumes above the obstacle.

Transmission (Transfer) System. The transmission or transfer system includes the facilities necessary to transfer the freshwater from the diversion point and deliver it to the distribution system at the edge of the swamp. As with the distribution system in the swamp, alternate measures for the hydraulic conveyance of the freshwater into the swamp have been identified. These include a trapezoidal earthen channel, a trapezoidal concrete-lined channel, underground conduits, and existing natural and man-made drainage systems. The transfer system will be designed for the range of flows expected to be diverted to the swamp including the maximum flow. Concerns of the system are: 1) maintaining an elevated water surface so there is sufficient head to allow distribution in the swamp; 2) sediment deposition which could reduce capacity of the system and require maintenance costs to dredge and transport; and 3) crossing existing infrastructure with an elevated conveyance system.

All transfer alignments cross two active roads and an active railroad. Temporary detour roadways will be required to maintain traffic flow while allowing open-cut construction across the existing roadways. A railroad spur will have to be constructed to maintain rail traffic during open-cut construction across the existing rail alignment.

Diversion System. The diversion for the Blind River project will be located on the east bank of the Mississippi River at a point with available alignments into the Maurepas Swamp.

Diversion Point. Seven potential diversion point locations were identified. In addition to a single diversion point, multiple diversion points were considered as the project progressed. The following potential alternative diversion point locations have been reviewed:

- Mile 152.5 – Belmont Crevasse
- Mile 159.0 – Convent
- Mile 161.8 – Nita Crevasse
- Mile 162.1 – Romeville
- Mile 162.5 – Proposed steel mill
- Mile 166.9 – South of the Bridge
- Mile 168.9 – North of the Bridge
- Dual Points – Miles 152.5 and 168.9
- Dual Points – Miles 161.8 and 168.9
- Dual Points – Miles 162.5 and 168.9

There are several factors that will be considered in selecting the diversion point in addition to the cost of transferring the water from the diversion point to the swamp. The location on the River may affect the way the diversion receives sediment due to the sediment load variations related to bends and depth in the Mississippi River. The upstream diversion points allow for greater areas of the swamp to be served without additional pumping.

Levee Crossing. Previous studies considered both siphons and gated culverts to divert the freshwater from the Mississippi River across the flood control levee on the east bank of the river. In addition, a pumped diversion was also identified, which could be used to maintain a base diversion flow when the Mississippi River stage is too low for siphon operation for further consideration in the plan formulation process.

At the proposed diversion points, the batture is approximately 300 feet (90 meters) wide from the Mississippi River bank to the toe of the levee. The levee crossing measures will have to include provisions for batture crossing, namely:

- Intake Canal – An intake canal can be cut across the batture to nearly the levee, as with the Davis Pond diversion. The bar screens and inlets to the siphons, culverts, or pumps can be located near the base of the levee.
- Extended Siphon Pipes – The diversion siphon pipes could be extended across the batture to the Mississippi River bank, as with the Naomi siphon and other siphons. Bar screens would be located near the river. The siphon pipes would have to be extended down the river bank and protective bollards would be required for protection from navigation.
- Extended Culverts – The diversion culverts could be extended across the batture to the river bank. Bar screens would then be located near the river bank.

Water Quality Management. Water quality management measures are required for two broad purposes:

- Provide the desired water quality and parameters in the freshwater delivered to, and applied in the swamp.
- Protect and possibly improve the water quality in the streams and water bodies downstream of the targeted service area.

The swamp has specific needs to promote revitalized growth, including the freshwater, suspended sediment, and nutrients in the water. The Mississippi River water may have pollutants that can be assimilated in the swamp, such as mercury, pesticides, and nutrients.

After it discharges out of the swamp, diverted water can directly influence the Blind River (through and downstream of the swamp), existing man-made drainage channels in and adjacent to the swamp, Lake Maurepas, Lake Pontchartrain, and other waterbodies. Water quality management measures will be required to both avoid negative impacts in the downstream systems, and to improve water quality. Measures identified include intake elevation control, construction of a sedimentation basin to remove coarse sediments, treatment facilities such as wet detention treatment basins and wetland treatment to remove nutrients, aeration to add dissolved oxygen either mechanically or passively, and a salinity barrier in Blind River to prevent saltwater intrusion into the swamp.

Sediment Management. The existing ground surface in the swamp has had a net loss of elevation relative to sea level due to ground subsidence trends and sea level rise. Several measures were identified to introduce sediment directly into the swamp. Sediment can assist with vertical accretion and will be supplemented by vegetation and litter fall that will also add to the soil base in the swamp. Specific strategies to add sediments include:

Sediment diversions from the Mississippi River – The current Blind River program is based on a freshwater diversion from the Mississippi River, but takes advantage of the fine sediment load suspended in the water. The River has a significant sediment load that occurs primarily in the deeper parts of the River. A sediment diversion could be used, withdrawing water at deeper levels to intercept more sediment. This management measure includes the diversion, transfer to the swamp, application cells, sediment, and discharge facilities.

Disposal of construction spoils – During the construction phase, excess dirt may be generated. This spoil should stay in the swamp, and be used in a programmed manner to build ground elevations in carefully selected areas.

Imported dirt – Dirt could be imported into the swamp for land building.

Sediment Pumping from the River - If dredging occurs on the Mississippi River in the general area, disposal areas (cells) could be created in the swamp to build specific areas, and help with tree regeneration. Sediment could also be mined in this manner.

3.2.2.2 Non-Structural Management Measures (Activities)

An activity is defined as a "non-structural" action. An activity can be a one-time occurrence, or it can be a continuing or periodic occurrence. A total of 24 activities were developed for consideration in this study.

Water Quality Management.

Extended diversion duration to freshen Blind River. The anticipated diversion period will be in the spring. During the dry season, the Blind River becomes stagnant, due to lack of local rainfall and runoff. The diversion period could be extended into the dry seasons to freshen the Blind River and downstream water courses. This management measure would require a corresponding measure at the diversion point, such as pumps, to allow diversion during low water levels in the Mississippi River.

Extended diversion duration to counter salinity intrusion. The study area is subject to high levels of salinity backing up from the Gulf of Mexico due to stochastic events (Lane et al. 2003, Shaffer et al. 2003, Day et al. 2004).

These include extended area droughts and tropical storm surges. Providing capabilities for extended diversion periods, as discussed above, could assist in flushing out the system after the salinity intrusion events.

Vegetation Management. A major objective of the diversion project is to improve conditions for baldcypress and tupelo germination and saplings to promote regeneration. Measures can be taken to assist in regeneration and to protect against loss of seedlings and saplings, including:

- Plant seedlings in targeted areas. This could be a one-time planting, or routine plantings in different areas over the design life of the project;
- Identify areas and control the water levels to mimic the natural wet – dry cycle; and
- Control herbivore grazing of the seedlings with fences or other means.

Recreational Access and Enhancements. The swamp and the existing wildlife management area is a recreational destination for the general public. A diversion will enhance nutrient assimilation and thereby improve water quality and in turn fish and wildlife habitat which will enhance recreational activities. Opportunities may exist to improve access and care must be taken to maintain existing uses. For example, construction of open-channel water conveyance systems will limit the access across these waterways. Also, control structures within channels and canals will impede boat access. Potential management measures to improve recreational access include:

- Crossings at diversion and distribution channels, consisting of culverts of bridges
- Facilities to allow boat passage at weirs and control structures in the drainage canals
- Installation additional boat launches to allow full access to all of the existing and proposed channels
- Underground conduits to avoid loss of access and wildlife movement within the swamp
- Allowance for recreational access to use of construction and maintenance trails

Real Estate (purchase and preservation). Real estate acquisition will be required for all elements of the project, including the diversion structure, the transmission system, and all elements within the targeted project service area in the swamp. The following non-structural real estate management measures have been identified for further analysis in the plan formulation process:

Fee Ownership. Full property ownership rights (fee) can be obtained for the project facilities, especially where the land is currently in private ownership.

Project-specific Easements. Easements can be acquired from private and public agencies for the project, with project-specific purposes. Examples include easements with rights for the diversion facilities, the transmission system, drainage easements, and access easements. Flood inundation (or flowage) easements may be required, if the water surface elevations are increased in and adjacent to the study area.

Conservation Easements. Conservation easements are a proposed management measure to obtain the land rights to perform the swamp restoration activities. Conservation easements can also preserve and protect the improvements and benefits of the project.

Temporary Construction Easements. Temporary construction easements will be necessary to allow the construction of road detours and temporary railroad relocations while projects elements are being constructed.

Permits and Approvals. Some agencies will not grant easements, but will instead grant permits, or allow the facilities on the basis of written approvals. Other pre-project facilities are in place under easements or permits, and the facility owner, without land ownership rights, cannot issue easements. These entities can issue permits or approvals for the crossings. Examples of anticipated permits and approvals are the following:

- Pipelines - The project will cross pipeline easements, with the potential for conflicts between the project element and the pipeline. As a pre-project facility, the pipeline easement will typically have senior (prior) rights. As the pipeline is typically in an easement, and not a fee strip, the pipeline owner cannot grant an easement. The project facility will need a permit or approval from the pipeline owner.
- Roads – the highway and local roadway departments will typically issue permits for road crossings.
- Railroads – railroads have a permit system.

Inter-agency Agreements. Where one agency department owns the land, an inter-agency agreement may be sufficient to give the other department for the project.

3.2.3 Screening / Evaluation of Management Measures

Table 3-1 includes a complete list of management measures. The measures highlighted in red were screened-out and the measures highlighted in Blue were added during initial screening. The rationale for screening-out or adding specific management measures is provided in the last column of Table 3-1 and discussed in more detail below.

3.2.3.1 No Action

A specific "no action" management measure, NA-1, was added to form the basis of the "no action" alternative (also termed Alternative 0 later in this report).

3.2.3.2 Structural Measures (Features)

Water Management Measures in the swamp. Water management measures in the swamp are needed to direct the water in the swamp to ensure that the water introduced through diversion flows through the swamp are consistent with the ecosystem goals of the project. Fourteen management measures were identified under this category. Three measures were screened-out, one measure was added, and twelve were retained for further analysis. Management measure WM-14 was added to provide a path for water under Highway US-61 and Interstate 10 (I-10). Management measures WM-1, "no new control structures", was screened-out because it duplicates NA-1. WM-12, "water management in swamp – unit cost", and WM-13, "water management in swamp", were screened-out because they are not really management measures; they are combinations of measures already included under this category. The water management is critical to the success of this project. The management will include operational considerations for pulsing the hydrologic units or adjusting flow rates to achieve optimum water quality for discharge to the Blind River. Existing ponding and erosion issues will be addressed by the Water Management Measures in the swamp.

Table 3-1: Management Measure Screening[1],[2]

Project: Small Diversion at Convent/Blind River Project - Feasibility
Date: July 4, 2009
This spreadsheet contains a summary list of potential management measures and first level conceptual estimates of capital and O&M costs (May 2009)

Note red highlight indicates that this management measure was screened out and will not be pursued further.
Note blue highlight indicates that this management measure was added during screening

Code	Management Measure	Management Measure Size/Number	Capital Costs, $	Present Worth O&M Costs, $	Present Worth Life Cycle Costs, $	Comments	Additional Screening Comments
	NO ACTION						
NA-1	No Action						
	STRUCTURAL MANAGEMENT MEASURES						
WM	**Water Management in the swamp**					WM-1 thru WM-11 are flow control tools that will be used in various combinations and sizes to manage and control the flow of the freshwater onto, over, and out of the individual Hydrologic Units.	
	Flow controls						
WM-1	No new controls (No Action)						covered above under no action
WM-2a	Weirs - adjustable (US-61 and/or I-10)	30cfs	70,000	3,000	73,000	Assume 2 weirs to divert/release flow into each square mile of swamp service area.	
WM-2b	Weirs - fixed	30 cfs	35,000	0	35,000	Assume 2 weirs to divert/release flow into each	

[1] All costs are in October 2009 prices
[2] Present worth costs were computed using a discount rate of 4-3/8% over a 50-year period

Code	Management Measure	Management Measure Size/Number	Capital Costs, $	Present Worth O&M Costs, $	Present Worth Life Cycle Costs, $	Comments	Additional Screening Comments
						square mile of swamp service area.	
WM-3	Control valves/gates	10 cfs	25,000	0	25,000	Assume 6 canal gates (sluice gates) to divert/release flow into each square mile of swamp service area.	
WM-4	Filling and regarding	1 acre	4,120	0	4,120		
WM-5	Ditches and swales	30 cfs	117,000	0	117,000	15'x3' - 3 miles throughout study area	
WM-6	Earthen berms	10 cfs	289,291	0	289,291	10'x3' - 10 miles long throughout study area	
WM-7	Gap existing berms	10 cfs	15,000	0	15,000	Assume a 10' wide gap in an existing berm that is 4' high by 10' wide.	
WM-8	Rock flow control berms	10 cfs	1,062,917	0	1,062,917	10'x3' - 10 miles long throughout study area	
	Crossings at existing drainage and infrastructure						
WM-9	Inverted siphons under existing infrastructure	390 cfs	466,325	0	466,325	2 - 10'x8' - 200' long	
WM-10	Aqueduct over existing infrastructure	390 cfs	6,998,292	0	6,998,292	8.5' RCP Piping	
WM-11	Adjust existing infrastructure	390 cfs	684,000	0	684,000		
	Systematic controls						
WM-12	Water Management in Swamp - unit cost	1 square mile	600,000	200,000	800,000	Based on assumed water control needs. Can use some or all or the flow control tools in WM-1 thru WM-11	Not really a management measure, but some combination of the 12 management measures identified above.
WM-13	Water Management in swamp	1,000 cfs - 18.0 Sq. Mi.	10,800,000	3,600,000	14,400,000	Based on assumed water control needs. Can use some or all or the flow control tools in WM-1 thru WM-11	Not really a management measure, but some combination of the 12 management measures identified above.
WM-14	Culverts under US-61 and/or I-10	1,000 cfs - 18.0 Sq. Mi.	1,100,000	0	1,100,000	4 - 10'x10' Box Culverts, each 20 ft long	
DS	**Distribution System to the Hydrologic Units in the Swamp**						
	Use existing Parish drainage channels						
DS-1	No Modifications (No Action)	0 cfs	0	0	0		Covered above under no action
DS-2	Pump from channels	1,000 cfs - 18.0 Sq. Mi.	13,000,000	8,200,000	21,200,000		

Code	Management Measure	Management Measure Size/Number	Capital Costs, $	Present Worth O&M Costs, $	Present Worth Life Cycle Costs, $	Comments	Additional Screening Comments
DS-3a	Control structures on canals with berm cuts (w/o Navigation)	1,000 cfs - 18.0 Sq. Mi.	7,400,000	1,200,000	8,600,000		
DS-3b	Control structures on canals with berm cuts (w/ Navigation)	1,000 cfs - 18.0 Sq. Mi.	9,000,000	1,200,000	10,200,000		
DS-3c	Control structures on channels (w/o Navigation) (Area 2)	390 cfs	2,900,000	1,200,000	4,100,000		
DS-3d	Roadway crossing culverts on Hwy. 61 (Area 3)	390 cfs	3,500,000	0	3,500,000	Serves 6.7 sq. mi. east of Hwy 61 - needs about 390 cfs	
DS-3e	Pumps from Blind River (Area 3)	390 cfs	8,000,000	2,100,00	8,000,000	Serves 6.7 sq. mi. east of Hwy 61 - needs about 390 cfs	
	Separate distribution system in Swamp						Mitigation required for impacts to swamp
DS-4	Earthen trapezoidal channels	1,000 cfs - 18.0 Sq. Mi.	48,900,000	1,700,000	50,600,000	Double the cost of earthen, based on Transfer Canal cost estimates.	
DS-5	Concrete-lined trapezoidal channels	1,000 cfs - 18.0 Sq. Mi.	97,800,000	1,700,000	99,500,000		Not cost effective relative to DS-4
DS-6	Gravity conduits	1,000 cfs - 18.0 Sq. Mi.	244,600,000	1,700,000	246,300,000		Not cost effective relative to DS-4
DS-7	Pressure conduits and pump station	1,000 cfs - 18.0 Sq. Mi.	272,100,000	1,700,000	273,800,000	DS-8 thru DS-10 will be sized for individual locations as data collection and design progresses.	Not cost effective relative to DS-4
	Crossings at existing channels and infrastructure						
DS-8	Inverted siphons under existing infrastructure	390 cfs	466,325	0	466,325	2 - 10'x8' - 200' long	
DS-9	Aqueduct over existing infrastructure	390 cfs	6,998,292	0	6,998,292	8.5' RCP Piping	
DS-10	Adjust existing infrastructure	390 cfs	684,000	0	684,000		Adjustments for relocation, culverts under I-10 or US-61?
TS	**Transmission System From Diversion to Distribution System**						
	Use existing drainage courses						
TS-1	Existing drainage courses, minimal improvements	250 cfs	1,000,000	1,000,000	2,000,000	Assume minimal improvements to get minimal capacity.	
TS-2	Existing drainage courses, with improvements	1,000 cfs	16,300,000	2,000,000	18,300,000	Higher maintenance due to multiple uses	

Code	Management Measure	Management Measure Size/Number	Capital Costs, $	Present Worth O&M Costs, $	Present Worth Life Cycle Costs, $	Comments	Additional Screening Comments
	Alignments separate from existing drainage courses						
TS-3	Earthen trapezoidal channel with levees	1,000 cfs	16,300,000	1,000,000	17,300,000	The operating water surface in the canal will be above natural ground. Earthen channels are typically the lowest cost solution.	
TS-4	Concrete-lined trapezoidal channel with levees	1,000 cfs	33,400,000	1,000,000	34,400,000	Concrete-lined channels normally used in very limited rights-of-way, or where the right-of-way acquisition costs are very high.	Not as cost-effective relative to TS-3 and TS-6
TS-5	Conduits (underground pipes or culverts)	1,000 cfs	77,400,000	1,000,000	78,400,000	Underground conduits should be screened out on the basis of costs.	Not as cost-effective relative to TS-3 and TS-6
TS-6	Earthen trapezoidal channel at grade	1,000 cfs	16,100,000	1,000,000	17,100,000	The operating water surface will be below natural ground.	
	Crossings at infrastructure					Costs for the road and railroad crossings are included in TS-3 thru TS-6. Culverts are normally used for lower flow rates, bridges for high flow rates.	
TS-7	Culverts at LA 3125	1,000 cfs	1,500,000	0	1,500,000	O&M are in channel costs	
TS-8	Bridge at LA 3125	1,000 cfs	3,200,000	0	3,200,000	O&M are in channel costs	
TS-9	Inverted Siphons	1,000 cfs	1,400,000	0	1,400,000		Impractical to maintain due to issues with sediments
TS-10	Adjust existing infrastructure	1,000 cfs	2,400,000	0	2,400,000	O&M are in channel costs	Gas lines, fiber optics, power lines, water and sewer utilities, etc
TS-11	Culverts at Railroad	1,000 cfs	3,600,000		3,600,000	O&M are in channel costs	Railroad coordination required
TS-12	Bridge at Railroad	1,000 cfs	1,000,000	0	1,000,000	O&M are in channel costs	Considered impractical due to schedule delay for additional railroad coordination and permitting (will allow only two days for culverts vs. bridge with track closures)

Code	Management Measure	Management Measure Size/Number	Capital Costs, $	Present Worth O&M Costs, $	Present Worth Life Cycle Costs, $	Comments	Additional Screening Comments
TS-13	Culverts at elevated River Road	1,000 cfs				The River Road crossing cost is included in each of the Diversion Structure costs. The road is so close to the levee base that it needs to be dealt with as part of the diversion structure.	
DV	**Diversion System**						
	Diversion Point						
DV-1	No diversion (No Action)						covered above under no action
DV-2	Single diversion point					See DA-1 thru DA-7.	Specific measures included under diversion alignments below
DV-3	Multiple diversion points					See DA-8 thru DA-11.	Specific measures included under diversion alignments below
	Diversion Method					The siphon is the lowest cost option. However, may need a culvert or pumps if the diversion period is extended beyond spring.	
	Levee crossing						
DV-4	Culverts through the levee	1,000 cfs	19,700,000	1,300,000	21,000,000		
DV-5	Siphon over the levee	1,000 cfs	10,900,000	1,500,000	12,400,000		
DV-6	Pump over the levee	1,000 cfs	50,000,000	8,900,000	58,900,000	Siphon - 2/3 of time, pump - 1/3 of time	Allow pump station to pump both ways
DV-7	Combine siphon and pump	1,000 cfs	30,000,000	8,900,000	38,900,000	Siphon - 2/3 of time, pump - 1/3 of time	
	Batture crossing						Considered part of the levee crossing
DV-8	Canal	1,000 cfs		0		O&M are in diversion structure costs	Batture is short and pipes are needed
DV-9	Pipes (pressure conduits from pump station)	1,000 cfs		0		O&M are in diversion structure costs	Considered part of the levee crossing
DV-10	Culverts (extend siphon)	1,000 cfs		0		O&M are in diversion structure costs	Considered part of the levee crossing
DV-11	Reverse Cycle Pumps						Suggested by VE Team for ecosystem restoration and incidental NED
	Diversion Alignment						Most alignments are similar in length, except Convent. The next screening step needs to consider

Code	Management Measure	Management Measure Size/Number	Capital Costs, $	Present Worth O&M Costs, $	Present Worth Life Cycle Costs, $	Comments	Additional Screening Comments
							performance in overall alternatives, and ease/difficulty of ROW acquisition.
DA-1	Mile 152.9 - Belmont Crevasse	1,000 cfs	16,100,000	900,000	17,000,000		May impact three historic mounds, least advantageous hydraulically
DA-2	Mile 159.0 - Convent	1,000 cfs	24,500,000	1,400,000	25,900,000		No information available yet, long route,
DA-3	Mile 161.8 - Nita Crevasse	1,000 cfs	16,300,000	1,000,000	17,300,000		No information available yet, but would impact healthy wetlands, and may impact the two plantations
DA-4	Mile 162.1 - Romeville	1,000 cfs	16,300,000	1,000,000	17,300,000		Impacts Helvetia and Wilton Plantations, shorter route, at the scour bend, low topographically, sugar cane fields adjacent to route allow for treatment as needed
DA-5	Mile 162.5 - Nucor - Future steel mill	1,000 cfs	16,500,000	1,000,000	17,500,000		No impacts to any known sites (Nucor is purchasing the Wilton and Helvetia Plantations), steel mill would develop the entire site - implications for the cultural resources?
DA-6	Mile 166.9 - South of Sunshine Bridge	1,000 cfs	16,900,000	1,000,000	17,900,000		Impacts Monroe Plantation, hydraulically allows access to a large benefit area
DA-7	Mile 168.9 - North of Sunshine Bridge	1,000 cfs	15,400,000	1,000,000	16,400,000		No known impacts, allows access hydraulically to the largest benefit area, not in St James Parish
DA-8	Mile 152.9/168.9 - Belmont & North of Sunshine Bridge	1,000 cfs	31,400,000	1,800,000	33,200,000	500 cfs each alignment. Costs do not decline linearly for low flow rates; have minimum or base costs.	Belmont may impact three historic mounds, least advantageous hydraulically
DA-9	Mile 161.8/168.9 - Nita & North of Sunshine Bridge	1,000 cfs	31,700,000	1,800,000	33,500,000		
DA-10	Mile 152.9/162.1 - Belmont & Romeville	1,000 cfs	32,300,000	1,800,000	34,100,000		Belmont may impact three historic mounds, least advantageous hydraulically
DA-11	Mile 162.1/168.9 - Romeville & North of Sunshine Bridge	1,000 cfs	31,700,000	1,800,000	33,500,000		

Code	Management Measure	Management Measure Size/Number	Capital Costs, $	Present Worth O&M Costs, $	Present Worth Life Cycle Costs, $	Comments	Additional Screening Comments
WQ	**Water Quality Management**						
	Sediment Control						
WQ-1	Control intake elevation in Miss. River	1,000 cfs	4,200,000	2,000,000	6,200,000		
WQ-2	Sedimentation basin (remove coarse sediments)	1,000 cfs	18,000,000	3,400,000	21,400,000		
	Treatment facilities						
WQ-3	Wet detention treatment basins	5 acres	5,000,000	4,200,000	9,200,000	$1,000,000 per acre for construction costs	
WQ-4	Wetland treatment	12.5 acres	3,750,000	1,200,000	4,950,000	$300,000 per acre for construction costs	
	Aeration to add dissolved oxygen						
WQ-5	Mechanical aerators					Included in Treatment Facility Costs	
WQ-6	Passive aeration					Included in Treatment Facility Costs	
WQ-7	**Salinity barrier in Blind River**					Included in Treatment Facility Costs	Salinity not considered an issue in this part of the Blind River
SM	**Sediment Management**						
SM-1	Sediment diversion from Mississippi River	1,000 cfs	42,000,000	10,500,000	52,500,000		Impractical, too expensive, limited benefit and does not provide freshwater
SM-2	Reuse of excess construction materials beneficially					Considered in levee crossing	Ridge habitat, reuse material from levee cuts as available, already required, therefore not needed as a mgt measure
SM-3	Imported soil		79,000,000	0	79,000,000		Impractical, too expensive, limited benefit, and does not provide freshwater
SM-4	Sediment pumping from Miss. River (dredging or mining)	1,000 cfs	42,000,000	10,500,000	52,500,000		Impractical, too expensive, limited benefit, and does not provide freshwater
	NON-STRUCTURAL MANAGEMENT MEASURES						
WQ	**Water Quality Management**						
WQ-NA	No water quality management facilities (No Action)						covered above under no action

Code	Management Measure	Management Measure Size/Number	Capital Costs, $	Present Worth O&M Costs, $	Present Worth Life Cycle Costs, $	Comments	Additional Screening Comments
WQ-BAS	Extended diversion duration to freshen Blind River		0	250,000	250,000		Operational consideration, flush Blind River and also provide salinity benefits downstream (Lake Maurepas)
WQ-SAL	Extended diversion duration to counter salinity intrusions		0	250,000	250,000		Salinity not considered an issue in this part of the Blind River
SM	**Sediment Management**						
SM-NA	No sediment management facilities (No Action)						Covered above under no action
VM	**Vegetation Management**						
VM-1	Plant seedlings	1 acre	36,000	0	36,000		
VM-2	Salvinia management	1/10 Yearly Man Hour	6,000	3,200	9,200		This is a maintenance need
VM-2	Seed stock with soil	1 acre	36,000	0	36,000		Complement to structural sediment management measures that were screened-out
VM-3	Control hydro period and flooding levels		0	0	0		Not really a management measure
VM-4	Plant seedlings - Baldcypress - unit costs	1 acre	36,000	0	36,000		Part of WM-1 above
RA	**Recreational Access and Enhancements**						
RA-1	Consider recreational enhancements		315,000	10,000	325,000		Consider public safety, potential liability, and potential impacts to system operations from vandalism. Consider meandering transfer canal.
RA-1	Improved or additional access points		25,000	0	25,000		Part of management measure RA-1 above
RA-2	Improved access ways in swamp		15,000	0	15,000		Part of management measure RA-1 above
RA-3	Hiking and hunting trails		85,000	0	85,000		Part of management measure RA-1 above
RA-4	Bird watching platforms-lookouts		65,000	0	65,000		Part of management measure RA-1 above
RA-5	Boat ramps and access		125,000	10,000	135,000		Part of management measure RA-1 above. Limit boat access to dual use drainage network for water management and hydraulic needs

Code	Management Measure	Management Measure Size/Number	Capital Costs, $	Present Worth O&M Costs, $	Present Worth Life Cycle Costs, $	Comments	Additional Screening Comments
RE	**Real Estate (purchase and preservation)**						
RE-1	Real estate purchase	1,000 cfs	2,158,000	0	2,158,000		Required for the overall project - not a management measure
RE-2	Project-specific easements	25% of Real Estate Purchase	539,500	0	539,500		Required for the overall project - not a management measure
RE-3	Conservation Easements	25% of Real Estate Purchase	539,500	0	539,500		
RE-4	Temporary construction easements	1,000 cfs	11,250		11,250		Required for the overall project - not a management measure
RE-5	Permits and approvals		62,609	0	62,609		Required for the overall project - not a management measure
RE-6	Inter-agency agreements	1,000 cfs	2,400,000	0	2,400,000		Required for the overall project - not a management measure
RE-7	Real estate purchase - Diversion Structure & Transfer Canal	1,000 cfs	45,000	0	45,000		Required for the overall project - not a management measure
RE-8	Temp. const. easements - Diversion Structure & Transfer Canal	25% of RE-7	11,250	0	11,250		Required for the overall project - not a management measure
M	**Monitoring**						
M-1	Monitoring	1,000 cfs	0	1,200,000	1,200,000	Includes equipment costs and operation/monitoring.	Required for the overall program - not a management measure

Distribution System. A distribution system is needed to ensure that the water introduced into the swamp by diversion can be routed to the twenty-two (22) hydraulically distinct units within the study area. [Note: The twenty-two (22) units initially identified were later refined into twelve (12) larger units for ease of analysis.] Eleven management measures were initially identified under this category. Four measures were screened-out, three measures were added, and ten were retained for further analysis. DS-3c, DS-3d, and DS-3e were added to provide for the control of water into, through, and out of the swamp. DS-1, "no modifications", was screened-out because it duplicates NA-1, "no action", DS-5, "concrete-lined trapezoidal channel", DS-6, "gravity conduits", and DS-7, "pressure conduits and pump station", were screened out because they were not cost-effective when compared to DS-4, "earthen trapezoidal channels".

All of the remaining alternatives use the St. James Parish Drainage channels and any associated utility channels to distribute water to each of the distinct hydrologic units. The ability of the drainage canals to distribute water will be enhanced by installing water level control structures in the channels prior to their discharge to the Blind River. During diversions or during rainfall events the water surface elevation will be controlled to distribute water into the swamp either through or over control structures that will regulate the inflow to the swamp hydrologic units. Note that this method of distribution applies to the areas that are south and east of the Blind River. For areas north of the Blind River and the area between highway 61 and Interstate 10, the North Bridge diversion will need to be used to distribute flow to Highway 61 and under the highway to the north. Without this option the other feasible solutions would involve pumping water from the Blind River back into the swamp or diverting Conway Canal flows through the swamp for hydration of the hydrologic units.

Transmission System. A transmission system is needed to transfer the water removed from the Mississippi River to the swamp. Thirteen management measures were identified under this category. Four measures were screened-out and nine were retained for further analysis.TS-4, "concrete-lined trapezoidal channel with levees", and TS-5, "conduits (underground pipes or culverts)", were screened-out because they were not cost-effective when compared to TS-3, "earthen trapezoidal channel with levees", and TS-6, "earthen trapezoidal channel at grade". TS-9, "inverted siphons", was screened-out because it was considered impractical to maintain due to issues with sediments. TS-12, "bridge at railroad" was "screened-out" because it was considered impractical due to schedule delay for additional railroad coordination and permitting. In general, the railroads will only allow two days for track closures and this is insufficient for bridge construction[3].

[3] The railroad crossings will all require temporary relocations for construction. Culverts and a bridge may both be evaluated, but our analysis to date indicates that culverts will be more cost effective and bridges will not likely be acceptable to the railroads due to construction impacts.

Diversion System. A diversion system is needed to remove water from the Mississippi River and deliver it to the transmission system for transfer to the swamp. Ten management measures were initially identified under this category. Six measures were screened-out, one additional measure was added, and five were retained for further analysis. DV-11, "reverse cycle pumps", was added based on recommendations from the Value Engineering (VE) Team. The VE Team suggested that reverse cycle pumps would enhance ecosystem restoration potential and could result in incidental NED benefits. DV-1, "No diversion (No Action)", DV-2, "single diversion point", and DV-3, "multiple diversion points", were screened-out because they are covered by other management measures that will be carried forward for additional analysis. DV-8, "canals", DV-9, "pipes", and DV-10, "culverts", were screened-out because they are considered integral parts of management measures DV-4 through DV-7 and not separate management measures.

The diversion system selection is tied to the desired hydro period to meet the project objectives. The type of diversion will have flow delivery characteristics that are related to the stage in the Mississippi River. The design team is developing the relationships of flow to river stage for each of the diversion methods. Additional analysis of the hydraulics in the swamp will be required to determine the diversion systems which will match the flow requirements.

Diversion Location. A diversion location is needed to provide a construction footprint for the diversion system and transfer system. Seven individual diversion locations and four combinations of dual diversion location measures, for a total of 11, were initially identified. Five measures were screened-out and six were retained for further analysis. DA-1, "Mile 152.9 - Belmont crevasse", was screened out because it may impact three historic mounds and it is the least advantageous hydraulically. DA-2, "Mile 159.0 - Convent", was screened-out because it is a much longer route from the Mississippi River to the swamp without affording any benefit over other routes retained for further analysis. DA-6, "Mile 166.9 - South of the Highway 70 Bridge", was screened-out due to potential impacts to the historic Monroe Plantation and because it does not offer any advantages over DA-7, "Mile 168.9 - North of the Highway 70 Bridge". Alternatives DA-8, "Mile 152.9/168.9 - Belmont & North of The Highway 70 Bridge", and DA-10, "Mile 152.9/162.1 - Belmont & Romeville", were screened out because they include screened-out diversion locations.

Water Quality Management. Water quality management measures may be needed to: (1) provide the desired water quality and parameters in the freshwater delivered to, the swamp; and (2) to protect and possibly improve the water quality in the streams and waterbodies within and downstream of the study area. Seven management measures were identified under this category. One measure was screened-out and six were retained for further analysis. WQ-7, "salinity barrier in Blind River", was screened-out because salinity is not considered an issue in the Blind River within the study area.

Sediment Management. Sediment management measures were identified to directly introduce sediment into the swamp to assist with vertical accretion within the study area. Four management measures were identified under this category. All four measures were screened-out and none were retained for further analysis. SM-1, "sediment diversion from Mississippi River", SM-3, "imported soil", and SM-4, "Sediment pumping from the Mississippi River (dredging or mining)", were screened-out because they were considered impractical due to high cost and limited benefit and not because they are not consistent with the goal of delivering freshwater to the swamp. SM-2, "Reuse of excess construction materials beneficially", was screened-out because it is required and would be an integral component of any management measure included in the tentatively selected plan.

3.2.3.3 Non-Structural Management Measures (Activities)

Water Quality Management. Water quality management measures may be needed to: (1) provide the desired water quality and parameters in the freshwater delivered to, the swamp; and (2) to protect and improve the water quality in the streams and water bodies within and downstream of the study area. Three management measures were identified under this category. Two measures were screened-out and one was retained for further analysis. WQ-NA, "no water quality management facilities (No Action)", was screened-out because it is part of NA-1, "no action". WQ-SAL, "extended diversion duration to counter salinity intrusions", was screened out because although there are salinity issues in the portion of the Blind River outside of the study area, salinity is not an issue within the study area and does not warrant extended diversion durations.

Sediment Management. Sediment management measures were identified to directly introduce sediment into the swamp to assist with vertical accretion within the study area. One management measures was identified under this category. One measure was screened-out and none were retained for further analysis. SM-NA, "no sediment management facilities (No Action)", was screened-out because it is part of NA-1, "no action"

Vegetation Management. Vegetation management measures were identified to directly address the issue of regenerating vegetation within the swamp. Five management measures were identified under this category. Four measures were screened-out and one was retained for further analysis. WM-2, "*Salvinia* management", was screened-out because it is considered a maintenance item to be accomplished as needed as part of O&M and not a management measure. VM-3, "control hydro period and flooding levels", is considered to be an operational consideration and part of O&M and not a management measure. VM-4, "plant seedlings – Baldcypress – unit cost", was screened-out because it is part of VM-1, "plant seedlings". VM-1 was retained for further analysis on an as needed basis as part of the adaptive management plan.

Recreational Access and Enhancements. Recreation-related measures were identified to take advantage of the opportunity to improve recreation access and enhance the recreational experience within the swamp consistent with public safety considerations and the overall objective of restoration of the degraded swamp ecosystem. Six management measures were identified under this category. Five measures were screened-out and one was retained for further analysis. RA-2, "improved or additional access points", RA-3, "improved access ways in swamp", RA-4, "hiking and hunting trails", "RA-5, "bird watching platforms-lookouts", and RA-6, "boat ramps and access", were screened-out because they are all part of RA-1, "consider recreational enhancements".

The study area supports a wide-range of recreational activities: fishing, hunting, camping, boating, sightseeing, hiking, bird watching, and trapping have all been common. Sporting game hunted in the project has historically included deer, raccoon, squirrel, rabbit, and waterfowl. Common sport fisheries pursued are largemouth bass, bream, perch, catfish, sac-a-lait (crappie), garfish, and choupique (bowfin). Additional recreational activities allowed annually in the WMA and in the study area are contract trapping for alligators and permit trapping for nutria. A project to reverse the trend of degradation in the swamp would have a positive influence on these recreational activities in the study area by improving the quality of the experience. The area is however fairly remote and accessible to only fairly skilled sportsmen. Accordingly no specific recreational facilities will be included in the final array of plans.

Real Estate. Eight management measures were identified under this category. All 8 real estate measures were screened-out because they are required for the overall project and will be developed for the TSP/Recommended Plan. There is not a need to consider them separately as management measures. RE-1, "real estate purchase", RE-2, "project-specific easements", RE-3, "conservation easements", RE-4, "temporary construction easements", RE-5, "permits and approvals", RE-6, "inter-agency agreements", RE-7, "real estate purchase," and RE-8, "temporary construction easements" are all project components that are integral to and included into a project as needed to make it a complete, functional project.

Monitoring. Monitoring was identified as a measure to verify the effectiveness of any plan selected for implementation. The measure (M-1) was screened-out at this level because it will be required for the overall project and will be developed for the TSP/Recommended Plan. There is not a need to consider monitoring separately as a management measure.

3.2.4 Management Measures not Carried Forward for Further Analysis

Management measured screened-out are discussed above and highlighted in pink on **Table 3-1.**

3.3 Preliminary Alternative Plans

3.3.1 Development of Preliminary Alternative Plans

As an initial step the screened list of management measures was evaluated based on benefits, constraints, and relative costs. The management measures were then grouped into an array of preliminary alternatives for further evaluation to achieve the overall project goals and objectives. The alternatives were formulated to consider different options for the diversion point, the diversion method, the transmission system, the distribution system, and the benefit area. The plans described below in terms of their constituent management measures. The plans are designated with a "P" for preliminary.

Early on in the study process a VE Study was conducted. A summary of the VE recommendations and how these recommendations were incorporated into the study is provided below. For additional information on the VE study see **Appendix H**.

During the week of May 18 to May 22, 2009 the VE team met to consider three LCA projects: Small Diversion at Convent Blind River, Amite River Diversion Canal Modification, and Medium Diversion at White Ditch. The results of the VE study were published in a report prepared by Value Management Strategies, Inc. dated June 2009.

For the Small Diversion at Convent Blind River the VE team identified three (3) items as key strategies to consider and three (3) additional items to also be considered. The key items and the follow up for how the item was covered in the final feasibility study development are included for each as follows.

CB-1 Provide method for transferring water under the railroad and US 61 to the north restoration area.

Response: The project Recommended Plan includes 4 culvert crossings under highway 61 which follows the recommendation of the VE study. During project development it was discovered that several existing openings are provided under the railroad so those culverts for connectivity are not required. The culverts provide the connectivity to the more northerly hydrologic units.

CB-2 Use the Blind River to distribute fresh water to the project area.

Response: The Blind River does divide the project area and receives all of the water diverted through the swamp. As the project was further developed, the concept of using additional berm gaps to distribute flow made the use of the Blind River for distribution a lower priority. In addition, further research on the Blind River designation as a scenic river in the State of Louisiana, greatly restricted any features that could be placed in the River. The advanced hydraulic calculations showed good distribution through the use of control structures and berm gaps, so using the River for distribution was no longer required.

CB-3 Consider reversible pumping of proposed river siphons to facilitate low river stage diversion flow

Response: The project Recommended Plan does not use siphons. When the final hydraulics and cost estimates were completed the least costly diversion method was gated culverts. These culverts are located so that there will be flow diverted for most of the year with the exception of extreme low river stages.

The additional three items are as follows with how each item was treated in the final feasibility study:

CB-4 Construct "environmentally friendly" conveyance channels

Response: The transmission canal is designed with shallow 5:1 side slopes and the right of way was widened from 400 feet to 500 feet to allow a more environmentally friendly foot print which could be part of a recreation feature.

CB- 5 Define the hydrologic connectivity of project areas

Response: The later modeling in the study determined the amount of flow from the diversion, through the berm gaps and into the hydrologic units in the study area. These flows were also used in the WVA to determine the environmental benefits derived from the diverted flows.

CB-6 Obtain Total Maximum Daily Flow (TMDL) waiver for diversion into Blind River

Response: The diversion will force flow through the swamp area utilizing the berm gaps and the control structures. The swamp will have sufficient vegetation that the nutrients will be utilized and the flow into the Blind River should be relatively clean from both nutrients and sediment. It is anticipated the Blind River will environmentally benefit from the greater flows from the diversion.

The overall project has an extensive monitoring plan and includes costs for adaptive management to assure that the overall water quality in the Blind River is not degraded. The State agencies will work together to monitor the diversion operation to assist with the overall environmental improvement of the Blind River.

In addition to the six (6) Blind River specific recommendations there were ten (10) General and Plan Formulation recommendations. The following is a list of those recommendations and how they were addressed specifically in the Blind River report.

G-1 Develop plan strategies that account for rise in sea level

Response: This project prepared a complete analysis of sea level rise scenarios and the results are made part of the report.

G-2 Provide clarification and address the WRDA 2007 regarding specified authorized funding limits and the extent of planning development of LCA projects

Response: The Blind River project reviewed the WRDA language and the proposed Recommended Plan is within the WRDA funding limits.

G-3 Define plan alternatives that can be optimized within project authorization

Response: The Blind River project is within the authorization and was optimized at a flow of 3000 cubic feet per second diversion rate.

G-4 Amend project authorizations to include additional federal funding for "first phase" adaptive management measures.

Response: The Blind River cost estimate includes the costs for monitoring and adaptive management for the first 10 years of the project.

G-5 Establish permanent trust fund for project maintainability

Response: The project is proposed to be maintained by the State of Louisiana. The State will have adequate funds for long term maintenance and operation.

G-6 Identify impacts of multiple diversion structures on the Mississippi River and fresh water and sediment requirement of project areas

Response: The State of Louisiana and the Corps of Engineers are conducting parallel studies on the Mississippi River and the Lake Maurepas areas to determine the long term effects of the combination of diversions and other coastal restoration efforts.

3.3.2 Description of Preliminary Alternative Plans

The 12 preliminary plans, plus the no action are described below:

Alternative P-0 - No Action Alternative – This alternative is the future expected without any project. This future without condition is the basis for comparison with project alternatives.

The No Action Alternative will continue the following conditions which will lead to eventual degradation of the swamp area: Local drainage occurs in episodic events and sends large quantities of water to the Blind River and the swamp. This local drainage can contain significant pollutants in terms of sediment, nutrients, pesticides and herbicides. Without the natural assimilation capacity of the swamp, these pollutants can cause stresses on the aquatic life in the Blind River.

Without adequate flow of water through the swamp and with issues relating to subsidence from relative sea level rise and ponding and drainage from pipeline channels, the hydroperiod of the swamp is not conducive to the health and regeneration of several natural tree species, including baldcypress and water tupelo. The swamp has been traversed with many man-made features including railroad embankments and channels which have disrupted the normally anticipated hydroperiod of the swamp and limited the vertical accretion that would occur from prolific vegetation growth from the Mississippi River nutrient input.

The result of the No Action Alternative is failure to meet the objectives of the project.

Alternative P-1 – Water management enhancements in the swamp and redirection of local hydrology. The benefit area would be up to 34 square miles. This would include potential regrading, berm cuts, and other flow improvement enhancements to increase distribution of flow from existing rainfall into and through the Blind River wetlands without a Mississippi River diversion. As an example, there are more than 40 miles of existing berms and spoil banks throughout the wetland that would be potentially gapped (cut) at regular intervals to allow a more distributed flow pattern in the wetland. There are also existing gaps that have not been maintained and need improvement. This alternative could also include 5 to 10 culverts under Highway 61 to reconnect the hydrology of the swamp across that man-made feature. To redirect surface drainage into the swamp variable control structures at the two St. James Parish outfall channels or at either US-61, I-10 or both can be used to manage water surface elevations to support regulation of the hydroperiod in the swamp. This alternative could potentially help the water quality of the Blind River by changing the runoff patterns into the River and develop a more constant water flow by using the swamp as both a water quality and quantity buffer.

The principal features of this alternative would raise the water surface elevation of the St. James Parish drainage system during normal rainfall events to direct local drainage through the swamp for additional detention and treatment. The additional advantage is the short duration rain events that currently drain to the Blind River unimpeded would be detained in the swamp where the outflow would result in a higher quality and more constant flow. Combining this feature with flow distribution in the swamp would enhance the ability to adjust the hydroperiod to improve baldcypress and tupelo germination and sapling survival and contribute to a higher rate of vertical accretion in the swamp.

The ability to direct water across Highway 61 may be limited due to the hydraulic gradient, but modeling of the system will determine the feasibility to hydrate the areas north of Highway 61 and the area north of the Blind River and south of Highway 61.

Alternative P-2 – Diversion at Romeville by a Siphon. The benefit area would be up to 18 square miles. Water management in the swamp would be similar to Alternative P-1. The diversion from the Mississippi River would be a multi-barrel siphon with a capacity of up to 2,500 cfs. More barrels can be added to increase the flow to 5,000 cfs, but an analysis is currently underway to determine if culverts may be more cost effective once a higher rate of flow is required.

The transmission system would be primarily an earthen channel and modified existing drainage channels from River Road (LA44) to LA 3125 and to the St. James Parish drainage canal system. River Road would be elevated over the transmission system siphon connection. Culverts would be used at the Canadian Northern Railroad and LA 3125 crossings.

The distribution system would consist of up to six variable control weirs without navigation access at the ends of the existing drainage system to allow dual use for diverted flow distribution during dry weather while maintaining flood control level of service during wet weather events. The elevated water surface in the drainage channels created by the variable control weirs would allow the use of either fixed or variable flow weirs to distribute flow into the swamp along the periphery of the Parish drainage canals that border the swamp.

Alternative P-3 – Diversion North of the Highway 70 Bridge by a Siphon. The benefit area would be up to 34 square miles. Water management enhancements in the swamp would be similar to Alternative P-1. The transmission system would be earthen channels and modified drainage channels from River Road (LA 44) to LA 3125. This system would be extended to Highway 61 so flow can be distributed along Highway 61 and then across Highway 61 to the north and to the area bounded on the north by Interstate 10. River Road would be elevated over the transmission and siphon connection. Culverts would be used at the Canadian Northern Railroad and LA 3125 crossings. The distribution system would consist of 5 to 10 variable control weirs without navigation access at the ends of the St. James Parish existing drainage system to allow dual use for diverted flow distribution while maintaining flood control level of service. In addition a control structure would be used on the drainage system on the south side of Highway 61. This channel would be hydraulically connected to the area north of Highway 61 by culverts beneath the roadway. Additional control structures may be required on the north side of Highway 61 to be sure flows are distributed north prior to exiting to the Blind River to the east. Depending on the culvert configuration it may be necessary to slightly elevate the current highway to allow for sufficient clearance for culvert installation.

Alternative P-4 – Diversion at Romeville by a Siphon plus Inline Treatment. This alternative is the same as Alternative P-2 with a wet detention treatment system located along the transmission system for sediment collection and treatment of excess nitrogen and other parameters. The in line treatment option will require additional right-of-way to allow for the additional volume for the detention time to be sufficient for sediment, metals, and nutrient assimilation. The standard width is estimated at 400 to 500 feet for a trapezoidal channel. With a meandering stream and small lakes to increase detention time, the right-of-way requirement could be 1000 to 1500 feet. The additional area could also allow for increased recreational benefits at minimal cost to the project

Alternative P-5 – Diversion North of the Highway 70 Bridge by a Siphon plus Inline Treatment. This alternative is the same as Alternative P-3 with a wet detention treatment system located along the transmission system for sediment collection and treatment of excess nitrogen and other parameters.

Alternative P-6 – Diversion at Romeville by a Gated Culvert System plus Inline Treatment. This alternative is the same as Alternative P-4 with a gated culvert system through the levee instead of the siphon. The gated culvert system is more cost effective for larger flows and for operation during longer periods of low Mississippi River stage.

The culvert system has several advantages over the siphon system. It is less operational concern since the adjustment of the flow is simplified by closing or opening a gate. The siphon system involves the use of electrical and mechanical vacuum pumps which must be used each time the siphon is restarted. The culverts would be able to operate over a wider operating river stage range. This would allow for longer periods of diversion when the River is low compared to the siphon which must have a minimum river stage to operate.

Alternative P-7 – Diversion North of the Highway 70 Bridge by a Gated Culvert System plus Inline Treatment. This alternative is the same as Alternative P-5 with a gated culvert system through the levee instead of the siphon. The gated culvert system is more cost effective for larger flows and for operation during longer periods of low Mississippi River stage.

Alternative P-8 – Diversion at Romeville by a Pumped Diversion System plus Inline Treatment. This alternative is the same as Alternatives P-4 and P-6 with a pumped system over the levee instead of the siphon or the culverts. The pumped system may have an advantage if designed with an option to pump storm water from the back side of the levee into the River during flood events to assist with local drainage issues.

Alternative P-9 – Diversion North of the Highway 70 Bridge by a Pumped Diversion System plus Inline Treatment. This alternative is the same as Alternatives P-5 and P-7 with a pumped system over the levee instead of the siphon or the culverts. The pumped system may have an advantage if designed with an option to pump storm water from the back side of the levee into the River during flood events to assist with local drainage issues.

Alternative P-10 – Diversion at Nita Crevasse by a Siphon plus Inline Treatment. This alternative is the same as Alternative P-4 except the diversion location is downstream of Romeville by about 1500 feet in an area that was historically know as the Nita Crevasse. This area is slightly lower in elevation than Romeville, but there are two industrial complexes that will make the routing more difficult.

Alternative P-11 – Diversion at Nucor Steel Mill Site by a Siphon plus Inline Treatment. This alternative is the same as Alternative P-4 with a siphon over the levee at the proposed Nucor Steel Mill site. This option has the same characteristics as Romeville, but the cost of the channel can be shared with Nucor as an environmental enhancement of their property and a source of water supply.

Alternative P-12 – Diversions at Romeville and North of the Highway 70 Bridge by a Siphon plus Inline Treatment. This alternative is the same as Alternative P-4 with siphons over the levee at both Romeville and North of the Highway 70 Bridge. This alternative has the advantage of keeping the size of each siphon small while still having the location and volume to serve the whole 34 square-mile (88 square-kilometer) distribution area.

3.3.3 Screening / Evaluation of Preliminary Alternative Plans

The preliminary array of twelve alternatives plus the no action were developed as the reasonable range of alternatives to address the specific problems, needs and objectives of the study as described in Chapter 2. The alternative in the preliminary array underwent an initial screening process to develop the intermediate array of alternatives. The screening process analyzed the specific components or features that were included in the alternatives. Diversion Location, Diversion Flow Rates and Diversion Methods were analyzed.

Analysis of Diversion Locations. An initial evaluation of the preliminary alternatives determined that diversion location is an important factor in the benefits associated with each alternative. In total 11 diversion locations were identified through the plan formulation process and were considered for the diversion, five in the vicinity of Romeville and six in the vicinity of the Sunshine Bridge. The siting of these potential diversion locations are shown in **Figure 3-1** below. Preliminary conclusions are that a diversion in the vicinity of Romeville is a hydraulically efficient[4] location from which to provide freshwater, nutrients, and sediments to that portion of the benefit area south of the Blind River; a diversion in the vicinity of the Sunshine Bridge is a hydraulically efficient location from which to provide freshwater, nutrients, and sediments to that portion of the benefit area north of the Blind River; and that diversions at both locations are hydraulically efficient locations from which to provide freshwater, nutrients, and sediments to the entire benefit area. The screening rationale associated with each of these diversion locations is provided in **Table 3-2** below. The Romeville and the South Bridge alignments were retained for further analysis along with the possibility of a two diversion alternative with diversions at both locations.

Analysis of Diversion Flow Rates. Two separate analyses were conducted to analyze various sizes for a diversion into southeastern Maurepas Swamp. The diversion at Convent/Blind River was authorized by WRDA 2007 as a small diversion. Small diversions are for a maximum diversion rate of 5,000 cubic feet per second (cfs). As part of the planning process public input was taken and several members of the public expressed interest in higher diversion rates of as much as 25,000 cfs. This input was included for consideration in the intermediate array of alternatives.

As a first step in this process to refine and screen the diversion flow rates, higher diversion rates of 10,000 and 25,000 cfs were analyzed. The results of this analysis concluded that:

- The St. James drainage canals have limited capacity with 2,000 cfs about the maximum flow they can accommodate without overtopping into the swamp. If we accept the overtopping as a desired effect, the Blind River will have a capacity that is only about 5,000 cfs (the current authorized maximum flow rate). Flows in excess of 5,000 cfs will be difficult to control without major modifications to the drainage channels and possible alterations to the Blind River.
- The Mississippi River nutrient loading at these flow rates would exceed the assimilation capacity of the swamp by factors of 20 to 50. These excessive loading rates would have the effect of passing high levels of nutrients to the Blind River and Lake Maurepas.
- Flow rates higher than the 5,000 cfs currently authorized for this study would not improve the objectives of the study and may cause additional problems with soil erosion and nutrient loading downstream of the distribution area. One of the problems identified is the inability of the swamp to properly drain so as to assist in tree propagation. Higher flows

[4] The term "hydraulically efficient" means that the level of the river and the distance between the river and the swamp are matched so the diversion water can be delivered with a high starting head (upstream on the Mississippi) and minimize friction loses (shorten the transmission distance) to the swamp so the application water head is as high as possible. An explanation has been added to the report.

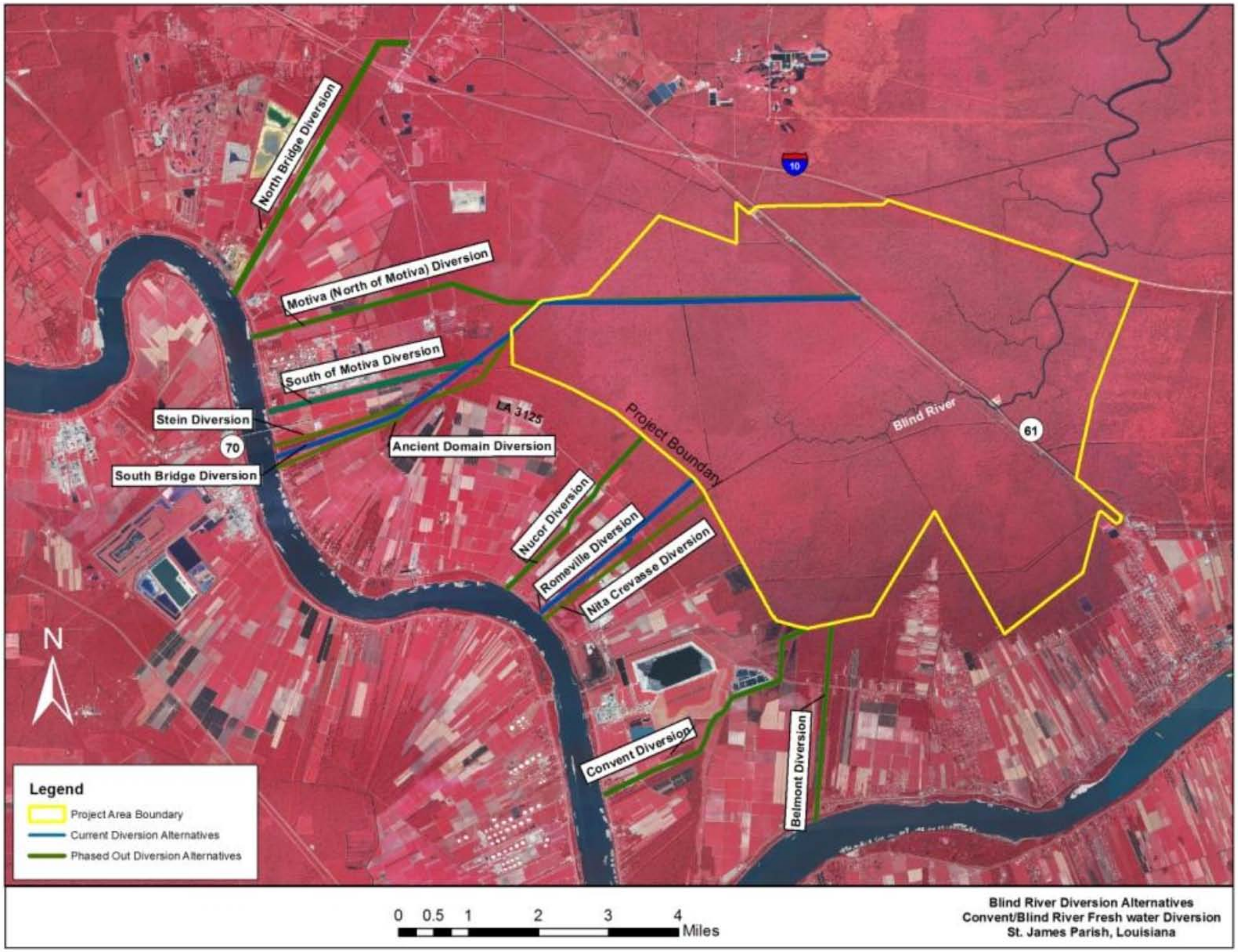

Figure 3-1: Location of screened diversion routes.

Table 3-2: Diversion Locations

Vicinity of Romeville	
Belmont	Screened out. May impact three historic mounds, least advantageous hydraulically
Convent	Screened out. Long route. More costly than Romeville without additional advantage
Nita Crevasse	Screened out. Higher wetland impacts than Romeville with essentially the same output. This site also has some difficult routing issues through existing industrial facilities
Romeville	Retained for further analysis
Nucor	Screened out. Would seriously interfere with Nucor's future development of the property, does not serve the total 35-mile study area and for the area it can serve it is at least as expensive as the Romeville alignment and does not provide any greater benefit.
Vicinity of Sunshine Bridge	
Ancient Domain	Screened out. Grain elevator currently under construction at this location
South Bridge	Retained for further analysis
Stein	Screened out. Impacts a barge fleeting area and alignment is too narrow
South of Motiva	There are significant HTRW problems associated with the Motiva Refinery property
Motiva	Screened out. Significant HTRW problems associated with the Motiva Refinery property
North Bridge	Screened out. Discharges to Conway canal and the Conway Canal has insufficient capacity to receive discharged flows and would be very expensive due to long transmission channel and need to cross I-10 compared to the South Bridge alignment

- would make it more difficult to adjust hydroperiods to allow for greater tree propagation.

Based on this analysis, alternatives greater than 5,000 cfs were eliminated from further consideration. See **Appendix L** for further description.

As a second step in this process to refine and screen the diversion flow rates, flow rates less than 5,000 cfs were modeled and analyzed to determine how the hydroperiod would respond to the different diversion flow rates. The amount of flow diverted (re-introduced) to the swamp depends on the amount of flow, sediments, and nutrients needed for swamp restoration and improvement, with consideration of the extensive amount of backflow from Lake Maurepas.

Diversion capacity was incrementally increased in successive simulation analyses (from 1,000 cfs to 5,000 cfs capacities). Water was diverted only when the average water level in the swamp was below the Lake level. Diversions were discontinued when the average water level in the swamp exceeded the Lake level, or when the lake dropped below 0.5-feet NAVD (to accommodate potential dry-out conditions).

In addition to tracking the total volume of diverted water, five other hydrologic metrics were tracked over the 16-year analysis period for comparative purposes:

- Average annual freshwater inflow (includes runoff and diversions)
- Frequency at which the average swamp water level exceeds Lake Maurepas water level (to help prevent backflow)
- Frequency at or above certain water depths in the swamp
- Long-term average depth of water in the swamp
- Annual average Total Suspended Solids (TSS) into the swamp (using data from the USGS NWISWeb database, Station 07374000: Mississippi River at Baton Rouge).

Figure 3-2 illustrates the results of the sensitivity analysis, as the diversion capacity was increased from 1,000 cfs to 5,000 cfs. The graphs illustrate two important findings. First, no substantial change in the response of the system to the introduction of diversions occurs until a capacity of at least 1,000 cfs is provided. At this "point of departure," many of the hydrologic metrics outlined above begin to respond dramatically to increased diversion capacity. Second, once diversion capacity exceeds 3,000 cfs, the hydrologic metrics for those areas of the swamp that are most substantially affected generally become much less sensitive to increased diversion capacity. That is, above 3,000 cfs, there would be diminishing returns on further increases in capacity with respect to hydrologic sensitivity. This is due in part to the fact that additional capacity may not always be needed to help keep the swamp above the lake elevation. These findings were confirmed (and refined) with the HEC-RAS hydraulic model, which suggested that a minimum capacity of 1,500 cfs would be required to substantively reduce backflow potential, and that 3,000 – 4,000 cfs would be required to practically guard against it completely (using 2003 conditions). Some of the areas that receive little to no impact do begin to show modest hydrologic changes above 3,000 cfs, but they are generally small with respect to the much more substantial effects in the most heavily impacted areas. Impacts to these areas were examined in greater detail with subsequent modeling once the screening of the most effective flow range was accomplished.

It was not the goal of the screening-level analysis to completely characterize the hydrologic impacts to each area of the study area with precision. Rather, the goal was to identify the range of diversion capacities that would be successful in achieving the overall project objective to reverse the trend of deterioration of southeast Maurepas Swamp and Blind River. For these reasons, a minimum diversion capacity of 1,500 cfs was established for the alternatives, and a maximum capacity of 3,000 cfs was established.

The 16 year period was used because that was the limit of available historic data that was considered reliable. The primary concern with the diversion is how it reacts within the swamp which is the primary objective of the project. The swamp has the ability to receive a limited amount of water and nutrients based on the statistical characteristics o f the Mississippi River water. In addition there needs to be a drying period in the swamp for the germination a propagation of new bald cypress trees. There are also hydraulic restrictions in the existing drainage canals which would have been more detrimental to the swamp to be able to transmit higher volumes. The 3,000 cfs is a nominal flow and there may be opportunities using the current configuration to deliver much more water, if it is determined to be needed in the future. In many cases the flow will be lowered to allow the swamp to drain but still maintain a flow in the Blind River. The project as currently configured has a great deal of operational flexibility.

The results of the sensitivity analysis were confirmed for each of the alternative locations, and the same trends were observed. That is, whether the diversion site was Romeville, South Bridge, or a division of the total capacity between the two, the response patterns of the hydrologic parameters was very similar. Additionally, all three alternatives for the diversion location yielded substantive hydrologic effects.

Analysis of Diversion Methods.

Diversion by siphons over the Mississippi River Levee and gated culverts through the Mississippi River Levee were considered. An analysis of construction costs indicates that siphons are more cost effective for flow rates below 1,000 cfs and gated culvert systems are more cost effective for flow rates greater than 1,000 cfs. Accordingly, siphons are used as the diversion method for flows less than 1,000 cfs and gated culvert systems are used for flows greater than 2,000 cfs in formulating a final array of alternatives. This information is presented graphically in **Figure 3-3** below.

Preliminary Alternative Plans Screened due to Analysis of Diversion Methods and Effectiveness and Completeness Considerations

Alternative P-1 – Water management enhancements in the swamp and redirection of local hydrology – This alternative was found to improve swamp drainage during periods of low flow, but to increase drainage times during high flow periods when the water level in the swamp was lower than the water level in Lake Maurepas. Accordingly this alternative was eliminated as a standalone alternative, but incorporated into each diversion alternative as defined below.

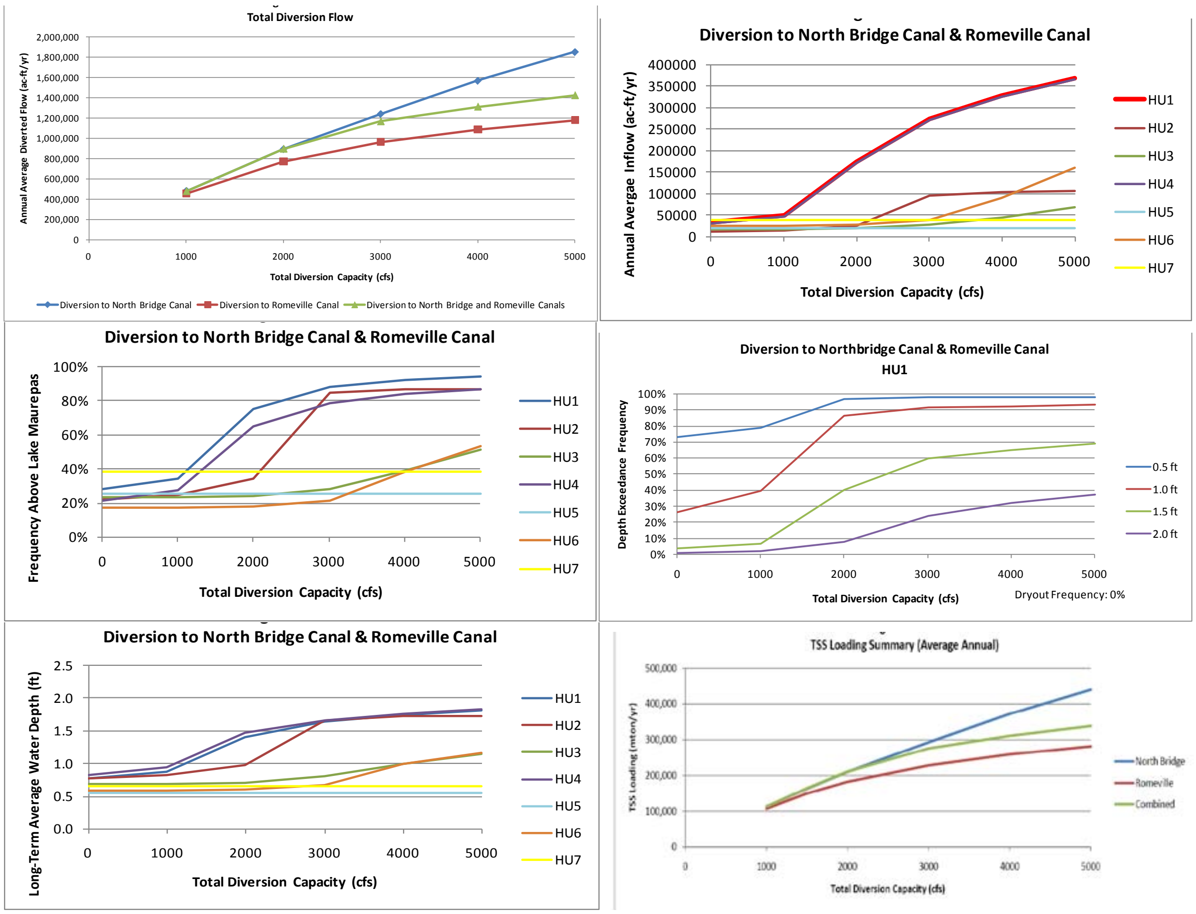

Figure 3-2: Assessment of hydrologic benefits by Hydrologic Unit (HU) received in relation to flow rate[5]

Alternative P-2 – Diversion at Romeville by a Siphon – Alternative P-2 was eliminated from further consideration because it does not include provisions for sediment collection and treatment of excess nitrogen and other parameters. Water quality and sediment management measures may be needed for proper function of the project consistent with applicable water quality requirements. Positive control of the heavy sediment load will reduce the long term maintenance costs for the project by reducing the requirements for dredging.

Alternative P-3 – Diversion North of the Highway 70 Bridge by a Siphon – Alternative P-3 was eliminated from further consideration because it does not include provisions for sediment collection and treatment of excess nitrogen and other parameters. Water quality and sediment management measures may be needed for proper function of the project consistent with applicable water quality

[5] Results represent the introduction of water at both locations simultaneously, with the capacity divided equally between the two. Trends are similar with respect to individual locations for water introduction to the swamp.

requirements. Positive control of the heavy sediment load will reduce the long term maintenance costs for the project by reducing the requirements for dredging.

Alternative P-8 – Diversion at Romeville by a Pumped Diversion System plus Inline Treatment – Alternative P-8 was eliminated because the purpose of a pump system is to allow pumping during periods of low flow in the Mississippi River. Historically when the swamp flooded it was when the Mississippi River was high and overflowed its banks. Additionally, pumped diversion systems have a very high operating cost and the gated culverts provide essential the same flows without the added maintenance and operating costs. Accordingly, pumping is eliminated because it is not considered necessary for the restoration goal for this project.

Alternative P-9 – Diversion North of the Highway 70 Bridge by a Pumped Diversion System plus Inline Treatment – Alternative P-9 was eliminated because the purpose of a pump system is to allow pumping during periods of low flow in the Mississippi River. Historically when the swamp flooded it was when the River was high and overflowed its banks. Additionally, pumped diversion systems have a very high operating cost and the gated culverts provide essential the same flows without the added maintenance and operating costs. Accordingly, pumping is eliminated because it is not considered necessary for the restoration goal for this project.

Alternative P-10 – Diversion at Nita Crevasse by a Siphon plus Inline Treatment – Alternative P-10 was eliminated because this alternative has higher wetland impacts that Alternative P-4 with essentially the same output. This site also has some difficult routing issues through existing industrial facilities.

Alternative P-11 – Diversion at Nucor Steel Mill Site by a Siphon plus Inline Treatment – Alternative P-11 was eliminated because this alternative would seriously interfere with Nucor's future development of the property, does not serve the total 34 square-mile benefit area, and, for the area it can serve, it is at least as expensive as the Romeville alignment and does not provide any greater benefit.

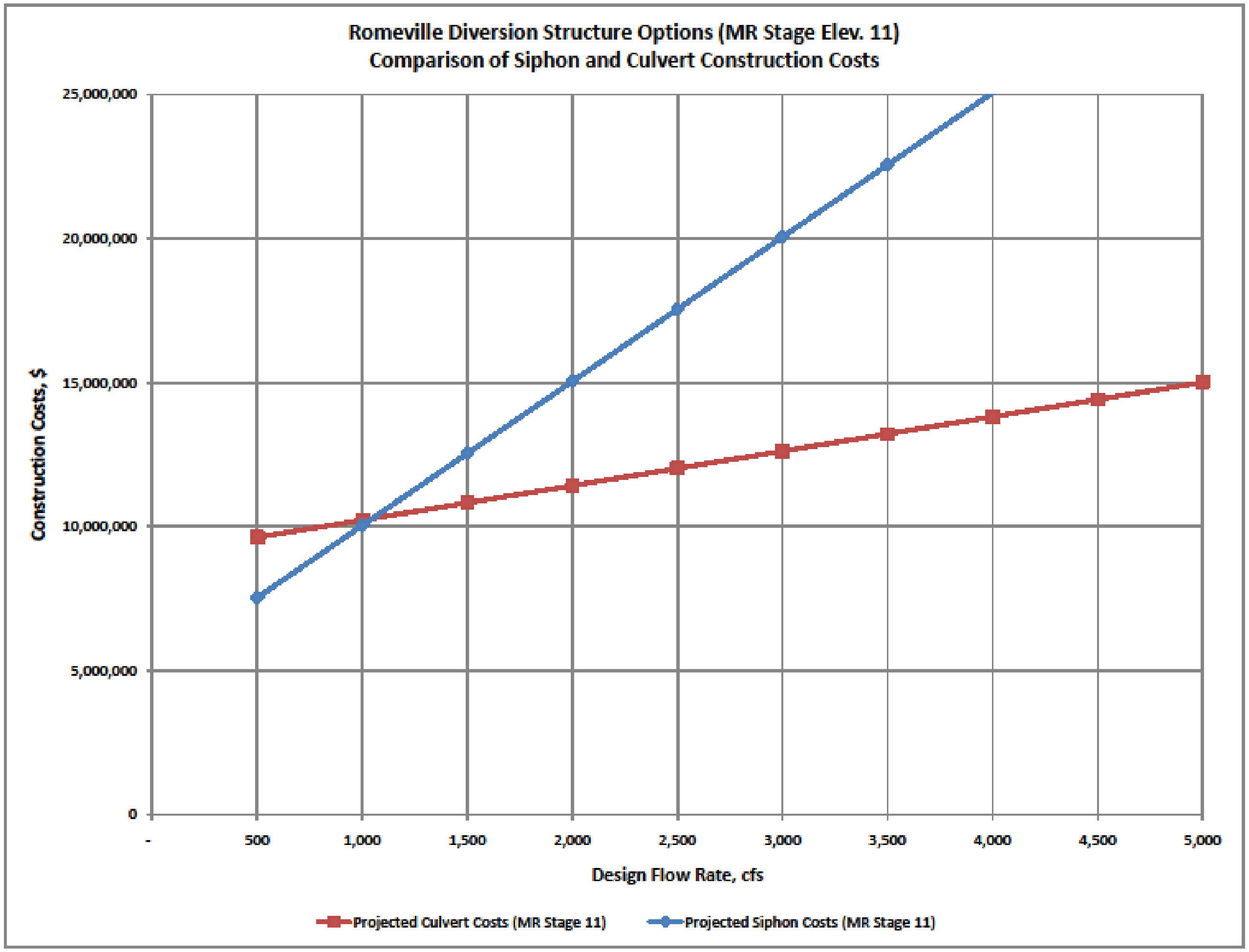

Figure 3-3: Comparison of Romeville structure options based on price and desired flow rate (cfs) [6]

[6] All costs are in October 2009 prices

3.3.4 Intermediate Array of Alternative Plans

The alternatives remaining after the screening of preliminary alternative plans were further developed into the following eight intermediate alternatives (designated as No Action and Alternatives 1 through 6 and 4B). These 8 alternatives were subjected to a more detailed analysis and screening to arrive at a final array of alternatives.

- No Action
- Alternative 1 – 1,500 cfs Romeville Diversion (Siphons)
- Alternative 2 – 3,000 cfs Romeville Diversion (Gated Culvert System)
- Alternative 3 – 1,500 cfs South Bridge Diversion (Siphons)
- Alternative 4 – 3,000 cfs South Bridge Diversion (Gated Culvert System)
- Alternative 4B – 3,000 cfs Diversion at South Bridge with split flows (Gated Culvert System)
- Alternative 5 – 1,500 cfs diversion split equally between Romeville & South Bridge (Siphons)
- Alternative 6 – 3,000 cfs diversion split equally between Romeville & South Bridge (Siphons)

An analysis of the data used to create the figures in **Figure 3-2** indicates that the system responds to diversions between 1,500 and 3,000 cfs with the response steepening at 1,500 cfs and then starting to flatten out at 3,000 cfs. The 1,500 cfs flow range is the minimum amount of flow that has the potential to provide substantive prevention of saline backflow and inundation from Lake Maurepas; but only to a limited benefit area.

An additional analysis of the availability of water from the Mississippi River indicates that stage conditions could diminish the diversion capacity during certain months (generally August – November) to varying degrees, based on total head differential across the swamp system. This, in turn, would effectively reduce the total average capacity of each alternative. For the 1,500 cfs alternatives, this was a concern, since our analysis suggested that this capacity was at or near the lower end of prospective capacities capable of providing substantive hydrologic effects. Reduction in the 3,000 cfs capacity was less of a concern, since many of the sensitivity curves actually began to exhibit diminishing hydrologic effects at capacity levels below 3,000 cfs.

Each of the alternatives was also analyzed with respect to features (berm gaps and control structures) that would maximize the flexibility of operations based on understanding of the dynamics of the Blind River/Maurepas Swamp system. More detailed operational analysis was completed for the final array of alternatives discussed in the Section 3.4, and is presented in **Appendix L2.10**.

After considering the hydrologic factors discussed above, the 1,500 cfs diversion alternatives were analyzed in terms of their capacity to contribute to the planning objectives. See **Table 3-3** below. As can be seen the 1,500 cfs alternatives are not effective in substantially contributing to the planning objectives. Accordingly alternatives 1, 3, and 5 (1,500 cfs) will not be considered further.

Table 3-3: Contribution of 1,500 cfs Diversion Alternatives to the Planning Objectives

Objective	Contribution to Objectives
Promote water distribution in the swamp to increase the area of freshwater inundation for low to average flood events by 10 to 25% from existing conditions to increase swamp productivity and wetland assimilation.	Effective when Stages in Lake Maurepas are lower than in the swamp. Ineffective in providing enough freshwater to the swamp when Lake Maurepas tailwater elevations are higher than the swamp.
Facilitate swamp building, at a rate greater than swamp loss due to subsidence and sea level rise, by increasing swamp productivity, as described above and by increasing sediment input by up to 1,000 grams per square meter per year in order to decrease the annual subsidence rate 50 to 100% in the swamp.	Ineffective because the amount of flow would affect a limited benefit area. In addition there would be limited effectiveness when Lake Maurepas stages are high, and not enough water available when Mississippi River stages are low.
Establish hydroperiod fluctuation in the swamp to improve baldcypress and tupelo productivity and their seeding germination and survival by decreasing flood duration in the swamp by 10 to 25% for high flood events, increasing the length of dry periods in the swamp (no standing water) by 10 to 25%, and by increasing the number of baldcypress and tupelo saplings per acre by 25 to 50% from existing conditions.	Ineffective because the amount of flow would affect a limited benefit area. In addition there would be limited effectiveness when Lake Maurepas stages are high, and not enough water available when Mississippi River stages are low.
Improve fish and wildlife habitat in the swamp and in Blind River by increasing the existing Wetland Value Assessment (WVA) Habitat Suitability Index (HSI) in the swamp by 10 to 25% five years after project implementation and by a 5 to 10% increase in the average dissolved oxygen in Blind River from existing conditions.	Effective when Stages in Lake Maurepas are lower than in the swamp. Ineffective in providing enough freshwater to the swamp when Lake Maurepas tailwater elevations are higher than the swamp.

3.4 Final Array of Alternatives (Alternative Studied in Detail)

Based on the analysis discussed above, it was determined that 3,000 cfs is the flow needed to provide both prevention of saline backflow and inundation from Lake Maurepas and also achieve the overall goal of reversing the trend of degradation in the swamp. The following five alternatives were identified for further consideration and inclusion in the Final Array are:

- No Action (required to establish baseline conditions and the need for a diversion)
- Alternative 2 – 3,000 cfs Diversion at Romeville (Gated Culvert System)
- Alternative 4 – 3,000 cfs Diversion at South Bridge (Gated Culvert System)
- Alternative 4B – 3,000 cfs Diversion at South Bridge with split flows (Gated Culvert System)
- Alternative 6 – Two 1,500 cfs Diversions at Romeville and South Bridge (Siphons)

No Action (Future without Project Conditions)

The No Action Alternative will - lead to the eventual degradation of the swamp in the distribution area. Local drainage occurs in episodic events and sends large quantities of water to the Blind River and the swamp. This local drainage can contain significant pollutants in terms of sediment, nutrients, pesticides and herbicides. Without the natural assimilation capacity of the swamp, these pollutants can cause stresses on the aquatic life in the Blind River.

Without adequate flow of water through the swamp and with issues relating to subsidence, and - relative sea level rise as well as - ponding and drainage from pipeline channels, the hydro period of the swamp is not conducive to the health and regeneration of several native tree species, including baldcypress and water tupelo. The swamp has been traversed with many man-made features including railroad embankments and channels, which have disrupted the natural hydro period of the swamp and limited the vertical accretion that would occur from sediment input and prolific vegetation growth from the nutrient input from the Mississippi River.

Alternative 2 – A 3,000 cfs Diversion at Romeville

This alternative adds a gated culvert system and transfer canal along the Romeville alignment, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp and adds 3 new culverts at 4 locations under U.S. HWY 61. The purpose of the diversion is to bring freshwater, sediment, and nutrients to the swamp at strategic times during the year.

Alternative 4 – A 3,000 cfs Diversion at South Bridge

This alternative adds a gated culvert system and transfer canal along the Cox alignment south of the U.S. HWY 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp and adds 3 new culverts at 4 locations under U.S. HWY 61. The purpose of the diversion is to bring freshwater, sediment, and nutrients to the swamp at strategic times during the year.

Alternative 4B – A 3,000 cfs Split Diversion at South Bridge

This alternative adds a gated culvert system and transfer canal along the Cox alignment south of the U.S. HWY 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp, and adds 3 new culverts at 4 locations under U.S. HWY 61. This alternative includes a modification to the distribution of the diversion provided by Alternative 4 by sending 1,500 cfs to the south through the St. James Parish Canal in order to achieve a similar distribution to Alternative 6. The purpose of the diversion is to bring freshwater, sediment, and nutrients to the swamp at strategic times during the year

Alternative 6 – A 3,000 cfs Dual Diversion at Romeville and South Bridge

This alternative adds a gated culvert system- and a transfer canal- along the Romeville alignment and a gated culvert system- and transfer canals along the Cox alignment south of the U.S. HWY 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp and adds 3 new culverts at 4 locations under U.S. HWY 61. The purpose of the diversion is to bring freshwater, sediment, and nutrients to the swamp at strategic times during the year.

3.5 Comparison of Alternative Plans

The four alternatives in the final array plus the no action were compared based on preliminary costs, benefits, and impacts. The first cost and annual costs (annualized for 50 years) for the final four alternatives are shown in **Table 3-4** and **Figure 3-4** and **3-5** below. Alternative 2 is the least expensive with a preliminary first cost of about $102 million with Alternative 6 being the most expensive at over $155 million. Alternatives 4 and 4B are slightly less expensive than Alternative 6 at $152.2 million and $146.9 million, respectively. A summary comparison of the final array of alternatives with respect to environmental consequences and plan impacts is provided in **Table 3-5.**

Table 3-4: Preliminary Cost (millions of dollars) of alternatives in the final array.[7],[8]

	Cost (millions of dollars)			
Item	Alt. 2	Alt. 4	Alt. 4B	Alt 6
Construction Subtotal	$73.5	$110.7	$106.8	$111.2
Engineering & Design (E&D)	$3.7	$5.5	$5.3	$5.6
Supervision & Administration (S&A)	$2.2	$3.3	$3.2	$3.3
Real Estate	$2.2	$2.2	$2.2	$4.4
Subtotal	$81.6	$121.8	$117.5	$124.5
Contingencies @ 25%	$20.4	$30.4	$29.4	$31.1
Total First Cost	$102.0	$152.2	$146.9	$155.6
Annualized First Cost	$5.06	$7.55	$7.28	$7.72
Annual O&M Costs	$0.59	$0.59	$0.67	$0.74
Total Annual Cost	$5.65	$8.14	$7.95	$8.46
Life Cycle Cost	$114.0	$164.2	$160.4	$170.6

Please note the costs in the above table are preliminary costs used for planning purposes only and in the IWR analysis. They do not represent a fully funded cost estimate.

[7] All costs are in October 2009 prices
[8] First costs were annualized using a discount rate of 4-3/8% over a 50-year period

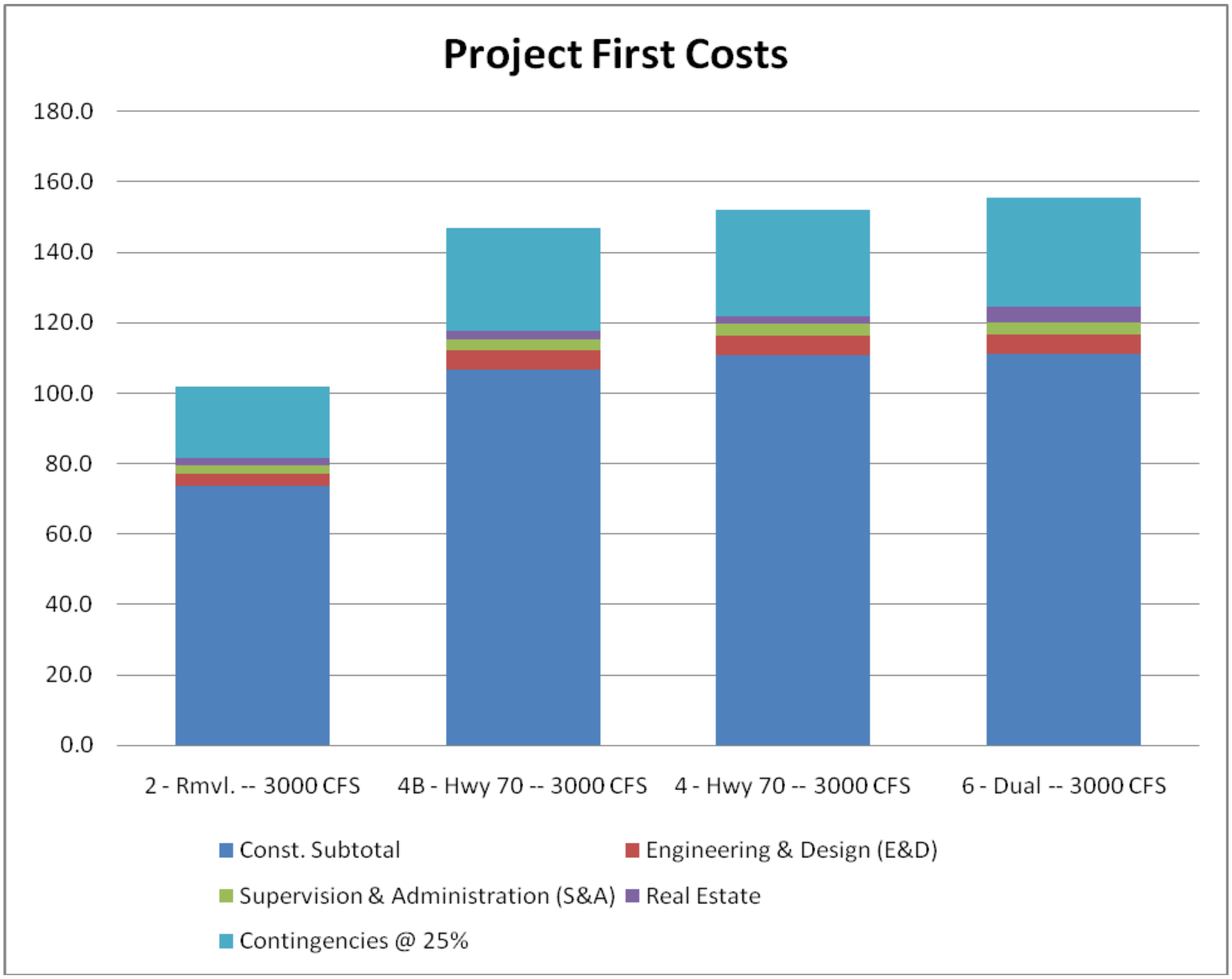

Figure 3-4: Assessment of project first costs[9] for the final array of alternatives.

[9] All costs are in October 2009 prices

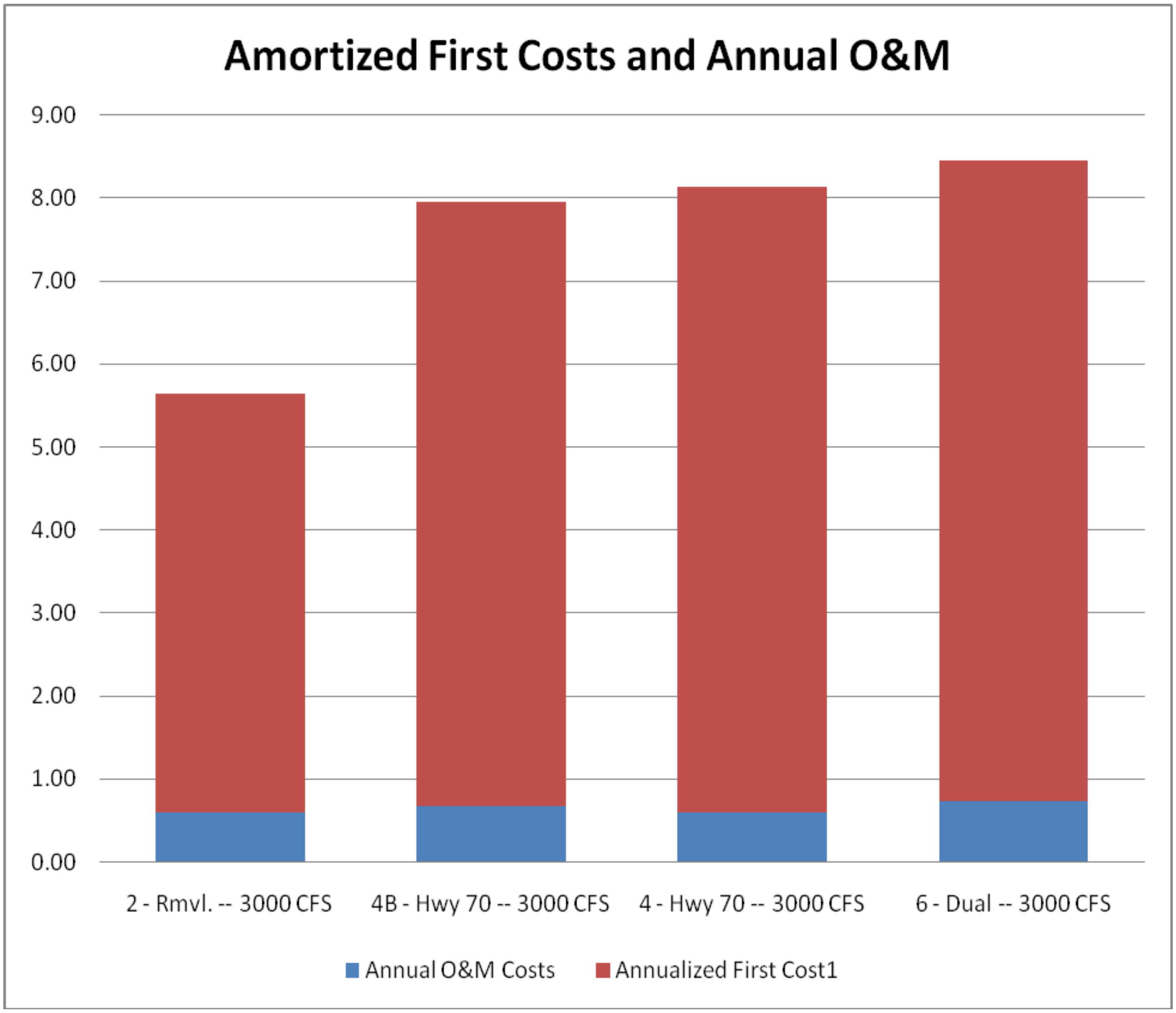

Figure 3-5: Amortized first costs and annual operation and maintenance for the final array of alternatives[10],[11].

Direct benefits and impacts to swamp habitat associated with the final array of alternatives were quantified by acreage and habitat quality (i.e., average annual habitat units or AAHUs).

[10] All costs are in October 2009 prices
[11] First costs were annualized using a discount rate of 4-3/8% over a 50-year period

Table 3-5:

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
1. PLAN DESCRIPTION		No Action/Without Project Condition	Gated culvert system and transfer canal along the Romeville alignment, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds 6 control structures at strategic locations in the swamp and adds 3 new culverts at 4 locations under U.S. HWY 61.	Gated culvert system and transfer canal along the Cox alignment south of the U.S. HWY 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds 6 control structures at strategic locations in the swamp and adds 3 new culverts at 4 locations under U.S. HWY 61.	Gated culvert system and transfer canal along the Romeville alignment and a gated culvert system and transfer canal along the Cox alignment south of the U.S. HWY 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds 6 control structures at strategic locations in the swamp and adds 3 new culverts at 4 locations under U.S. HWY 61	Gated culvert system and transfer canal along the Cox alignment south of the U.S. HWY 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds 6 control structures at strategic locations in the swamp, and adds 3 new culverts at 4 locations under U.S. HWY 61.
2. IMPACT ASSESSMENT						
	A. NER					

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
	1) Total Project Cost[12]	$0	$102,000,000	$152,200,000	$155,600,000	$146,900,000
	2) Annual Cost (not fully funded)[13]	$0	$5,650,000	$8,140,000	$8,460,000	$7,950,000
	3) Annual Net Benefits (AAHU)	0	6,421	6,124	7,114	7,103
	4) Cost Effective (yes/no/best buy)		Best Buy	No	Best Buy	Best Buy
	B. Environmental Resources					
	1) Soils and Water Bottoms	Continued advanced degradation of soils within the SA and increase in acreage of water bottoms.	Increased delivery of sediment to the SA and prevention of conversion of swamp to fresh and marsh open water.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	2)Hydrology: Flows and Water Levels	Persistence of existing conditions including a limited ability to drain and persistent flooding that conflict with historic drying cycles in the swamp, ponding and stagnant waters in some areas, and	Increased hydrologic connectivity that will allow water to flow out of the swamp more easily during periods when Lake Maurepas is low. Increased delivery of freshwater to the	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.

[12] All costs are in October 2009 prices
[13] First costs were annualized using a discount rate of 4-3/8% over a 50-year period

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
		minimal contribution and circulation of nutrients and sediments in the swamp.	SA will provide nutrients and sediments to the swamp that will enhance productivity and accretion.			
	3) Hydrology: Sedimentation and Erosion	Continued lack of sediment inputs into SA.	Increased delivery of freshwater to the swamp will deliver nutrients and sediments to the swamp that will enhance productivity and accretion.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	4) Hydrology: Groundwater	Nearby human populations and industry continue to increase resulting in increased groundwater demands and decrease in groundwater resources. Continued decreasing swamp habitat no longer functions as	Minor variations in groundwater seepage due to head gradients created by the diversion and improved drainage of Maurepas Swamp. Restoration of swamp acts as natural water quality filtration system to the	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
		effectively as natural water quality filtration system to aquifers.	aquifers.			
	5) Water Quality	Conversion of swamp vegetation to fresh marsh and open water reduces natural water quality filtration.	Temporary negative impacts (e.g., increased turbidity, decreased dissolved oxygen) during construction. Restoration of the swamp contributes to improvements in water quality.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	6) Water Quality: Salinity	Continued increases in salinity in Blind River, Maurepas Swamp, and Lake Maurepas.	Decreases in salinity in Blind River, Maurepas Swamp, and Lake Maurepas due to the fresh water inputs.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
	7) Air Quality	Air quality in the study area continues to decline due to: continued population growth, further commercialization and industrialization, increased numbers of motor vehicles, and increased emissions from various engines.	Temporary impacts to air quality associated with construction. Overall improvement of air quality through restoration of Maurepas swamp.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	8) Noise	Limited increases in noise due to limited transportation, development, and navigation in the SA.	Temporary increases in noise levels during construction activities. Buffering of noise levels in the swamp due to increases in productivity and canopy cover.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
	9) Vegetation Resources	Continued loss of vegetated wetland habitats, including; loss of baldcypress-tupelo and bottomland hardwood resources, increased saltwater intrusion, increased flood duration and impoundment, and increased herbivory.	Benefits to vegetation resources including swamp building (accretion), increased baldcypress and water tupelo seedling survival, recruitment, and forest stability. Forest productivity would also increase.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	10) Wildlife	Continued decline in quality of wildlife habitat adversely impacts wetland dependent wildlife populations.	Temporary impacts to wildlife due to construction activities. Improvement and creation of habitat for wetland dependent wildlife. Increases in populations of wildlife dependent on swamp habitat.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	11) Fisheries	Persistence of existing conditions including low oxygen that could lead to fish kills and	Localized and temporary impacts to fisheries during construction. Overall increases	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
		low species diversity in the SA. Loss of wetland habitats used by fish species for shelter, feeding, and life cycle requirements.	in productivity and fisheries populations in the SA. Displacement of some fish species due to changes in salinity.			
	12) Aquatic Resources	A shift in plankton and benthic populations to species assemblages that prefer open water habitats as swamp conversion continues.	Localized and temporary impacts to aquatic resources during construction. Increases in populations due to increases in productivity in the swamp.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
	13) Essential Fish Habitat (EFH)	Potential shift in EFH in Lake Maurepas due to salinity changes. Potential decrease in habitat for juvenile stages of red drum and white shrimp.	No EFH located within the SA. Potential shift in EFH in Lake Maurepas. Potential increase in habitat for juvenile stages of red drum and white shrimp.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	14) Threatened and Endangered Species	Continued degradation, conversion, and eventual loss of important wetland habitats used by threatened and endangered species.	Potential entrainment of pallid sturgeon in the intake structures. Potential creation of structures beneficial to pallid sturgeon. Possible displacement of manatee during construction activities.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2 with additional impacts associated with two intake locations.	Impacts similar to Alternative 2.

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
	15) Cultural Resources	No impacts to cultural resources should occur within the SA as a result of the No-Action Alternative.	No impacts to cultural resources should occur within the SA as a result of this alternative. Potential protection of cultural resources due to deposition of sediment and restoration of swamp.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	16) Aesthetics	Continued swamp degradation and conversion of existing wetlands to fresh marsh and open water habitats resulting in decreased structural complexity and habitat diversity.	Improvement of the visual aesthetics of the SA through restoration of the forested swamp where it has been deteriorating.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
	17) Recreation	Continued degradation of existing wetlands would diminish the wildlife habitat of the area, which in turn would adversely impact the recreational opportunities of the SA. Decreasing annual dollar revenues.	Localized and temporary impacts to recreation during construction. Overall, this alternative would serve to maintain and improve natural habitat, thereby maintaining and increasing recreational opportunities within the SA and leading to a substantial increase in recreational economic value. $35,000 annual dollar revenues based on unit day values.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2. $36,400 annual dollar revenues based on unit day values.	Impacts similar to Alternative 2.

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
	19) Socioeconomics: Displacement of Population and Housing	There would be no impacts to populations or housing under the No Action Alternative.	There would be no impacts to populations or housing under Alternative 2.	Potential displacement of at most three houses and their inhabitants along the South Bridge transmission canal.	Impacts similar to Alternative 4.	Impacts similar to Alternative 4.
	20) Socioeconomics: Employment, Business, and Industrial Activity	Continued natural habitat degradation would have localized impacts on fishery- and wildlife-related employment and industries.	Potential for temporary employment in construction of proposed action. Overall, economic activities dependent upon the natural habitats in the SA would be maintained and possibly increased.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	21) Socioeconomics: Availability of Public Facilities and Services	No impacts to the availability of public facilities and	No impacts to the availability of public facilities and	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
		services should occur within the SA as a result of the No-Action Alternative.	services should occur within the SA as a result of the proposed action.			
	22) Socioeconomics: Transportation	Continued wetland degradation would diminish the ease of travel within the SA.	Impacts on transportation resources would include temporary increase in demand of the transportation network during construction.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	23)) Socioeconomics: Disruption of Desirable Community and Regional Growth (including Community Cohesion)	Continued natural habitat degradation would have localized impacts on fishery- and wildlife-related employment and industries, which could impede community and regional growth.	Economic activities dependent upon the natural habitats in the SA would be maintained and possibly increased, which in turn could enable positive community and regional growth.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	24) Socioeconomics: Tax Revenues and Property Values	The continued natural habitat degradation could potentially cause the property value of the	The proposed action would protect and enhance the visual aesthetic of the SA,	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
		private land within the SA to decline, thereby decreasing tax revenue.	which could potentially increase the property value of the privately-owned parcels within the SA.			
	25) Socioeconomics: Infrastructure	Continued wetland degradation, including coastal land loss, would impact infrastructure along and leading to the coastline, affecting both relocations and maintenance.	The proposed action would preserve and enhance the existing land, thereby reducing the need for increased maintenance and/or relocation of the infrastructure within the SA.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	26) Socioeconomics: Environmental Justice	Continued natural habitat degradation would have localized impacts on fishery- and wildlife-related employment and industries, which could lead to a rise of lower-income residents within the SA.	Economic development dependent upon the fish and wildlife within the SA would be maintained and possibly increased due to the protection and enhancement of the natural habitat.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
			Thereby, boosting the income of those employed in this sector.			
	27) Socioeconomics: Navigation	There will be no impacts to navigation as a result of the No Action alternative.	Potential impacts to navigation in St. James Parish canals when control structures are in use. No impacts to navigation on the Mississippi River or Blind River.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	28) Socioeconomics: Agriculture	There will be no impacts to agriculture as a result of the No Action alternative	A small loss of agricultural land in production due to the construction of the transmission canal.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2 with the additional loss of agricultural land associated with the construction two transmission canals.	Impacts similar to Alternative 2.
	29) Socioeconomics: Forestry	Continued degradation of the swamp greatly reducing the potential for forestry activities.	Wetland preservation and increased productivity that would benefit forest resources in the SA. A small	Wetland preservation and increased productivity that would benefit forest resources in the SA. The loss	Wetland preservation and increased productivity that would benefit forest resources in the SA. The	Impacts similar to Alternative 4.

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
			loss of forested swamp associated with construction activities.	of forested wetland due to the construction of the South Bridge diversion would be more extensive than Alternative 2 due to the longer length of the transmission canal.	impacts of this alternative would be similar to those described for Alternative 2 with the additive direct impacts of Alternative 4.	
	30) Socioeconomics: Public Lands	Continued loss of public land and access resulting from swamp degradation and conversion to fresh marsh open water.	Preservation of public lands due to the diversion slowing or reversing the trend of swamp degradation and habitat conversion in the SA.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	31) Socioeconomics: Water Use and Supply	Continued increases in the salinity of Lake Maurepas and Lake Pontchartrain, which may render this minor water supply source unsuitable for water uptake.	Decreases in salinity of Lake Maurepas would benefit this minor water supply source.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
	32) Socioeconomics: Oil, Gas, and Utilities	The effects of land loss and degradation could lead to increased costs for maintaining and repairing existing oil, gas, and utilities in the SA.	Prevention of the deterioration of substrate upon which oil, gas, and utilities are constructed associated with sediment inputs from the diversion.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	33) Socioeconomics: Flood Control and Hurricane Protection	Continued degradation of forested wetlands that provide some unknown level of hurricane and tropical storm abatement (USACE 2009). Consequently, there could be an increase in storm surge and risk of flooding due to coastal land loss.	Restoration of Maurepas Swamp would provide some level of buffering against future storm surge.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	34) Socioeconomics: Commercial Fisheries	Persistence of existing conditions including the continued conversion of existing wetlands to	Overall increases in fisheries productivity due to increased nutrient inputs and wetland building processes.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
		open water habitats, restricted water circulation, and decreased water quality that could result in declines in commercial fisheries.	The potential short term displacement of some commercial fisheries.			
	35) Socioeconomics: Oyster Leases	There would be no impacts to oyster leases from the No Action Alternative.	There would be no impacts to oyster leases from Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
	36) HTRW	An HTRW Phase I ESA was performed on the study area, and identified a low probability of encountering contaminants of concern. Increasing human populations, development, industry, and other activities in adjacent areas could increase potential for HTRW in SA.	Potential for impacts to the SA from implementation of Alternative 2 is low and would likely continue to be low into the future.	Potential for impacts to the SA from implementation of Alternative 4 is low and would likely continue to be low into the future. One underground storage tank was identified near the South Bridge transmission canal route.	Potential for impacts to the SA from implementation of Alternative 6 is low and would likely continue to be low into the future. One underground storage tank was identified near the South Bridge transmission canal route.	Potential for impacts to the SA from implementation of Alternative 4B is low and would likely continue to be low into the future. One underground storage tank was identified near the South Bridge transmission canal route.
3. Plan Evaluation	**A. Contribution to Planning Objectives**					

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
	1) Promote water distribution in the swamp.	0	2	2	2	2
	2) Facilitate swamp building, at a rate greater than swamp loss due to subsidence and sea level rise.	0	2	2	2	2
	3) Establish hydroperiod fluctuation in the swamp to improve bald cypress and tupelo productivity and their seeding germination and survival.	0	2	2	2	2
	4) Improve fish and wildlife habitat in the swamp and in Blind River.	0	2	2	2	2
	B. Planning Constraints					
	1) Minimize impact for the ability of the Mississippi River & Tributaries flood control project to continue to fulfill its authorized purposes.	2	2	2	2	2

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
	2) Minimize impact for the ability of authorized navigation projects to continue to fulfill their purpose.	2	2	2	2	2
	3) Do not violate limitations imposed by the designation of the Blind River as a scenic river by the LDWF. (e.g. do not include structures in the Blind River).	2	2	2	2	2
	4) The project will have to be constructed and operated so it would not conflict with the Wildlife Management Area in the study area.	2	2	2	2	2
	5) The operation of the project is constrained by the availability of freshwater, nutrients, and sediments from the Mississippi River. The Mississippi River annual high water (spring) and low water (summer) cycle will impact the hydraulic design of the diversion structure, transmission channel and swamp distribution system. The annual cycle could	2	2	2	2	2

		No Action	Alternative 2	Alternative 4	Alternative 6	Alternative 4B
	also reduce the ability to intercept a significant sediment load and to control the nutrient level received by the swamp.					
	6) The operation of the project will be constrained by Lake Maurepas tail water conditions (i.e. The Lake Maurepas tailwater is of the higher than the water level in Maurepas Swamp).	2	2	2	2	2
	7) Do not violate water quality standards as administered by the Louisiana regulatory agency.	2	2	2	2	2
	C. Response to Evaluation Criteria					
	1) Completeness	0	2	2	2	2
	2) Effectiveness	0	2	2	2	2
	3) Efficiency	0	2	2	2	2
	4) Acceptability	0	2	2	2	2

Note: Response to Evaluation Criteria

0 = Does Not Meet

1= Partially Meets Criteria

2=Meets Criteria

3.5.1 Alternatives Hydraulic and Water Quality Modeling

The engineering calculations and hydraulic modeling for each of the four alternatives are fully covered in the engineering **Appendix L in Section L2.10**. This section shows how the flow from the diversion is distributed through each of the hydrologic units using a finite element model analysis. From the modeling work, a general flow diagram with magnitudes was developed and is shown graphically in Figure L2.10.1-3. The model produced this diagram for all of the alternatives and the results by hydrographic unit are shown in Figures L2.10.5-1 through L2.10.5-4. These modeling results were derived from the alternative layouts showing key features in Figures L2.10.1-1, L2.10.2-1, L2.10.3-1 and L2.10.4-1.

The hydraulic analysis for each of the alternatives including water quality was factored into the WVA by hydrographic units as discussed below in Section 3.5.2. Once the appropriate cost and benefit information was derived to rank alternatives, more detailed information was prepared on Alternative 2. The detailed information on Alternative 2 is also contained in the tables and graphics in Appendix L Section 2.10.

3.5.2 Wetland Value Assessment

The Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) Wetland Value Assessment (WVA) methodology was used to quantify the benefits and impacts on swamp habitat. The WVA is used to evaluate coastal restoration projects, and is similar to the U.S. Fish and Wildlife Service's Habitat Evaluation Procedures (HEP), in that habitat quality and quantity (acreage) are measured for baseline conditions, and predicted for future without-project and future with-project conditions. For each habitat type, the model defines an assemblage of variables considered important to the suitability of an area to support a diversity of fish and wildlife species. As with HEP, the WVA provides a quantitative estimate of project-related impacts to fish and wildlife resources; however, the WVA uses separate models for fresh/intermediate marsh, brackish marsh, saline marsh, and swamp habitat.

The WVA models operate under the assumption that optimal conditions for fish and wildlife habitat within a given coastal wetland type can be characterized, and that existing or predicted conditions can be compared to that optimum to provide an index of habitat quality. Habitat quality is estimated and expressed through the use of a mathematical model developed specifically for each wetland type. Each model consists of: 1) a list of variables that are considered important in characterizing community-level fish and wildlife habitat values; 2) a Suitability Index graph for each variable, which defines the assumed relationship between habitat quality (Suitability Index) and different variable values; and, 3) a mathematical formula that combines the Suitability Indices for each variable into a single value for wetland habitat quality, termed the Habitat Suitability Index (HSI).

Each community model (WVA) contains a set of variables which is important in characterizing the habitat quality of several coastal wetland habitat types relative to the fish and wildlife communities dependent on those environments. The final list of variables for the swamp WVA model developed by the CWPPRA Environmental Work Group (2001) includes: 1) stand structure, 2) stand maturity, 3) water regime, and 4) mean high salinity during the growing season. Baseline values are determined for each of those variables to describe existing conditions in the study area. Future values for those variables are projected to describe conditions in the area without the project and with the project.

Variable V_1 - Stand structure. Most swamp tree species do not produce hard mast; consequently, wildlife foods predominantly consist of soft mast, other edible seeds, invertebrates, and vegetation. Because most swamp tree species produce some soft mast or other edible seeds, the actual tree species composition is not usually a limiting factor. More limiting is the presence of stand structure to provide resting, foraging, breeding, nesting, and nursery habitat and the medium for invertebrate production. This medium can exist as herbaceous vegetation, scrub-shrub/midstory cover, or overstory canopy and preferably as a combination of all three.

This variable assigns the lowest suitability to sites with a limited amount of all three stand structure components, the highest suitability to sites with a significant amount of all three stand structure components, and mid-range suitability to various combinations when one or two stand structure components are present.

Variable V_2 - Stand maturity. Because of man's historical conversion of swamp, the loss of swamp to saltwater intrusion, historical and ongoing timber harvesting, and a reduced tree growth rate in the subsiding coastal zone, swamps with mature sizeable trees are a unique but ecologically important feature. Older trees provide important wildlife requisites such as snags and nesting cavities and the medium for invertebrate production. Additionally, as the stronger trees establish themselves in the canopy, weaker trees are out-competed and eventually die, forming additional snags and downed treetops that would not be present in younger stands. The suitability graph for this variable assumes that snags, cavities, downed treetops, and invertebrate production are present in suitable amounts when the average diameter-at-breast height (DBH) of canopy-dominant and canopy-codominant trees is above 16 inches for baldcypress and above 12 inches for tupelogum and other species. Therefore, stands with those characteristics are considered optimal for this variable (SI = 1.0).

Another important consideration for this variable is stand density, measured in terms of basal area. A scenario sometimes encountered in mature swamp ecosystems is an overstory consisting of a very few, widely-scattered, mature baldcypress. If stand density was not considered, and average DBH only, then those stands would receive a high SI for this variable without providing many of the important habitat components of a mature swamp ecosystem, specifically a suitable number of trees for nesting, foraging, and other habitat functions. Therefore, the SI for this variable is dependent on average DBH and basal area which is used as a measure of stand density.

Variable V_3 - Water regime. This variable considers the duration and amount of water flow/exchange. Four flow/exchange and four flooding duration categories are described to characterize the water regime. The optimal water regime is assumed to be seasonal flooding with abundant and consistent riverine/tidal input and water flow-through (SI=1.0). Seasonal flooding with periodic drying cycles is assumed to contribute to increased nutrient cycling (primarily through oxidation and decomposition of accumulated detritus), increased vertical structure complexity (due to growth of other plants on the swamp floor), and increased recruitment of dominant overstory trees. In addition, abundant and consistent input and water flow-through is optimal, because under that regime the full functions and values of a swamp in providing fish and wildlife habitat are assumed to be maximized. Temporary flooding is also assumed to be desirable. Habitat suitability is assumed to decrease as water exchange between the swamp and adjacent systems is reduced. The combination of permanently flooded conditions and no water exchange (e.g., an impounded swamp where the only water input is through rainfall and the only water loss is through evapotranspiration and ground seepage) is assumed to be the least desirable (SI=0.1). Those conditions can produce poor water quality during warm weather, reducing fish use and crawfish production.

Variable V_4 - Mean high salinity during the growing season. Mean high salinity during the growing season (March 1 to October 31) is defined as the average of the upper 33 percent of salinity measurements taken during the specified period of record. Although baldcypress is able to tolerate higher salinities than other swamp species, species such as tupelogum and many herbaceous species are salinity-sensitive. Optimal conditions are assumed to occur at mean high salinities less than 1.0 ppt. Habitat suitability is assumed to decrease rapidly at mean high salinities in excess of 1.0 ppt.

Field data, monitoring reports, scientific literature, preliminary hydrologic modeling data, previous WVAs within the basin, and academic expertise were used to compute baseline HSI values and to predict HSIs for each target year (TY). Target years were established when future significant changes in habitat quality or quantity were expected under future with-project and future without-project conditions.

The product of an HSI value and the acreage of available habitat for a given target year is the Habitat Unit (HU), which is the basic unit for measuring project effects on fish and wildlife habitat. HUs are annualized over the project life (i.e., 50 years) to determine the Average Annual Habitat Units (AAHUs) available for each habitat type. The AAHUs are calculated by summing the HUs over the period of analysis (50 years) and dividing the total by the number of years in the life of the project.

AAHUs are calculated by summing the HU's over the period of analysis (50 years) and dividing the total (cumulative HUs) by the number of years in the life of the project. This method accounts for prestart changes in the analysis using the following equation.

$$\text{Cumulative HU's} = (T_2 - T_1)\left[\frac{(A_1H_1 + A_2H_2)}{3} + \frac{(A_2H_1 + A_1H_2)}{6}\right]$$

Where T1 = first target year of time interval

T2 = last target year of time interval

A1 = area of available habitat at beginning of time interval

A2 = area of available habitat at end of time interval

H1 = HIS at beginning of time interval

H2 = HIS at end of time interval

The time intervals used for the WVA calculation were 0, 1, 20, 30, and 50 years. The change (i.e., increase or decrease) in AAHUs for each future with-project scenario, compared to future without-project conditions, provides a measure of anticipated impacts. A net gain in AAHUs indicates that the project is beneficial to the fish and wildlife community within that habitat type; a net loss of AAHUs indicates that the project would adversely impact fish and wildlife resources. Figure 3-6 depicts the HU over time for alternative 2. The benefit evaluation period for the project is 2015-2065.

The WVA analysis was run for each alternative within the final array to determine the quantitative benefits for each alternative including the areas impacted by the construction. Further explanation of how impacts/benefits are assessed with the WVA and an explanation of the assumptions affecting HSI (i.e., quality) values for each target year for benefits/impacts to swamp habitat are available for review at the Service's Lafayette, Louisiana, field office, and provided in **Appendix K**.

For planning and hydrologic modeling purposes, the project area was divided into three benefit areas (i.e., benefit area 1, 2, and 3) and within those benefit areas are several sub-basins. Benefit areas and sub-basins are defined by topographic high areas (e.g., spoil banks, relict railroad grade, road embankments) or channels, natural or artificial (e.g., rivers, canals, channels, intermittent tributaries) that would serve to impede or intercept hydrologic flows. The area south and southwest of Blind River is defined as benefit area 1 (i.e., 100 sub-basin series). The area north of Blind River and west of U.S. Highway 61 is benefit area 2 (i.e., 200 sub-basin series), and the area north of Blind River and east of U.S. Highway 61 is benefit area 3 (i.e., 300 sub-basin series). For the purposes of the Wetland Value Assessment (WVA) the sub-basins are grouped into hydrologic units (**Figure 3-7**), or units that are considered to be under the same hydrological influences.

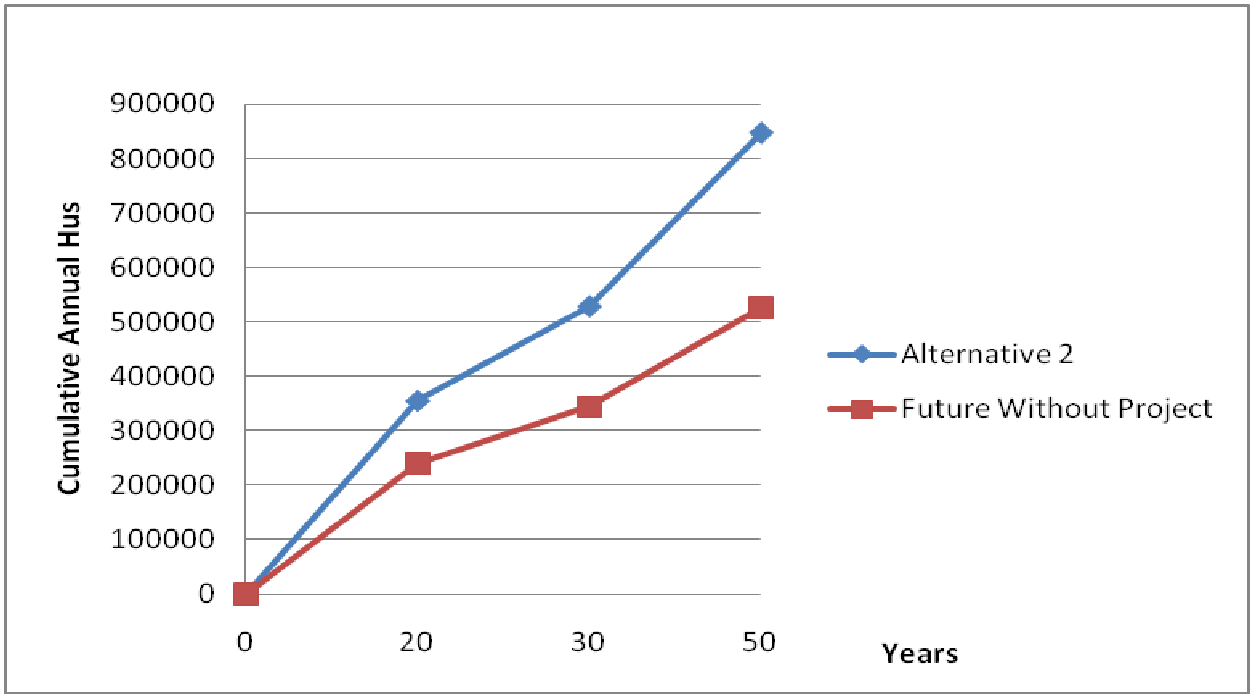

Figure 3-6 Annual Habitat Units

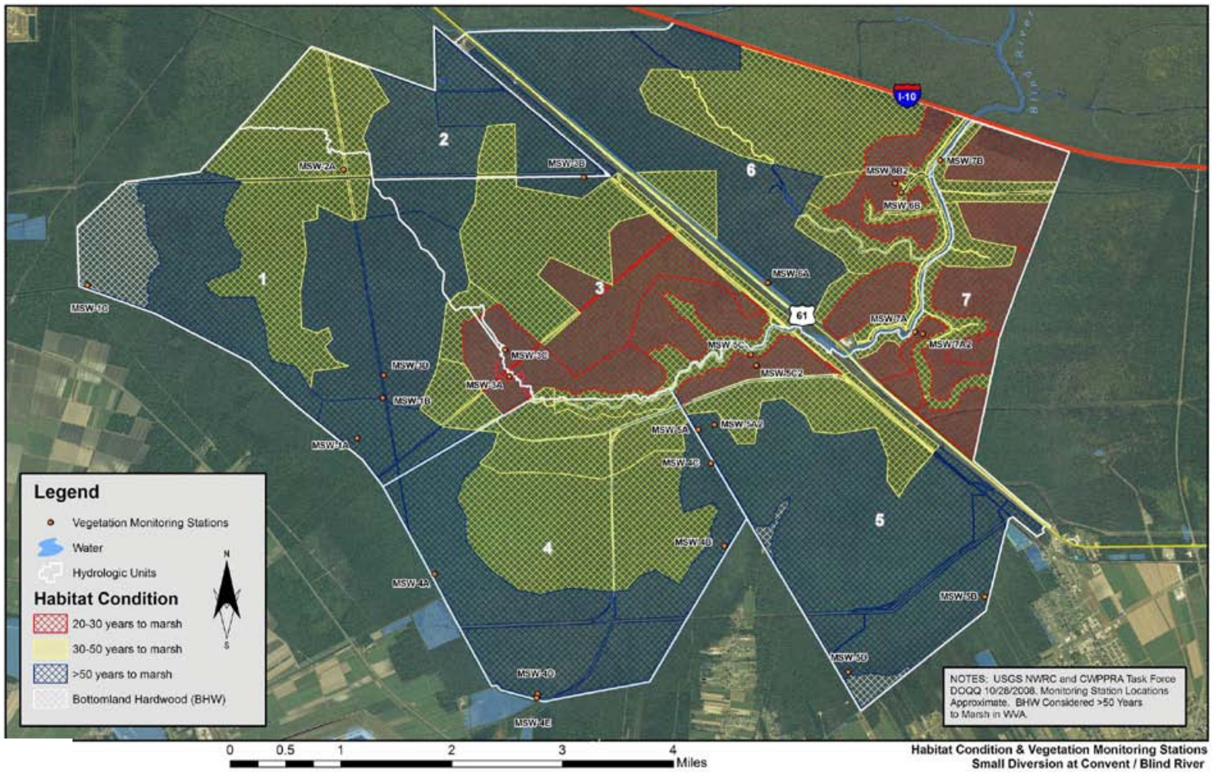

Figure 3-7. Hydrologic Units and Habitat Condition Classes for the Convent/Blind River Freshwater Diversion.

WVA Model Certification. The WVA model is completing model certification in accordance with EC 1105-2-407, May 2005 Planning Models Improvement Program: Model Certification. The model has undergone external review which is documented in the July 8, 2009, Draft Model Certification Review Report for the Wetland Value Assessment Models prepared by the Battelle Memorial Institute for the US Army Corps of Engineers, Ecosystem Planning Center of Expertise. The WVA revision documentation and spreadsheets have been submitted to the ECO-PCX. The ECO-PCX has reviewed the revisions and will forward a recommendation to certify the model for use in the LCA projects.

Since the WVA was still in the process of being certified, the projects using the WVA model were required to respond to specific comments related to the ongoing certification process and the use of WVA on the specific project. The specific comments and responses for the WVA as it relates to the project can be found in **Appendix K.** Based on satisfactory responses to these comments Planning Center of Expertise for Ecosystem Restoration has cleared the WVA model for use in evaluating the alternatives considered in this report.

Relative Sea level Rise. Relative sea level rise refers to the difference between the change in eustatic sea level and the change in land elevation. The combination of subsidence and eustatic sea level rise would likely cause the landward movement of marine conditions into estuaries, coastal wetlands and fringing uplands (Day and Templet, 1989). Relative sea level rise has been measured in the Mississippi Delta at rates as high as 10 mm/yr (Snedden et al., 2007). Based on guidance in EC-1165-2-211, it was determined that a low estimate for relative sea level rise over for the 50-year period of analysis (2061) is 1.5 ft (0.46 m); an intermediate estimate is 1.9 ft (0.58 m); and a high estimate is 3.2 ft (0.97 m). The WVA initial analysis was completed for the intermediate sea level rise scenario. The WVA analysis was also run on the low and high RSLR scenarios for the NER and Recommended Plan see Section 3.8.1.

3.5.3 Cost-effectiveness/Incremental Cost Analysis

The habitat values identified above, along with preliminary engineering costs, were used as inputs for the IWR Planning Suite to compare the alternatives in terms of outputs and costs as further described below.

Cost effectiveness and incremental cost analyses (CE/ICA) reveal information about good financial investments given the dollar costs and non-dollar outputs ("benefits") of alternative investment choices. The analyses are conducted in a series of steps that progressively identify alternatives that meet specified criteria and screen-out those that do not. US Army Corps of Engineer (USACE) Regulation 1105-2-100 requires cost effectiveness and incremental cost analyses to support recommendations for ecosystem restoration through implementation of the IWR Planning Suite (IWR). IWR takes user-defined solutions to planning problems and externally-generated estimates of each solution's effects and can formulate all possible combinations of those solutions, considering user-defined relationships between solutions. IWR will then identify which combinations are the best financial investments through cost effectiveness and incremental cost analyses. Each combination of solutions is an alternative plan and the use of IWR assists in identifying which plans are the best investments.

Cost effectiveness analysis begins with a comparison of the costs and outputs of alternative plans to identify the least cost plan for every possible level of output considered. The resulting least cost alternative plans are then compared to identify those that would produce greater levels of output at the same cost, or at a lesser cost, as other alternative plans. Details of the project cost development are provided in **Appendix L, Annex L-1**. Alternative plans identified through this comparison are the cost effective alternative plans. Next, the cost effective alternative plans are compared to identify the most economically efficient alternative plans, that is, the "Best Buy" alternative plans that would produce the "biggest bang for the buck." Finally, the additional costs for the additional amounts of output ("incremental cost") produced by the Best Buy alternative plans are calculated. The results of all the calculations and comparisons of costs and outputs provide a basis for addressing the decision question "Is it worth it?" i.e., are the additional outputs worth the costs incurred to achieve them?

In practice, USACE ecosystem restoration studies typically measure the ecosystem benefits of alternative plans in terms of physical dimensions (number of acres of wetlands, for example), or population counts (number of wading birds, for example), or various habitat-based scores ("habitat units" based on the U.S. Fish & Wildlife Service's *Habitat Evaluation Procedures*, or "HEP", or Wetland Value Assessment "WVA" for example).

The performance measures evaluated and selected for this project were habitat units (HUs). Habitat units are the metric that best integrate information regarding the quality and quantity of improved habitat for various representative species and/or communities within the project benefit area. Cost and HU output comparisons are summarized and illustrated in **Figure 3-8** below:

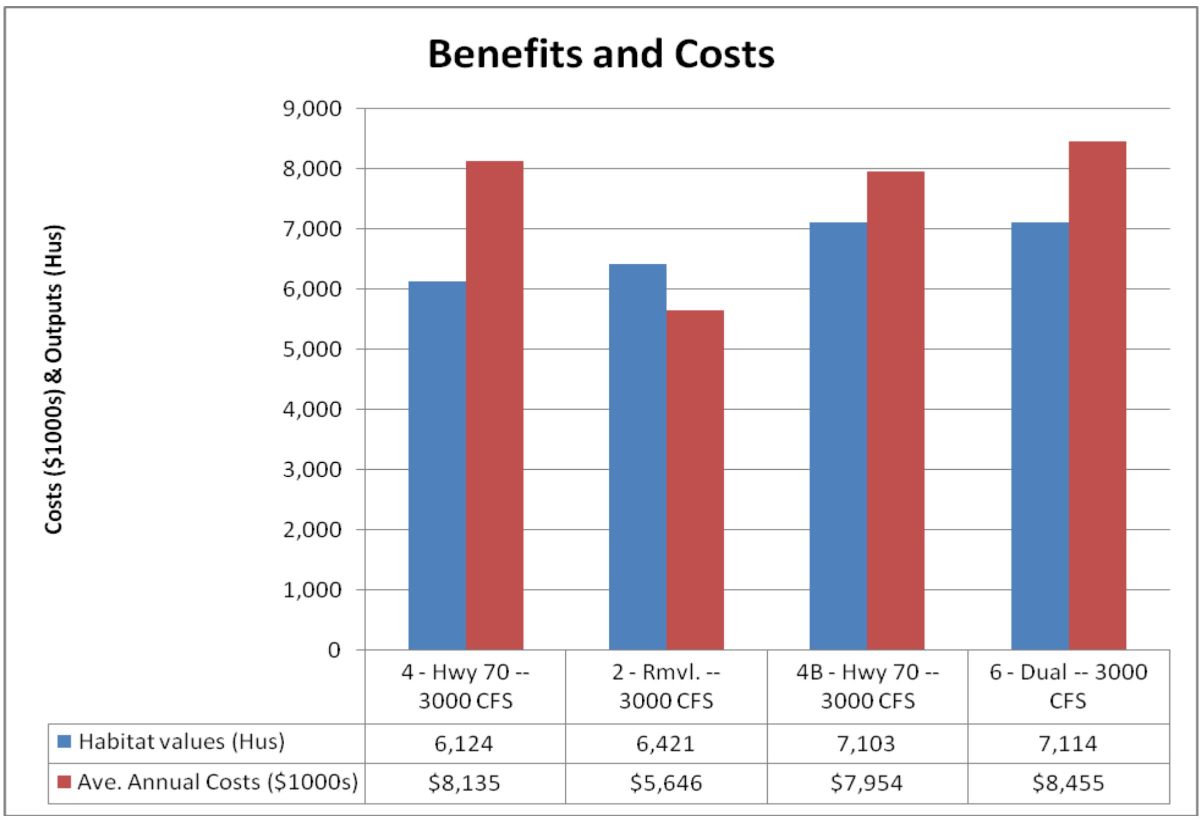

Figure 3-8. Benefits and costs of the final array[14,15]

The cost-effectiveness of the alternatives is presented in **Table 3-6** and **Figure 3-9**. The analysis indicates that Alternative 4 has lower benefits and higher preliminary costs than alternative 2 and is not a cost-effective solution. Therefore Alternative 4

[14] All costs are in October 2009 prices

[15] First costs were annualized using a discount rate of 4-3/8% over a 50-year period

will not be considered further. Alternates 2, 4B, and 6 are all cost-effective and are also best buy alternatives and will be considered further through an incremental cost analysis. However, it should be pointed out that Alternative 6 produced significant AAHUs at an extreme cost per habitat unit when compared to the other two alternatives. This is explained further in the following paragraphs.

Table 3-7 and **Figure 3-10** summarize the incremental analysis of the cost-effective alternative plans. Of the three alternatives, Alternative 2 provides the lowest increase in average annual habitat units when compared to the future without-project condition. By delivering 3,000 cfs of freshwater, sediments, and nutrients to the Southeast portion of the Maurepas Swamp drainage in the swamp would improve, there would be more dry periods to promote seed germination and sapling survival, and there would be a decrease in persistent inundation, short circuiting drainage patterns, and ponding and stagnation. Nutrients and sediment diverted and pulsed to the swamp will be more widely distributed in the swamp and that would result in increased nutrient assimilation and vegetative productivity as well as improved water quality in Blind River. Implementation of Alternative 2 would reverse the existing trend of swamp deterioration. The sediment diverted to the swamp and the increased productivity will increase accretion (soil building) and offset subsidence and sea level rise and reduce the decrease in the ground surface elevation in the swamp and reduce persistent inundation. Because of this strong contribution to the planning objectives, the $5,646,000 annual cost for Alternative 2 to produce 6421 average annual habitat units at a per unit cost of $880 is considered justified. The increment from Plan 2 to Plan 4b produces an additional 682 average annual habitat units at a cost of $2,309,000 or $3,384 per average annual habitat unit and the increment from Plan 4b to Plan 6 produces an additional 11 habitat units at a cost of $501,000 or $45,530 per average annual habitat unit. Alternative 2 provides over 90 percent of the benefits for about 67% of the cost of Alternative 6, the cost per AAHU is much lower for Alternative 2 that for the other two alternatives and the incremental cost per habitat unit in going from Alternative 2 to Alternative 4B and/or Alternative 6 is quite high. Due to the high incremental cost per habitat unit for the increments above Alternative 2 these increments are not considered to be justified. Alternative 2 is the alternative that reasonably maximizes ecosystem restoration benefits compared to costs and is designated as the National Ecosystem Restoration Plan.

Table 3-6. Cost-effectiveness analysis of the final array[16,17]

	Alternative 4	**Alternative 2**	**Alternative 4B**	**Alternative 6**
	South Bridge, 3000 cfs	**Romeville, 3000 cfs**	**South Bridge (split flow)**	**Dual Diversion**
HUs	6124	6421	7103	7114
Cost ($1,000s)	$8,135	$5,646	$7,954	$8,455
Cost-effective	No	Yes	Yes	No
Best Buy	No	Yes	Yes	Yes

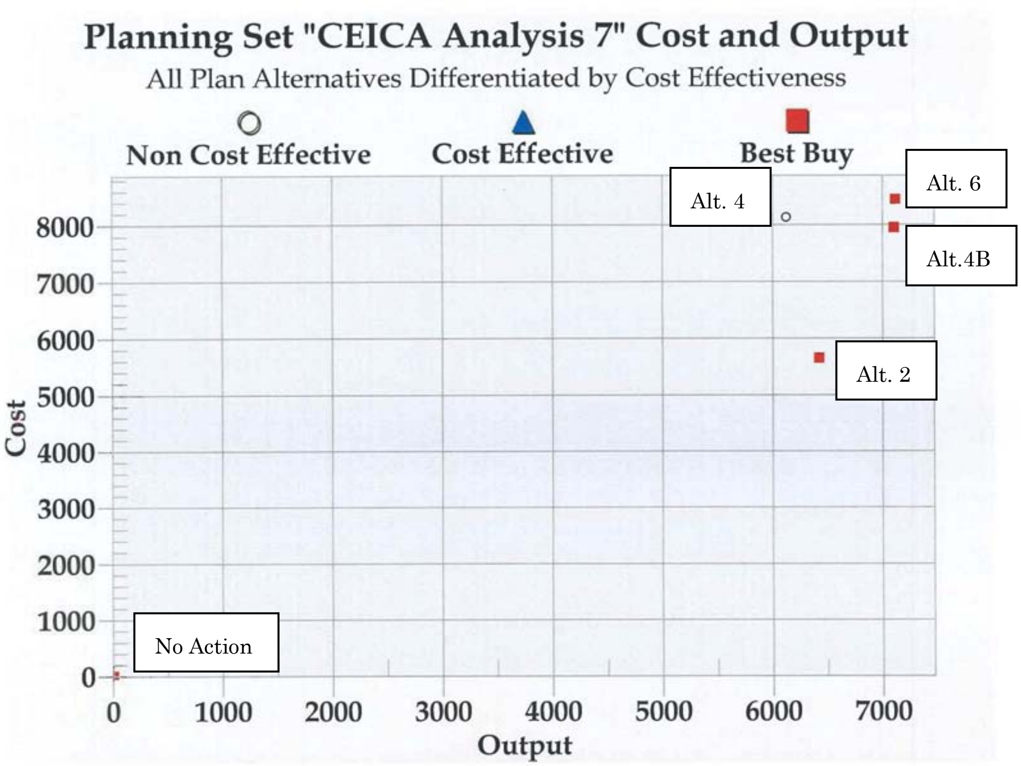

Figure 3-9. Cost-effectiveness of analysis of the final array

[16] All costs are in October 2009 prices
[17] First costs were annualized using a discount rate of 4-3/8% over a 50-year period

Table 3-7. Incremental cost analysis of the final array[18,19]

	Alt. 2 – Romeville	Alt. 4B 0 South Bridge (Split flows)	Alt. 6 – Dual Diversion
AAHUs	6,421	7,103	7,114
AA Cost ($1,000s)	$5,646	$7,954	$8,455 Yes
Δ AAHU	6,421	682	11
Δ AA Cost ($1000s)	$5,646	$2,309	$501
ΔAA Cost/AAHUs ($1000s)	$0.88	$3.39	$45.53

Please note the costs in the above table are preliminary costs used for planning purposes only and in the IWR analysis. They do not represent a fully funded cost estimate.

3.6 The National Ecosystem Restoration (NER) Plan

The National Ecosystem Restoration (NER) Plan is the plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective. Based on the comparison of alternatives above, Alternative 2, a 3,000 cfs diversion at Romeville is designated as the NER Plan

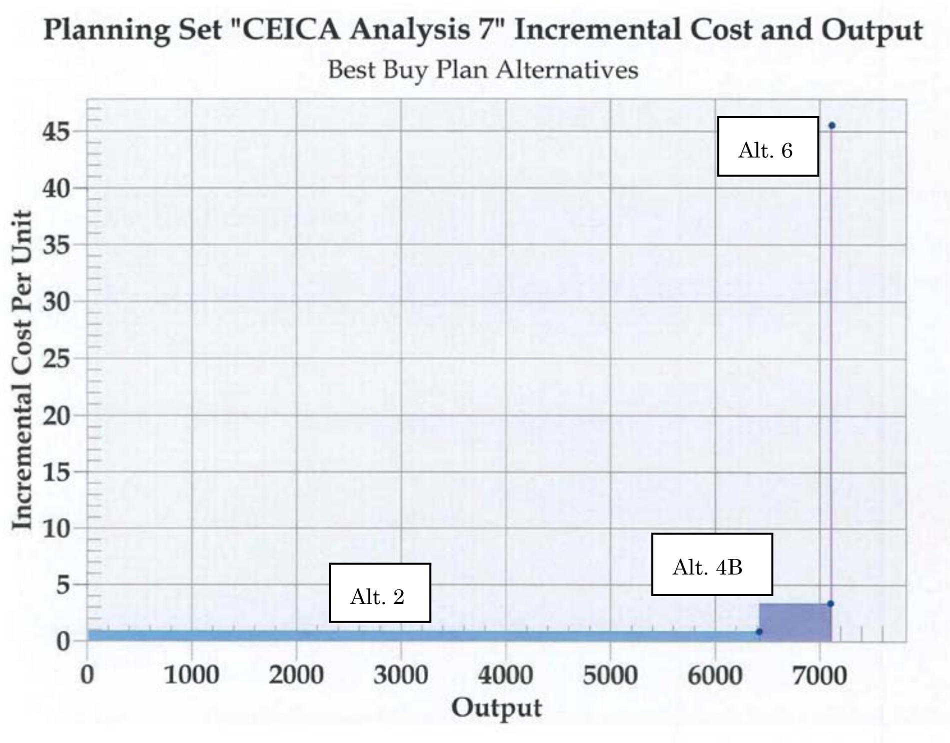

Figure 3-10. Incremental cost analysis of the final array[20,21]

[18] All costs are in October 2009 prices
[19] First costs were annualized using a discount rate of 4-3/8% over a 50-year period

3.7 Plan Selection – Tentatively Selected Plan/ Recommended Plan

After comparing the four alternative plans carried over for detailed analysis and the No Action Alternative, The NER Plan, Alternative 2, a 3,000 cfs diversion at Romeville was selected, as the TSP and was later confirmed as the Recommended Plan. Plan 2 best meets the screening criteria; would accomplish the planning objectives and goals; would be consistent with the Environmental Operating Principles; and would contribute to reversing the trend of deterioration in the -southeast part of the Maurepas Swamp. The Recommended Plan would improve a total of 21,369 acres (8,648 ha) of baldcypress-tupelo swamp that are in various stages of deterioration. The Recommended Plan would improve 3,295 acres (1,333 ha) of baldcypress-tupelo swamp that would become marsh in 20 to 30 years without project implementation, 7,934 acres (3,211 ha) of baldcypress-tupelo swamp that would become marsh in 30 to 50 years without project implementation, and 10,140 acres (4,104 ha) of baldcypress-tupelo swamp that would become marsh in greater than 50 years without project implementation.

The selected Recommended Plan is in within the scope and cost of the current authorization. According to the MCACES cost estimate, the total fully funded costs of constructing the Recommended Plan is $123,140,000, this is under the cost authorized by WRDA 2007. See Table 3.8.

Table 3.8- Maximum Cost Including Inflation through Construction

Authorized cost in WRDA 2007 Title VII, Section 7006 (e)(3)(A):	$88,000,000
* Cost Index Used EM 1110-2-1304 (Revised 31 Mar 2010)	CWBS- Features Codes 15 Floodway Control & Diversion Structure
Cost Index Ratio 1Q FY07 to 2Q FY14	1.14
** Current Project Cost Estimate (Inflation applied from 10/2006 to 1/2014)	$100,729,295
20% of Authorized Cost:	$17,600,000

[20] All costs are in October 2009 prices
[21] First costs were annualized using a discount rate of 4-3/8% over a 50-year period

*** Monitoring & Adaptive Management: (per WRDA 2007 Section 2039)	\$6,620,000- \$717,000 = \$5,903,000
Maximum Cost Limited by Section 902:	\$100,729,295+ \$17,600,000+ \$5,903,000 = \$**124,230,000**
Recommended Plan cost****	\$**123,140,000**

*Notes: * The cost index applied is derived from: EM 1110-2-1304, 31 Mar 10, Civil Works Construction Cost Index System (CWCCIS).** For the purposes of applying the Cost Index to the WRDA Authorized Cost, each project was adjusted for inflation from the October 2006 price levels through the mid-point of construction. *** The cost of any modifications required by law. This is derived from section 8.0 of each projects Monitoring and Adaptive Management Plan minus the project monitoring cost found on the LCA Cost Summary. ****Fully Funded Cost includes interest during construction.* ***Bolded numbers are rounded.***

3.7.1 Significance of Outputs

The Recommended Plan meets both 2004 and 2010 planning objectives. The Recommended Plan will restore the southeastern Maurepas Swamp to ensure its ability to provide hydrologic and habitat form and function for the 50 year period of analysis. Hydroperiods, water quality, and interior marsh habitat for fish and wildlife species will be restored, mimicking as closely as possible, conditions which occurred naturally in the area. The alternatives were designed to work with the natural, fluid, soft environment of coastal Louisiana. Without this project, the southeastern Maurepas Swamp will continue to deteriorate with eventual conversion to open water; the baldcypress-tupelo habitat characteristic of the swamp would be lost.

This plan, by increasing the flow-through of freshwater and nutrient inputs into a stagnant or starved system, would let the ecosystem recover and contribute to the objective of Civil Works ecosystem restoration "…to restore degraded significant ecosystem structure, function, and dynamic processes to a less degraded, more natural condition". With the plan, partial restoration may be possible, with significant and valuable improvement made to degraded ecological resources." The southeastern Maurepas Swamp provides important geomorphic, hydrologic, and habitat functions in the Pontchartrain Basin. Loss of these functions would have impacts beyond the project study area.

The Maurepas Swamp is a significant ecosystem within the Pontchartrain Basin in Southern Louisiana. The ecosystem outputs from the Maurepas swamp play an important role in the overall health of the southern Louisiana ecosystem. The outputs are institutionally recognized. The study area is almost wholly located within the Maurepas Wildlife Management Area, and the Blind River is a state-designated Scenic River. This project is listed in the Louisiana State Master Plan and it is designated as a critical near term feature in the LCA Ecosystem Restoration Study. There is public support in Louisiana for this project, with specific emphasis on beginning construction as soon as possible. The area is utilized for boating, fishing, hunting, and bird watching. Commercial and recreational fishing are culturally significant to many south Louisiana residents.

The outputs are technically recognized. Examples of technical significance are:

- Scarcity: Louisiana's coastline represents 90% of the wetlands in the contiguous United States and is currently disappearing at an alarming rate. This unique and scarce habitat has high fish and wildlife values.

- Representativeness: The project footprint is uninhabited. The Recommended Plan will restore the hydrologic and habitat of the swamp.

- Status and Trends: The project areas are declining and imperiled. While the project cannot stop the natural processes of sea level rise, subsidence and storm caused erosion, the project can greatly slow down the disappearance of these landforms and supported habitats by increasing the amount of freshwater, nutrients, and sediment in the swamp system.

- Connectivity: The Maurepas Swamp serves as a buffer between open water areas of Lake Maurepas and Lake Pontchartrain and developed areas along I-10/Airline Highway and it is one of the largest continuous tracts of baldcypress-tupelo on the coast, supporting fish and wildlife habitats. The swamp is also a valuable stopover habitat for migratory birds.

- Limiting Habitat: Much of the southeastern Maurepas Swamp is considered important habitat for nesting Bald Eagles and other migratory birds. The swamp provides necessary habitat for a variety of small mammals including deer, alligators, and fish species.

The Recommended Plan meets the four evaluation criteria specified in the P&G.

- Acceptability: The Recommended Plan is acceptable to the State and the Federal Agencies. The Recommended Plan was selected by an interagency and interdisciplinary team. There is broad based public support for the plan. The agencies' and public's greatest concern is beginning construction as soon as possible.

- Completeness: The plan provides and accounts for all necessary investments and actions to ensure the realization of the planned restoration outputs specified in the Recommended Plan. The plan prevents the conversion/disappearance of baldcypress-tupelo habitat for the 50 year period of analysis as stated in the project objectives. Consequently, the project improves the potential for long term survival of the swamp system.

- Efficient: The Recommended Plan was identified as cost effective solution and it has been designated as the National Ecosystem Restoration plan.
- Effectiveness: The plan makes a significant contribution to addressing the specific restoration problems. The Recommended Plan will prevent the loss of baldcypress- tupelo habitat, and conversion of the swamp to open water for the period of analysis, reducing land loss and providing essential habitat for wildlife. By maintaining the hydrologic and habitat form and function of a swamp system, salinity impacts on the wetland interiors will be lessened.

The Significance of specific resources within the project study area is summarized in the following **Table 3-9**.

Table 3-9 Significance of specific resources within the project study

Resource	Institutional Significance	Technical Significance	Public Significance
Soils	Soil resources are institutionally significant under the following statutes and memoranda: the Council on Environmental Quality (CEQ) memorandum of August 11, 1980, entitled "Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act (NEPA)"; Executive Order 11990 – Protection of Wetlands; and Agriculture and Food Act of 1981 (Public Law 97-98), which includes the Farmland Protection Policy Act (Public Law 97-98; U.S.C. 4201 *et seq*.).	This resource is technically significant because it is a critical element of coastal habitats and supports vegetative growth and open-water benthic productivity.	This resource is publicly significant because of the high value the public places on agricultural production, wildlife and fisheries supported by the soils in the area.
Water Bottoms	These resources are institutionally significant because of the national Environmental Policy Act of 1969; the Coastal Zone Management Act; and the Estuary Protection Act. Louisiana Revised Statute 41:1701 defines state water bottoms as "[t]he beds and bottoms of all navigable waters and the banks or shores of bays, arms of the sea, the Gulf of Mexico, and navigable lakes" and establishes the management and protection of the resources.	These resources are technically significant because 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.	

Resource	Institutional Significance	Technical Significance	Public Significance
Hydrology	This resource is institutionally significant because of the National Environmental Policy Act of 1969; Clean Water Act; 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.
Water Quality	This resource is institutionally significant because of the National Environmental Policy Act of 1969; the Clean Water Act; the Coastal Zone Management Act; and the Estuary Protection Act.	This resource is technically significant because the water quality supports most physical, chemical, geological, and biological processes throughout the entire estuarine system.	This resource is publicly significant because the public demands clean water and healthy wildlife and fisheries for recreational and commercial use.
Air Quality	This resource is institutionally significant because of the Clean Air Act of 1963, as amended, and the Louisiana Environmental Quality Act of 1983, as amended.	Air quality is technically significant because of the status of regional ambient air quality in relation to the National Ambient Air Quality Standards (NAAQS).	

Resource	Institutional Significance	Technical Significance	Public Significance
Wildlife and Habitat	This resource is institutionally significant because of the National Environmental Policy Act of 1969; the Coastal Zone Management Act; Estuary Protection Act; the Fish and Wildlife Coordination Act of 1958, as amended; the Migratory Bird Conservation Act of 1929, as amended; the Migratory Bird Treaty Act of 1918; the Endangered Species Act of 1973 (ESA), as amended; the Fish and Wildlife Conservation Act of 1980; the North American Wetlands Conservation Act; Executive Order 13186 Migratory Bird Habitat Protection; Migratory Bird Conservation Act; and the Marine Mammal Protection Act	Wildlife resources are technically significant because they are a critical element of the coastal ecosystem, they are an important indicator of the health of coastal habitats, and many wildlife species are important recreational and commercial resources.	Wildlife resources are publicly significant because of the high priority that the public places on their aesthetic, recreational, and commercial value.
Benthic Resource	These resources are institutionally significant because of the NEPA of 1969; the Coastal Zone Management Act; and the Estuary Protection Act.	These resources are technically significant because the bottom of an estuary regulates or modifies most physical, chemical, geological, and biological processes throughout the entire estuarine system through what is called a "benthic effect." Benthic animals are directly or indirectly involved in most physical and chemical processes that occur in estuaries (Day et al. 1989).	Benthic resources are publicly significant because members of the epibenthic community (e.g., oysters, mussels, etc.) provide commercial and recreational fisheries as well as creating oyster reef habitats used by many marine and estuarine organisms.
Fisheries	Fishery resources are institutionally significant because of the Fish and Wildlife Coordination	Fishery resources are technically significant because they are a critical	Fishery resources are publicly significant because of the high priority

Resource	Institutional Significance	Technical Significance	Public Significance
	Act of 1958, as amended; the Endangered Species Act of 1973; the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended (Magnuson-Stevens Act); the Magnuson-Stevens Act Reauthorization of 2006; the Coastal Zone Management Act; and the Estuary Protection Act.	element of many valuable freshwater and marine habitats; they are indicators of the health of various freshwater and marine habitats; and many species are commercially important.	placed on their aesthetic, recreational, and commercial value. Consistent with 40 CFR Parts §§1500.4 (j) and 1502.21 description of the fisheries resources provided in the LCA PEIS (2004) is hereby incorporated by reference.
Threatened and Endangered Species	This resource is institutionally significant because of the Endangered Species Act of 1973, as amended, and the Marine Mammal Protection Act of 1972.	Endangered (E) and threatened (T) species are technically significant because of the role these species play in maintaining ecosystems and, because of which, these species serve as indicators of overall ecosystem health.	These species are publicly significant because of the public desire to protect these species and their habitat.
Cultural and Historic Resources	This resource is institutionally significant based on State Historic and Preservation Office regulations, requirements, and policy to protect and preserve artifacts and remnants from our cultural past.	The technical significance of this resource is in providing knowledge of past cultures.	The public significance of this resource is in providing knowledge of past cultures.
Aesthetics	This resource's institutional significance is derived from laws and policies that affect visual resources, most notably the National Environmental Policy Act of 1969, the National Scenic Byway program, the Louisiana Scenic Rivers Act (1988).	This resource is technically significant because of the visual accessibility to unique geological and botanical features that are an asset to the study area.	Public significance is based on expressed public perceptions and professional evaluation. Consistent with 40 CFR Parts §§1500.4 (j) and 1502.21 description of the aesthetics resources provided in the LCA PEIS (2004) is hereby incorporated by reference.

Resource	Institutional Significance	Technical Significance	Public Significance
Recreation	This resource is institutionally significant because of the Federal Water Project Recreation Act of 1965, as amended, and the Land and Water Conservation Fund Act of 1965, as amended.	Recreational resources are technically significant because of the high economic value of recreational activities and their contribution to local, state, and national economies.	Recreational resources are publicly significant because of the 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.
Socioeconomics and Human	This resource is institutionally significant because of the National Environmental Policy Act of 1969; the Estuary Protection Act; the Clean Water Act; the River and Harbors Acts; the Watershed Protection and Flood Protection Act; and the Water Resources Development Acts. Of particular relevance is the degree to which the proposed action affects public health, safety, and economic well-being; and the quality of the human environment.	This resource is technically significant because the social and economic welfare of the nation may be positively or adversely impacted by the proposed action.	This resource is publicly significant because of the public's concern for health, welfare, and economic and social well-being from water resources projects.

3.7.2 Sustainability of Significant Resources

With the project in place the greatest risk to significant resources is related to relative sea level rise. USACE estimates for 50-year eustatic sea level rise (without the relative impacts of subsidence or accretion) range from 0.28 feet to 2.00 feet. This is a very broad range, as it coincides generally with the magnitude of normal water level fluctuations in the swamp. Future conditions for this project used the intermediate eustatic sea level rise estimate of 0.67 feet. Future subsidence rates used in this project, per USACE guidance, were 7.5 mm per year. This corresponds to 1.23 feet over a 50-year period. Coupled with the intermediate value of sea level rise, this yields a relative sea level rise of 1.90 feet over a 50-year period. However, the range of 50-year relative sea level rise estimates when subsidence is included is still very broad: 1.51 – 3.23 feet.

The form and function of the various significant resources within the study area are interdependent. Their viability is also dependent on the uncertainty of external forces including sea level rise and subsidence. A future without the project will consist of conditions that are expected to continue to degrade as lack of nutrients, accretion, and freshwater, and an increase in sea level rise, subsidence, episodic salt water intrusion, and storm events all take a toll on the swamp. As a result of these deteriorating conditions, tree mortality, will continue resulting in lower tree density. The canopy will continue to thin, and canopy cover will persist below 33 percent. Habitat disappearance and habitat switching are likely to occur as marsh converts increasingly to open water encouraging greater connectivity and influence from Lake Maurepas, and resulting in a greater potential for storm surge further inland.

Hydrologic and hydraulic analysis performed, using intermediate sea level rise values from available regional estimates of each contributing factor (eustatic sea level rise, subsidence, and accretion) suggest that over the effectiveness of the project over the 50-year project planning period will not be compromised by relative sea level rise. In other words, accretion effects expected with the project will at least, and in all likelihood, exceed the loss of elevation in the swamp expected without a project in place.

The analyses has considered a portion of this range of combined effects, looking primarily at future estimates of relative sea level rise accounting for subsidence, but hydraulic modeling was not completed with explicit representation of accretion and sedimentation (in order to offer conservative "worst case" estimates). The relative rise has been applied in the modeling analysis at the downstream boundary condition, specifically the water level in Lake Maurepas, and the primary impact it has on model results is increased backflow of Lake water into the swamp, and a greater need for diverted water in future years to overcome the backflow.

However, it is conceivable that the water levels in the Mississippi River (upstream boundary condition and flow input for this project) could also be affected by combined effects of eustatic sea level rise and changes in sediment load. This is important because the flow rating curves developed for the gravity-based diversion structure are based on the differential head across the system, not just on the water level in the Mississippi River. If downstream water level rises in Lake Maurepas but Mississippi River water levels are largely unchanged, the physical ability to divert water could be diminished.

Specific forecasts of future water elevation trends in the Mississippi River near the study area are not readily available, so the analysis presented should be evaluated with the following considerations:

- If the Mississippi River water level does not change appreciably in the future, total diversion capacity could be diminished based on the assumptions guiding the application of sea level rise estimates to Lake Maurepas (less differential head across the system, and correspondingly lower diversion flows). As stated elsewhere, if intermediate projections for all contributing factors to relative sea level rise are applied together, the net effect could be almost negligible (counterbalancing effects). Hence, while there is the potential that rising relative sea level coupled with stationary river level could reduce diversion throughput, there is some uncertainty with these projections.
- If the Mississippi River water levels rise in future decades, it should improve the ability to divert water to the Blind River system when compared to stationary water levels in the river.

It is uncertain which of these scenarios is more likely to occur, and to what degree. Therefore, the project team has evaluated the effects of the different phenomena in sensitivity analyses. The worst case for diversion project performance would be higher levels in Lake Maurepas that do not appreciably affect the Mississippi River. This case would effectively reduce the gravity head gradient from the diversion to the Maurepas Swamp system and increase the need for more diverted flow to provide equal swamp restoration and flushing benefits.

The following two factors were used in deciding how to estimate the design level upstream boundary conditions in future decades:

- Intermediate (medium) projections of relative sea level rise, accounting for eustatic changes, subsidence, and accretion, suggest that the relative rise could be practically negligible.
- If relative sea level does change appreciably, it might be inferred that backwater elevations in the Mississippi River could also increase, if not in direct proportion, somewhat commensurately.

For these reasons, neither the historic water surface elevations in the Mississippi River (used in the hydrologic and hydraulic analysis) nor the flow rating curves for the diversion structure (in which the Mississippi River water level is the independent variable) were adjusted for the analysis of sea level rise in future decades.

Analysis results were developed for the Recommended Plan with low, medium and high projections of sea level rise. The trends of the results for low and high relative sea level projections are consistent with the results for medium sea level rise and confirm the likelihood of the sustainability of the swamp under with-project conditions over the 50-year project planning period. Additional detail and graphics to support these analyses are included in **Appendix L**.

3.7.3 Components

Alternative 2, a 3,000 cfs diversion at Romeville, has six major components: a diversion structure, a transmission canal, control structures of various sizes, approximately 30 berm gaps, cross culverts at four locations along U.S. highway 61 and instrumentation to monitor and control the diversion flow rate and the water surface elevations in the diversion, transmission, and distribution system in the swamp. **Figure 3-11** illustrates Recommended Plan features that are described in detail in the following paragraphs.

Diversion Structure. The diversion culvert facility will divert freshwater from the Mississippi River, transfer it under the east levee through a box culvert, and discharge it into the transmission canal. The primary hydraulic elements of the diversion culvert facility are as follows:

- 3 – 10' x 10' multi-cell cast-in-place reinforced concrete box culverts under the east levee and LA 44
- 3 – 10'x10' cast iron sluice gates with motor operators on the culvert inlets
- Trash racks near the culvert inlet
- Inlet canal across the batture from the Mississippi River to the culvert inlet
- LA 44 (River Road) is adjacent to the levee, and the box culvert will be extended under the road and discharge into the transmission canal approximately 100 feet east of the road. Erosion protection will be provided as needed at locations with higher flow velocities and turbulence, such as at the Mississippi River bank, in the inlet canal entrance, at the box culvert entrance, and at the culvert outlet.
- Ancillary elements at the diversion culvert facility include a gate tower to raise the sluice gate operators and operator access above the Mississippi River flood stage, a steel sheet pile cut-off wall in the levee to reduce the potential for seepage and piping (loss of fines), and stop logs both upstream and downstream of the sluice gates to isolate them for maintenance. The diversion site will include an access driveway, a site road for access to the top of the levee, fence, drainage, lighting, a security system, and a control building. Additionally, a bar screen structure will be included to stop large debris and large fish and aquatic life from entering the diversion canal.

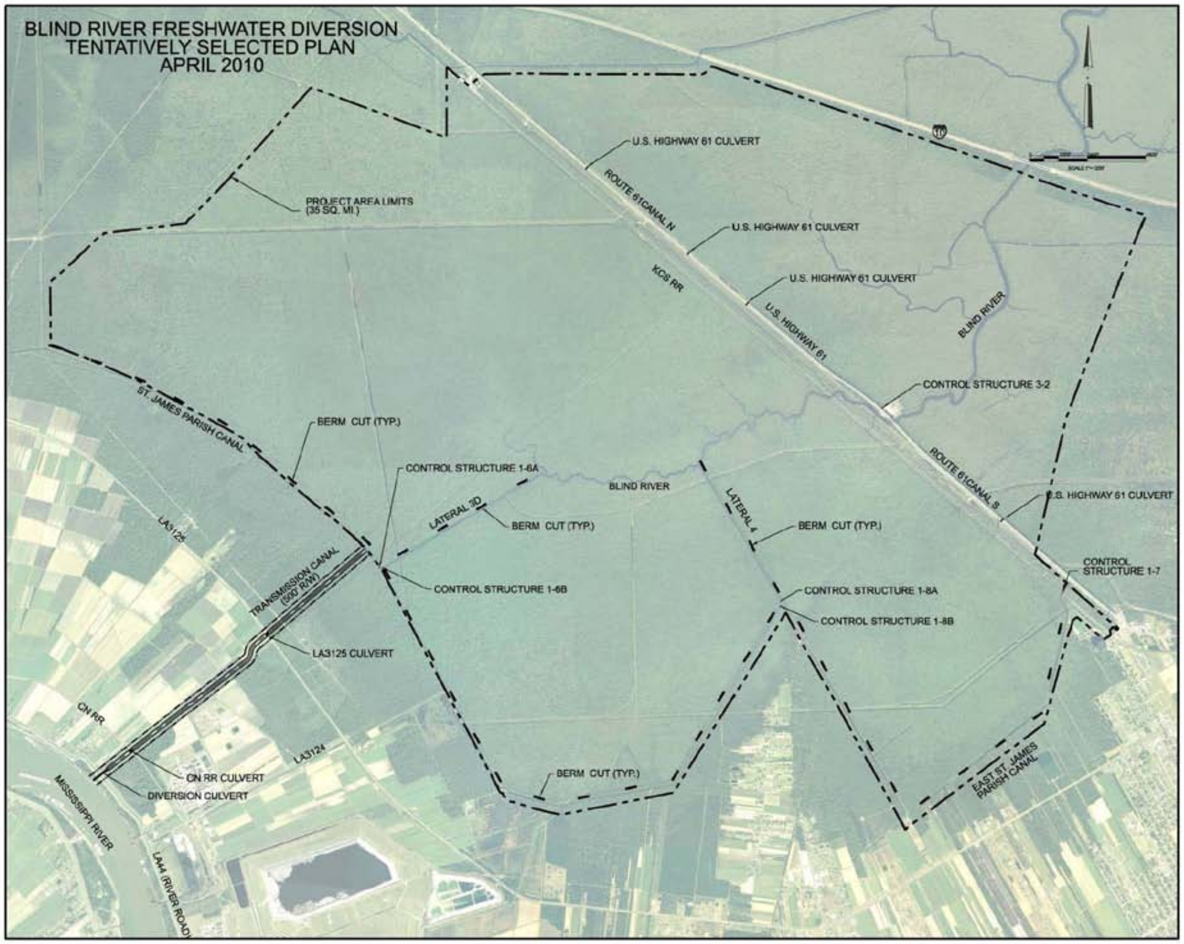

Figure 3-11: Recommended Plan design features

Transmission Canal. The transmission canal will transfer the diverted water approximately three miles from the diversion culvert facility to an existing drainage channel at the perimeter of the swamp. The transmission canal will be designed with a 25 percent factor of safety for the flow rate to avoid overtopping the berms. This is in anticipation that as the Mississippi River stage varies, the diversion control system will not control the flow rate to the precise design value. For the 3,000 cfs diversion, the transmission canal will be designed for 3,750 cfs.
The canal will be an earthen trapezoidal channel section, with a 155-foot wide bottom, 4:1 (H:V) side slopes, and a depth of approximately 12 feet, including a 2-foot freeboard. The top width will be approximately 250 feet. The hydraulic grade line will be above natural ground for most of the route. Therefore, embankments or berms with 12-foot wide tops will be constructed on both sides of the canal. During the PED process the borrow soils will be examined to determine if any additional modifications will be required to reduce the potential for seepage through the guide berms. The transmission canal alignment crosses the Canadian National Railroad (CN RR) and LA 3125, a local highway. Both crossings will consist of 8 – 12' x 8' reinforced concrete box culverts across the full right-of-way.

Control Structures. The project will use the existing drainage channels at the perimeter of the swamp to distribute the diverted flow throughout and into the swamp. The hydraulic grade line, or water surface elevation, will need to be raised above the existing levels and controlled to force the diverted water out of the drainage channels into the swamp. Control structures will be installed at key locations in the existing channels to perform this function.

For the feasibility level design, downward opening crest gates were used as the basis for design of structures and for cost estimating purposes. This is one of the more expensive options to keep our estimates of cost conservative and type of structure has a good track record of success on other projects, so there was a high level of confidence in their success. During PED other options on the control structures will be considered. There may be operationally equivalent devices to control the flow of water that can be installed at a lower initial cost and possibly have lower operating and maintenance costs. Final design of the control structures will be coordinated with the natural resource agencies to ensure that the design considers aspects of fish and wildlife conservation. The selection of other control technologies will have no bearing on the ranking of alternatives or the level of benefits derived from the project.

Berm Gaps. When the existing drainage channels were excavated in the swamp, the excavated material was cast to one side of the channel forming spoil banks. The size of the spoil banks vary, with the top elevations ranging from Elev. 4 to Elev. 12 (NAVD 88). From field observations and the hydro-dynamic modeling, it has been determined that the spoil banks currently block flow circulation into and out of the swamp, resulting in stagnant areas and poor circulation of water through the hydrologic units. In the current configuration, the spoil banks would continue to prevent the diverted water from easily entering and flowing through the swamp. Therefore, new 500-foot wide berm gaps will be excavated in the spoil banks at an approximate spacing of 2,500 feet on center. The gaps will be excavated to the elevation of the adjacent swamp natural ground elevations, and the spoil will be disposed behind the existing spoil banks. The spoil will be placed up to Elev. 6 (NAVD 88) to provide additional refuge areas for wildlife during flood events in the swamp. It should be noted that during the PED process additional hydraulic modeling will be performed to optimize the width and spacing of the gaps to provide an optimal distribution of diverted flows. The optimization was not done as part of the feasibility study because the outcome of the optimization will not significantly change the cost of the gaps nor will it significantly change the benefits derived from the gap optimization. The gap optimization will be included with the swamp distribution operating plan which will also include the optimization of the control structures and the operating plan. While all of these actions will improve the final system, the outcome will not change the ranking of the alternatives based on either cost adjustments or benefits adjustments due to the optimization.

Cross Culverts at the Highway 61 Corridor. The hydrodynamic modeling of the swamp study area indicated that the KCS RR and the U.S. HWY 61 embankments disrupt the natural flow and circulation of water through the swamp. This resulted in hydrologic units east and west of the KCS RR/Hwy 61 corridor having stagnant water, poor drainage, and lack of sources of freshwater input. New culvert crossings will be added under the KCS RR and U.S. HWY 61 at four locations. Each installation will consist of 3 – 3' x 4' reinforced concrete box culverts. Note that there may be sufficient cross drainage openings at the KCS RR, and additional culverts may not be required. Earthen channels (large ditches) will be excavated across the 500-foot space between the KCS RR and U.S. HWY 61 to interconnect the drainage capacity at the railroad with the new culverts at U.S. HWY 61.

Instrumentation. Instrumentation will be required to monitor and control the diversion flow rate and the water surface elevations in the diversion, transmission, and distribution system in the swamp. Real-time data is required from the system components to allow the operator to control and adjust the system flow rates. Satellite communication will be provided at each control structure in the U.S. HWY 61 corridor to communicate to the control building via a satellite at the diversion facility. Typically, flow rates and water levels will be measured and the feedback data will be used to adjust gate positions to control the desired parameters at the diversion culvert and the control structures. The monitoring and control data will be collected, analyzed, and transmitted to and from a control building on the diversion culvert site. Following are the main instrumentation for data collection and control at each component:

Diversion Culvert – The flow control at the diversion culvert will establish the flow rate for the project. The diversion flow rate will likely be set manually by an operator, with adjustments as necessary. The diversion culvert will have instrumentation for water levels at the culvert entrance and exit, for flow measurement, and for sluice gate positions. The control system at the diversion structure will be designed to automatically adjust the sluice gate openings as the Mississippi River stage varies to maintain a constant flow rate.

Control Structures – The control structures will require water level and water flow measurements on both sides. The control structures will likely have manually set positions, with occasional adjustments based on feedback from system monitoring.

Transmission Canal –The transmission canal will have level monitors at several locations to ensure that the berms are not overtopped.

Additional instrumentation may be required as part of monitoring and adaptive management.

Table 3-10 below provides a summary description of the Recommended Plan components.

Table 3-10: Recommended Plan Components

Item	**Description**
Diversion Culvert	3,000 cfs
Box Culverts[22]	3 – 10' x 10' reinforced concrete, multi-cell box culvert
Sluice Gates	3 – 10' x 10' cast iron gates with motor operators
Trash Racks	Coarse grid
Inlet Canal	Earthen channel – 40' bottom width, 4:1 SS, 27' deep
Transmission Canal	3,750 cfs (1.25x diversion flow rate)
Earthen Canal	155' bottom width, 4:1 SS, 12' deep
Berms	Earthen embankments, 12' top width, 3:1 SS (exterior)
Culverts at CN RR	8 – 12'x8' reinforced concrete multi-cell box culverts
Culverts at LA 3125	8 – 12'x8' reinforced concrete multi-cell box culverts
Control Structures	
Control Structure	Large concrete structure in existing channel
Control Building	Housing for instrumentation, HPU, generator

[22] Box culvert dimensions are horizontal x vertical inside dimensions.

Berm Gaps	
500-foot Wide Gaps	Excavate gaps at 2,500-foot spacing in spoil banks
Cross Culverts at Hwy 61	
Box Culverts	3 – 3'x4' Box Culverts at 4 locations
Instrumentation	
Local instrumentation	Monitoring and control at diversion and control structures
Stream Stage Monitors	Monitoring in Blind River and drainage channels
Communication	Remote satellites for communication to control building

3.7.4 Design, Environmental, and Construction Considerations

The purpose of the Blind River diversion project is to divert freshwater into the Maurepas Swamp to freshen the swamp, provide nutrients and sediment, and counter potential backflow of water from Lake Maurepas containing elevated levels of salinity. The hydraulic, hydro-dynamic, and environmental analyses of the swamp indicated that re-introducing freshwater from the Mississippi River back into the swamp and correcting the internal drainage and circulation problems could revitalize the target areas in the swamp. This is consistent with scientific research in the area that has indicated that once hydraulic connection is restored within a degraded freshwater swamp, tree vigor and stand productivity will increase (Shaffer *et al*. 2009). The hydraulic and the hydro-dynamic analyses identified means to divert the freshwater from the Mississippi River, deliver it to the swamp, and distribute it within the swamp to accomplish the environmental goals. The hydro-dynamic analysis identified specific actions necessary to improve the distribution and circulation of the water into and within the swamp. These included opening large gaps in the existing spoil banks along the existing drainage channels and adding cross culverts at the KCS RR and U.S. HWY 61 corridor to improve drainage and circulation between the hydrologic units in that area.

The major project components are primarily hydraulic conveyance and control structures designed to divert freshwater from the Mississippi River, transfer it to the Maurepas Swamp, and distribute and direct the diverted water into and through the swamp. Typically, the hydraulic designs were established through iterative processes that included the hydraulic needs, the hydraulic grade line of the overall system, component sizes, and costs.

The project will be constructed in two very different settings – upland areas where normal construction techniques apply, and the Maurepas Swamp where special techniques and approaches will be required. Construction considerations include existing site conditions, access, construction techniques, temporary construction facilities, detours for transportation facilities, construction sequences, dewatering and surface water control, storm water pollution prevention plans, and balancing earthwork volumes. All of these items can impact the design and the cost estimates of the components. Based on HTRW research in the study area the potential to encounter HTRW is low in most of the study area, nevertheless if any solid or hazardous wastes, or soils and/or groundwater contaminate with hazardous constituents are encountered during the project LDEQ will be notified. Additional details for design and construction are presented in **Appendix L, Section 11**.

3.7.5 Real Estate Requirements

The real estate requirements are in two categories: permanent and temporary construction. The permanent real estate primarily is for the transmission channel between the Mississippi River at River Mile 162.1 and the St. James Parish drainage canal. This easement will be 500 feet (150 meters) in width and will be 15,500 feet (4,700 meters) in length. This total area will be approximately 180 acres (75 hectares). In order to provide a 100 foot (30 meter) offset temporary detour for LA 44, the Canadian National Railroad, and LA 3125, an additional 10 acres (4 hectares) of temporary easement will be required during the construction of crossing culverts and bridges.

The other real estate requirement is a dual use easement for the diversion structure at the levee where the diversion will be co-located in the easement for the flood control levee.

Another area for real estate consideration is the use of Louisiana state land in the Wildlife Management Area for the six (6) control structures and berm gap construction. This will require that surveys and agreements for construction in the Wildlife Management Area be obtained from the Louisiana Department of Wildlife and Fisheries (LDWF), but no costs for easements are anticipated.

The last real estate consideration is to obtain permits to construct the bridges and culvert on state highway right of ways. These will require the project to maintain traffic lanes open at all times due to the importance of the roadways as hurricane evacuation routes. The Canadian National Railroad will also require a permit to construct a bridge across the transmission canal. The Real Estate Plan for the project study area is presented in **Appendix J**.

3.7.6 Operations and Maintenance Considerations

Operations and maintenance considerations have to be addressed on the diversion structures, transmission canal, berm gaps, control structures, and U.S. Highway 61 Cross Culverts.

Diversion Structure:

- **Operations** – An operator would set the flow rate into the swamp and Blind River. The gates would be automatically controlled to maintain the flow based on river stage and downstream water surface conditions.
- **Maintenance** – Maintenance would include the computerized control and monitoring system, the diversion gates and inspection and cleaning of the inlet trash grates. General maintenance of the control building and landscaping would also be required.

Transmission Canal:

- **Operations** – The transmission canal would be self operating with monitoring of flow and stage transmitted to the control building for processing. An automatic diversion gate closure would be initiated if the freeboard in the channel is less than 1.0. The sediment level in the channel would be periodically monitored, and the canal crossing would be inspected at annual intervals.
- **Maintenance** – The transmission channel right of way would be mowed and maintained, and the sediment deposited in the channel would be monitored and removed by dredging annually. Any erosion of internal or external slopes would be repaired as required. Planned maintenance excavation within the transmission canal will be coordinated with state and Federal resource agencies.

Control Structures:

- **Operations** – The gates on the controls structures would be positioned to provide flow through the swamp as required for flow, sediment and nutrient distribution. The gates would be lowered in the anticipation of heavy rain events. Due to the slow drainage time for the channels, the gates would be lowered 24 hours in advance of rain events greater than 1 inch.
- **Maintenance** – The control structures would have hydraulically operated gates with electric motors on the hydraulic pumps and generators providing power to the motors. General maintenance of pumps, motors and generators would be required. The units would be inspected and maintained monthly.

Berm Gaps:

- **Operations** – The berm gaps would have no operating features.
- **Maintenance** – The gaps would need to be inspected twice each year and debris cleared from the gaps as required. Should the gaps silt in there may need to be limited dredging that would be accomplished when the drainage channel dredging is accomplished.

- **U.S. Highway 61 Cross Culverts:**
- **Operations** – The culverts would have no operating features.

- **Maintenance** – Culverts would be submerged and would need to be desilted on an annual basis to assure that flow openings are maintained.

The operating plan will be to divert the water from the Mississippi River at 3,000 cfs for 6 to 9 months each year. The remaining 3 to 6 months will most likely be at a lower flow to allow the swamp to drain and for the cypress seeds to germinate and produce saplings of sufficient height to provide for survival once the swamp is then hydrated with the diversion. The exact flow rates will be determined once all of the parameters of the system can be determined and the final configurations of all the elements are designed. The following elements will be revised as part of the actual operating plan:

- Level of the downstream water surface in Lake Maurepas and the Blind River based on average tide elevations. The tide is influenced by time of year and is greatly influenced by prevailing wind speed and direction.
- Level of water in the swamp will be higher when nutrients are delivered to the vegetation in the early spring and summer. As late fall arrives the swamp will be drained to allow the seeds from the cypress trees to germinate. The drying period does not need to be annual, but should occur at least every three years to be sure sufficient new trees are propagated.
- Nutrient values will be monitored to assure that the swamp is assimilating the nutrients to a level that does not adversely affect the Blind River and more importantly Lake Maurepas. The calculations of nutrient uptake indicate the eutrophication of the lake should not be an issue. Monitoring of River nutrient levels and blind River levels will indicate how the nutrient removal process is performing. There is also considerable local nutrient addition from agricultural practices that will be improved by allowing the local drainage to filter through the swamp prior to discharge to the Blind River.
- The sediment load is mostly deposited in the transmission canal and distribution drainage canals and will need to be removed at periodic intervals. The drainage canals will be dredged as they are currently by the parish. The transmission canal will be dredged and the material directed into the swamp for disposal in low areas to help with soil building.
- The water quality in the Blind River will be monitored at several locations to assure that diverted water is keeping appositive velocity in the River and providing sufficient flows to prevent stagnation and low dissolved oxygen levels that are currently experienced.

The operating plan can accommodate the manipulation of all of these elements due to the flexibility in the volume of diversion that can be controlled and the height of the water in the distribution channels that can be controlled by the control structures. The exact operating plan will change from season to season and year to year based on the varying elements of the system. The operating plan is designed to mimic the natural system before the man made elements were created and to also counter the effects of subsidence and sea level changes. Additional operation and maintenance detail is presented in **Appendix L, Section 12**.

3.7.7 Monitoring Plan and Adaptive Management

A feasibility level monitoring and adaptive management (AM) plan have been developed for the Louisiana Coastal Areas (LCA) Small Diversion at Convent/Blind River project (**Appendix I**). The monitoring and AM plan for this project was developed with assistance from the LCA AM Formulation Team. The feasibility level monitoring and AM plan was developed to include a sufficient description of the proposed monitoring and adaptive management activities to identify the nature of proposed AM activities and to estimate the costs and duration of the monitoring and AM plan.

The project monitoring and AM plan describes and justifies adaptive management in relation to the proposed project management alternatives identified in the Feasibility Study. The plan also identifies how adaptive management will be conducted for the diversion at Convent/Blind River and who will be responsible for this specific AM program. The results of this project-specific AM program will be used to adaptively manage the project, including specification of conditions that will qualify project success and terminate the AM program. Status of the project as it is implemented and managed will be documented in a report by the managing agency approximately every three years.

The monitoring and AM plan identifies the restoration goals and objectives identified for the diversion at Convent/Blind River; outlines management actions that can be undertaken to achieve the project goals and objectives; presents a conceptual ecological model that relates management actions to desired project outcomes; and lists sources of uncertainty that recommend the project for adaptive management. Monitoring, assessment, decision making, and data management are also addressed in the monitoring and AM plan.

The level of detail in the monitoring and AM plan is based on currently available data and information from the FS/SEIS. Uncertainties remain as to the exact project features, monitoring elements, and adaptive management opportunities. Components of the monitoring and adaptive management plan, including costs, were estimated based on the currently available information. Uncertainties will be addressed in preconstruction, engineering, and design (PED), and a detailed monitoring and adaptive management plan, including a detailed cost breakdown, will be drafted at that time.

The primary incentive for implementing an adaptive management program is to increase the likelihood of achieving desired project outcomes in the face of uncertainty. All projects face uncertainties with the principal sources of uncertainty including (1) incomplete description and understanding of relevant ecosystem structure and function, (2) imprecise relationships between project management actions and corresponding outcomes, (3) engineering challenges in implementing project alternatives, and (4) incoherent management and decision-making processes.

Independent of adaptive management, an effective monitoring program is required to determine if the project outcomes are consistent with original project goals and objectives. The power of a monitoring program developed to support adaptive management lies in the establishment of feedback between continued project monitoring and corresponding project management. A carefully designed monitoring program is central to the Convent/Blind River AM program. For each project objective the monitoring program indicates performance measures, the desired outcome, and the monitoring design. Adaptive management triggers will be determined later in the AM process.

The plan identifies performance measures along with desired outcomes and monitoring designs in relation to specific project goals and objectives. Additional monitoring is identified under supporting information needs to help further understand and corroborate project effects.

Objective 1: Promote water distribution in the southeast portion of Maurepas Swamp to move stagnant water out of the system

Performance Measure: Area of swamp inundated with diverted water during operational events

Desired Outcome: Increase from pre-project conditions area of swamp inundated for low flow to high flow events. Specific targets are:

- Increase the area of freshwater inundation for low to average flood events by 10 to 25 percent
- Increase swamp productivity as measured by a 5 to 10 percent annual increase in the diameter at breast height (dbh) of baldcypress and tupelo
- Decrease average total nitrogen in Blind River by 10 to 25 percent
- Decrease average total phosphorous in Blind River by 10 to 25 percent
- Increase average dissolved oxygen in Blind River by 5 to 10 percent

Monitoring Design: Synoptic hydrologic surveys, using salinity, temperature, dissolved oxygen, conductivity, turbidity, pH, and velocity as tracers, will be conducted during selected low flow and high flow operational events to track distribution of freshwater.

Objective 2: Facilitate swamp building, at a rate greater than swamp loss due to subsidence and sea level rise, by increasing sediment input and swamp production to maintain or increase elevation in the swamp.

Performance Measure 2a: Sediment accretion and elevation

Desired Outcome: Accretion rate equals or exceeds subsidence rate after five years. The specific target is to increase sediment input by up to 1,000 grams per square meter per year.

Monitoring Design: Sediment erosion tables (SET) will serve as an elevation benchmark and marker horizons or sediment traps will be used to assess accretion.
Supporting Information Need: Total suspended sediment will be collected to help understand how sediment contributions through the diversion may enhance swamp productivity and land building.

Performance Measure 2b: Swamp production and extent
Desired Outcome: Increase in basal area increment of bald cypress & tupelo in the swamp from existing conditions, that is, existing conditions defined from preconstruction measurements from CRMS-Wetlands stations and Southeastern Louisiana University (SLU) historic monitoring
Monitoring Design: Diameter at breast height and overstory tree cover will be measured to estimate production.

Performance Measure 2c: Annual sediment discharge

Desired Outcome: Deliver 86,480 M tons of sediment through the Convent/Blind River diversion each year.

Monitoring Design: Hourly turbidity recorders will be deployed in the outfall channel and at hydrologic sites and correlated to TSS to investigate this measure.

Objective 3: Establish hydroperiod fluctuation in the swamp to improve bald cypress and tupelo productivity and their seed germination and survival, by increasing the length of dry periods in the swamp.

Performance Measure 3a: Depth, duration and frequency of flooding in the swamp.
Desired Outcome: A statistically significant decrease from pre-project condition average flood durations (existing conditions defined from pre-construction measurements from CRMS stations). The project will be operated to facilitate dry periods. These dry periods should be targeted every year if possible.
Desired Outcome: Maintain dry periods (moist soils) in the swamp for a minimum 7-35 days during summer and early fall for seed germination and maintain water levels below seedling height to promote seedling survival.
Monitoring Design: Hourly hydrologic recorders will be deployed to investigate this measure.
Performance Measure 3b: Number of bald cypress and tupelo saplings
Desired Outcome: 25% increase in the number of bald cypress and tupelo saplings per acre from pre-project conditions five years after project implementation and 50%increase after 10 years. Performance of this measure is dependent on achieving extended dry periods in the swamp. In addition:

- Decreased flood duration in the swamp by 10 to 25 percent for high flood events

- Increasing the length of dry periods in the swamp (no standing water) by 10 to 25 percent
- Increase the number of baldcypress and tupelo saplings per acre by 25 to 50 percent.

Monitoring Design: Understory vegetation (herbaceous, seedling and sapling) will be measured to assess regeneration and changes in cover classes.

Objective 4. Improve fish and wildlife habitat in the swamp and in Blind River

Performance Measure: No applicable performance measure

Desired Outcome: Swamp production, hydroperiod, and water quality measures will be used to assess this objective.

Monitoring Design: Fish and wildlife habitat is linked to the performance measures associated with objectives 1-3, focused on improving habitat. Therefore, no specific monitoring is proposed for this objective.

Risk Endpoint: Water quality impairment in Blind River and Lake Maurepas

Desired Outcome: Do not create or contribute to nitrate loading in Blind River that will result in a Louisiana 303 (d) listing. If listed, a total maximum daily load (TMDL) assessment will be considered in coordination with Louisiana Department of Environmental Quality (DEQ).

Monitoring Design: Nutrient sampling will be designed in coordination with Louisiana DEQ, if needed.

Feasibility level of detail cost estimates were calculated for implementation of adaptive management and monitoring. **Table 3-11** details these costs.

Table 3-11: Preliminary Cost Estimate for Implementation of a Monitoring Program

Category	Activities	2 yr PED Set-up & Data Acquisition	3 yr Construction	10 yr Post-Construction	Total
Monitoring: planning and management	Monitoring workgroup, drafting detailed monitoring plan, working on performance measures	$135,900	$53,200	$210,100	$399,200
Monitoring: data collection	Landrights, site construction, and surveying	$129,300			$129,300
	Vegetation	$64,900	$103,700	$409,600	$578,200
	Hydrology	$229,200	$366,600	$1,447,300	$2,043,100
	Sediment input	$37,400	$59,900	$236,300	$333,600

	Sediment accretion and elevation	$25,900	$41,500	$163,800	$231,200
	Water quality	$64,000	$102,400	$404,400	$570,800
Database management	Database development, management, and maintenance, webpage development for communication of data to stakeholders	$62,400	$99,800	$393,900	$556,100
TOTAL		**$749,000**	**$827,100**	**$3,265,400**	**$4,841,500**

3.7.8 Effectiveness of Recommended Plan in Meeting Goals and Objectives

The overall Small Diversion at Convent/Blind River project objective is to reverse the trend of deterioration of Maurepas Swamp (west) and Blind River.

The Specific Project Objectives are to:

- Promote water distribution in the swamp to increase the area of freshwater inundation for low to average flood events from existing conditions and to increase swamp productivity and wetland assimilation.
- Facilitate swamp building, at a rate greater than swamp loss due to subsidence and sea level rise by increasing swamp productivity and sediment input.
- Establish hydroperiod fluctuation in the swamp to improve bald cypress and tupelo productivity and their seedling germination and survival by decreasing flood duration and increasing the length of dry periods in the swamp, and
- Improve fish and wildlife habitat in the swamp and in Blind River.

The Recommended Plan would meet the overall and the specific project objectives. The diversion will bring nutrients, sediment and water to the swamp to increase productivity and accretion (swamp building). The construction of new gaps in berms, maintenance of existing gaps in the berms, and strategically placed control structures in the major conveyance channels, along with the diversion, will promote water distribution to increase productivity and accretion (swamp building). The operational flexibility provided in the Recommended Plan will allow establishment of hydroperiod fluctuations in the swamp to improve seedling germination and survival. Nutrient assimilation in the swamp of water diverted from the Mississippi River will improve water quality and thereby the fish and wildlife habitat in the swamp and in Blind River. These activities would reverse the trend of deterioration of Maurepas Swamp (west) and Blind River.

3.7.9 Effectiveness of Recommended Plan in Meeting Environmental Operating Principles

The Recommended Plan is effective in meeting the environmental operating principles. The Recommended Plan is environmentally sustainable as it minimizes operational activities to the extent possible while maintaining operational flexibility to restore a viable natural system. The Recommended Plan was developed to reverse deterioration of the swamp and Blind River by utilizing the natural swamp building and assimilation processes balanced with appropriate management activities while minimizing environmental consequences. The improvement of bald cypress-tupelo swamp provided by the Recommended Plan will mitigate for the unavoidable wetland impacts resulting from project implementation. Monitoring and adaptive management will provide knowledge on how to effectively implement small diversion projects to maintain and protect valuable swamp ecosystems. In addition, the Recommended Plan was developed with the inclusion of important stakeholder input.

3.7.10 Compensatory Mitigation Measures

Compensatory mitigation is not needed for this project. Wetland impacts were avoided and minimized to the extent possible in the preliminary design of the Recommended Plan. The Recommended Plan will impact 53 acres (21ha) of wetlands with construction of the Romeville diversion canal. The wetlands that will be impacted are not part of Maurepas Swamp that will be improved (as described above). The improvement of 21,369 acres (8,648 ha) of bald cypress-tupelo swamp, that are in various stages of deterioration, will mitigate for the wetland impacts resulting from construction of the Romeville diversion canal.

3.8 Risk and Uncertainty

Risk and uncertainty will be discussed as relates to the ability of the proposed system to meet the project objectives. Risk is defined as the reliability of an estimated value. Uncertainty is a measure of imprecision of knowledge of parameters and functions used to describe aspects of a project plan, such as the hydrologic, environmental and engineering design, operational performance and maintenance needs, as well as construction and economics. The following assumptions are key to the success of the project:

- The Mississippi River has sufficient sediment and nutrients to improve the characteristics of the Maurepas Swamp and within the 50 year life cycle the supply of sediment and nutrients will not change significantly. This assumption is based on historic information and demand versus supply within the River.
- There will be no legal restrictions imposed on withdrawing 3000 cubic feet per second from the Mississippi River.
- The net effects of local subsidence and sea level rise will not deviate significantly from the numbers estimated for this study.

- The study area can receive sediments and nutrients at an appropriate frequency without restrictions from the State agencies controlling the Wildlife Management Area.

3.8.1 Hydrologic Uncertainties

The hydraulic and hydrologic modeling results presented in the analysis to date (**Appendix L, Section 2**) have been developed with the best available information on historical hydrology, existing topography, sea level rise, subsidence, and accretion, however, each of these factors, alone or in combination, is subject to uncertainties which could pose risks to the hydraulic and ecological functionality of the project. These hydrologic uncertainties can be reduced as additional data is collected and additional modeling is conducted as the project moves forward. The uncertainties are discussed below:

Topography: All modeling to date has been completed using best available topographic and bathymetric data, in combination with available engineering plans to define channel cross-sections, roadway culverts, and surface storage areas. The available topographic data coupled with field reconnaissance provided sound definition of major hydrologic and hydraulic features for use in the development models. The model calculations that rely on topographic input such as estimates of water depths, residence times, and propensity of water to flow in assumed directions are limited in their resolution.

Future hydrology: The period of record used for extended analysis covered the period from 1989 through 2004. During this period, it appears that extended dry conditions that would support cypress germination and sapling survival occurred only every 5 to 6 years. The frequency at which conditions in the future may support growth cannot be accurately forecasted based only on this available data record. What can be inferred from the analysis is that careful flow management within the system can facilitate periodic hydrologic conditions that would support tree re-growth, but favorable ecological factors will also need to be present for this desired outcome.

- **Relative Sea Level Rise:** The basis for estimating relative sea level rise and associated impacts to the project are based on multiple components that all contain some elements of uncertainty as discussed below: Relative sea level rise consists of eustatic sea level rise and subsidence.
    - **Eustatic Sea level rise:** USACE estimates for 50-year eustatic sea level rise (without the relative impacts of subsidence or accretion) range from 0.28 feet to 2.00 feet. This is a very broad range, as it coincides generally with the magnitude of normal water level fluctuations in the swamp. Future conditions for this project used the intermediate eustatic sea level rise estimate of 0.67 feet (coupled with subsidence for a relative rise of 1.90 feet).

- **Subsidence:** Future subsidence rates used in this project, per USACE guidance, were 7.5 mm per year. This corresponds to 1.23 feet over a 50-year period. This is based on the measured local increase in sea level over 50 years (9.20 mm/yr) minus the global eustatic rate of sea level rise (1.7 mm/yr). Coupled with the intermediate value of eustatic sea level rise, this yields a relative sea level rise of 1.90 feet over a 50-year period. However, the range of 50-year relative sea level rise estimates when subsidence is included is still very broad: 1.51 – 3.23 feet. Further uncertainty is introduced when considering the subsidence value alone. For example, the LCA Amite River Diversion Canal Modification (ARDCM) Project used a subsidence estimate of 7.5 mm/year, selected from an estimate range of 4 mm/yr to 20 mm/year based on projects and limited research available for the region. Shaffer et al. 1992 cited (Turner and Cahoon, 1987) and presented a subsidence rate of 7.5 mm/yr for the Atchafalaya Delta region.
- **Accretion:** Estimates of future accretion rates are not included in the projections of future relative sea level rise. The LCA ARDCM Project identified a range of 5 mm/year to 25 mm/year of accretion, with an intermediate estimate of 12 mm/year. Over a 50-year period, this range translates into 3.28 feet of uncertainty with respect to accretion alone. The intermediate rate of 12 mm/year translates into 1.97 feet over 50 years, which would roughly offset the relative sea level rise of 1.90 feet (eustatic sea level rise plus subsidence). Rybczyk et al. (2002) reported on the effects of adding nutrient-rich, secondarily treated wastewater to a subsiding, forested wetland at Thibodaux, Louisiana and indicate that accretion rates in the treatment wetland site were 1.1 cm/yr or 11.0 mm/yr. In evaluating diversion of water, nutrients and sediment into forested wetlands upstream of the Bonnet Carre Spillway, Day et al. (2007) indicate that based on the amount of water diverted, the deposition of mineral sediments, the relationship between vertical accretion and mineral sediment deposition, accretion is expected to be 22mm/yr. Therefore, an accretion rate with a diversion is expected to keep pace with rates of RSLR (9.2 mm/yr).
- **Combined Effects:** Using ranges applied to the Blind River project and also developed for the LCA Amite River Diversion Canal Modification project, the cumulative 50-year effects of uncertainty with respect to eustatic sea level rise, subsidence, and accretion are as follows, using combinations of extreme values:
  - **Highest Estimated Relative Sea Level Rise:**

    Maximum Eustatic Rise + Maximum Subsidence – Minimum Accretion

    2.00 ft + 3.28 ft – 0.82 ft = **4.46 feet**
  - **Lowest Estimated Relative Sea Level Rise:**

Minimum Eustatic Rise + Minimum Subsidence – Maximum Accretion

0.28 ft + 0.66 ft – 4.1 ft = **-3.16 feet**

The total range, then, of cumulative effects of land and sea changes is approximately 7.62 feet, which represents a large range of potential future conditions, especially considering that the range spans almost equally in opposing directions. Relative sea rise conditions that result in a relative sea level reduction will not pose risk to the project, while increases in relative sea level could impact project performance. The use of intermediate values for all factors produces an estimated relative sea level rise is -0.07 feet, representing a condition in which accretion effectively offsets the combined effects of subsidence and eustatic sea level rise.

Using intermediate values from available regional estimates of each contributing factor (eustatic sea level rise, subsidence, and accretion) suggest that relative sea level rise over 50 years will not produce the adverse hydrologic impacts to project performance that were analyzed. Analysis results developed for Alternative 2 are presented in this report and utilized relative sea level rise for three projections; low, medium and high. The rates of sea level rise and the rate of accretion relative to the existing elevation of the swamp is depicted for reference **in Figure 3-12 and 3-13** below. A review of these graphs indicates that with project accretion will keep up with relative sea level rise under low and intermediate forecasts, but without project accretion will not be able to keep up with relative sea level rise for any of the three sea level rise forecasts.

Hydraulic modeling was not completed with explicit representation of accretion and sedimentation (in order to offer conservative “worst case” estimates). The relative rise has been applied in the modeling analysis at the downstream boundary condition, specifically the water level in Lake Maurepas, and the primary impact it has on model results is increased backflow of Lake water into the swamp, and a greater need for diverted water in future years to overcome the backflow.

However, it is conceivable that the water levels in the Mississippi River (upstream boundary condition and flow input for this project) could also be affected by combined effects of eustatic sea level rise and changes in sediment load. This is important because the flow rating curves developed for the gravity-based diversion structure are based on the differential head across the system, not just on the water level in the Mississippi River. If downstream water level rises in Lake Maurepas but Mississippi River water levels are largely unchanged, the physical ability to divert water could be diminished.

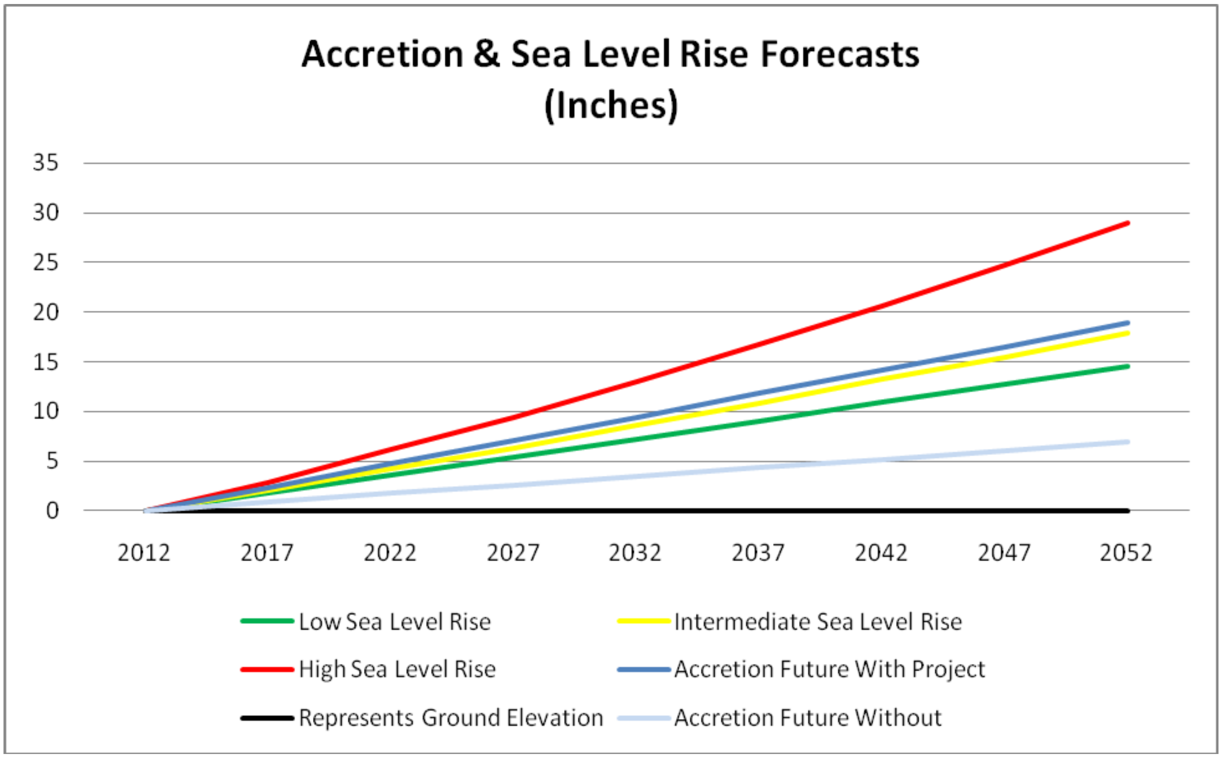

Figure 3-12. Accretion and Sea Level Rise Forecasts for the Recommended Plan

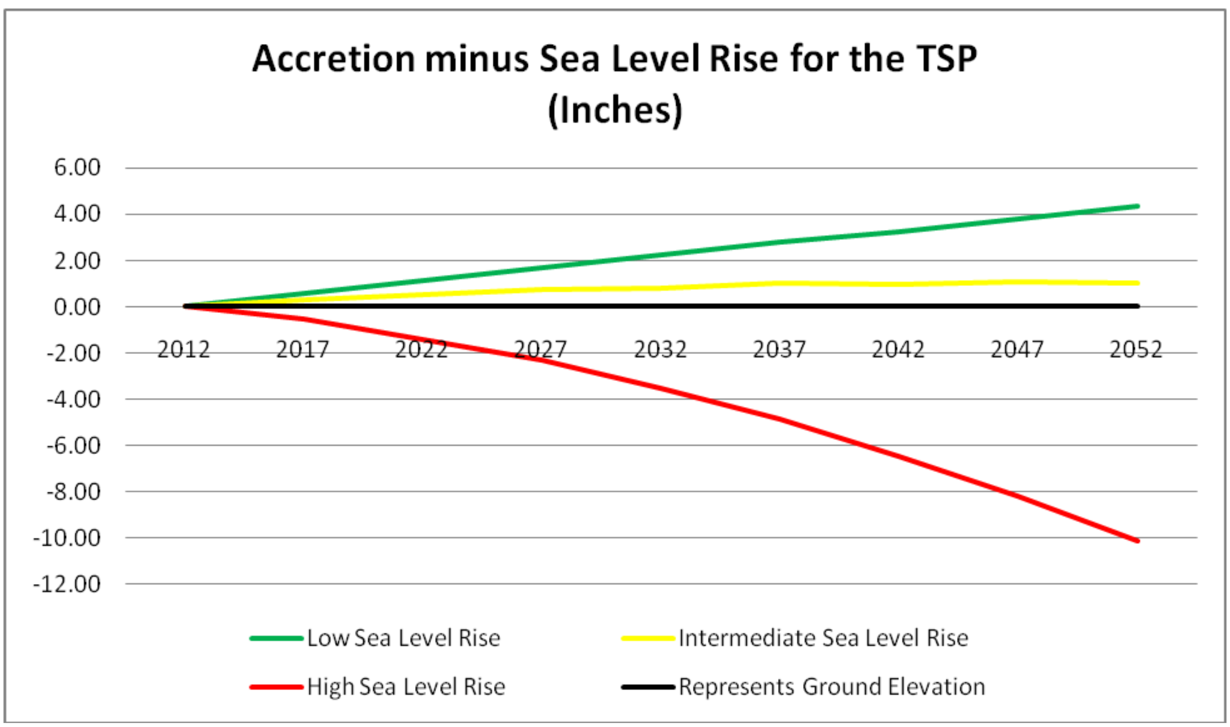

Figure 3-13. Accretion minus Sea Level Rise for the Recommended Plan

Specific forecasts of future water elevation trends in the Mississippi River near the study area are not readily available, so the analysis presented herein should be evaluated with the following considerations:

- If the Mississippi River water level does not change appreciably in the future, total diversion capacity could be diminished based on the assumptions guiding the application of sea level rise estimates to Lake Maurepas (less differential head across the system, and correspondingly lower diversion flows). As stated elsewhere, if intermediate projections for all contributing factors to relative sea level rise are applied together, the net effect could be almost negligible (counterbalancing effects). Hence, while there is the potential that rising relative sea level coupled with stationary river level could reduce diversion throughput, there is some uncertainty with these projections.
- If the Mississippi river water level rises in future decades, it should improve the ability to divert water to the Blind River system when compared to stationary water level in the river.

It is uncertain which of these scenarios is more likely to occur, and to what degree. Therefore, the project team has evaluated the effects of the different phenomena in sensitivity analyses. The worst case for diversion project performance would be higher levels in Lake Maurepas that do not appreciably affect the Mississippi River. This case would effectively reduce the gravity head gradient from the diversion to the Maurepas Swamp system and increase the need for more diverted flow to provide equal swamp restoration and flushing benefits.

The following two factors were used in deciding how to estimate the design level upstream boundary conditions in future decades:

- Intermediate (medium) projections of relative sea level rise, accounting for eustatic changes, subsidence, and accretion, suggest that the relative rise could be practically negligible.
- If relative sea level does change appreciably, it might be inferred that backwater elevations in the Mississippi River could also increase, if not in direct proportion, somewhat commensurately.

Significant uncertainty in each contributing factor provides the possibility for relative sea rise conditions that could affect the performance of the project. The sea level rise scenarios that were evaluated are considered to be conservative, since they account for eustatic rise and subsidence, but not for accretion. Uncertainty associated with relative sea level rise can be reduced with the collection and incorporation of additional information during subsequent project phases to better define local subsidence and probable accretion rates. In addition, adaptive management strategies should continue to be incorporated into the planned project in order to minimize potential impacts of relative sea and land elevations in the future. As additional information becomes available consideration of future conditions will continue to be refined during project design and to facilitate adaptive management after construction.

In the analyses performed, the use of intermediate values for eustatic sea level rise, subsidence, and accretion produces an estimated relative sea level rise representing a condition in which accretion effectively offsets the combined effects of subsidence and eustatic sea level rise. This suggests that that relative sea level rise will not produce adverse hydrologic impacts in project performance.

Hydraulics and Flood Levels: During the feasibility study phase of the Blind River project the hydraulic modeling was confined to the project area. During the PED phase the hydraulic modeling will be expanded to include several additional refinements to the results reported for the project for the feasibility phase. The areas where additional modeling will be conducted include downstream hydraulic benefits, effects of nutrients on downstream systems, water surface elevation control mechanisms as part of the operations system, optimization of flow through the berm gaps for both flooding and drainage of the swamp. The results of these additional investigations will be disclosed to the public. The additional work to refine the hydraulics during PED will optimize the Recommended Plan, but the ability to optimize the current plan will not make any of the previously considered alternatives more cost effective.

The level of hydraulics performed for the feasibility phase of the project leaves low levels of uncertainty that the existing plan is viable and will achieve the objectives and stated benefits of the project. The primary purpose of additional modeling will be to assist with better definition of the operations plan for the timing and control of diversions and for the adaptive management plan for in-swamp modifications to improve vegetation productivity. The key point is that the Maurepas swamp is a natural system and will be allowed to evolve naturally. As the ecological evolution of the swamp is monitored the project will have the flexibility to adapt to that evolution. The hydraulic modeling was adjusted over a wide range that indicates that the project can operate within those ranges and achieve the objectives and stated benefits. So while there are some hydraulic uncertainties, they can be accommodated within the operations plan of the system once it is optimized.

During PED there will be additional emphasis on how the operations system will work with the diversion optimization to control the amount of additional water surface level increase that would correspond to any adverse flooding effects. During the feasibility study the hydraulic calculations showed that the diversion flows presented no adverse impacts to water surfaces that were not already present due to rainfall and extreme tidal events. The entire area is subject to extreme tropical tidal surge events that far exceed the levels expected by the diversion of 3,000 cubic feet per second. There will be a need to coordinate the stopping of the diversion flows with high tidal and rainfall events so that the current level of flooding is not increased.

3.8.2 Environmental Uncertainties

Environmental uncertainties include the amount of water, sediment and nutrients needed to reverse swamp degradation, the affect of existing conditions on swamp degradation, and the level of future salinity impacts to the swamp. Less impoundment and greater throughput of water and an increase in hydro period fluctuation are needed to reverse swamp degradation, but the optimal target hydro period to maximize swamp productivity, accretion, nutrient assimilation, seed germination and sapling survival is unknown. Available information has been summarized regarding how swamps respond to a diversion or other applications of water, sediment and nutrients but the specific needs and the optimal target hydro period to reverse the degradation of this swamp will be determined through monitoring and adaptive management. These environmental uncertainties can, to some extent, be reduced in the future through adaptive management practices.

Water quality within the swamp and downstream of the swamp will likely change with diversion flow over time (refer to **Appendix L, Section L2.5.8.5**). The expectation is that water quality will improve in the swamp and the Blind River as freshwater, nutrients, and sediments from the Mississippi River are delivered to the project area by the project. The feasibility phase modeling of water flow and water quality used the best available data, however limited, to simulate existing conditions and estimate future change in water quality. While some uncertainty of change in water quality exists, water quality monitoring stations installed within the swamp and along Blind River as part of the feasibility phase will result in more substantial water quality and salinity data that will be used to refine water quality modeling during the PED phase. Additionally, as data and further analysis on other projects in the Maurepas Swamp area, such as Hope Canal, are available, the cumulative effects of all projects on water quality will be examined more fully. These additional data, analysis, and refined modeling results will be disclosed to the public prior to construction and a supplemental NEPA document prepared as appropriate.

3.8.2.1 WVA Results for Sea Level Rise Scenarios

In accordance with U.S. Army Corps of Engineers guidance outlined in EC 1165-2-211, project performance was assessed using three sea level change scenarios, a low estimate, an intermediate estimate, and a high estimate. Using the relative sea level rise rate of 9.20 mm/yr (a historic rate representative of the project area based on the West End at Lake Pontchartrain gage-85625) a starting year of 2012, and a 50-year project life, the low relative sea level rise rate is 1.51 feet for the year 2062. The low relative sea level rise rate of 9.20 mm/yr includes both eustatic sea level rise and subsidence. Estimates of the intermediate and high relative sea level rise rates were determined from NRC curves I and III.

The diversion of water from the Mississippi River at Romeville for the low sea level rise scenario would be a reduction in the average water depth relative to the existing condition in the Blind River and Maurepas Swamp for 20 years and 30 years. For the intermediate sea level rise scenario there would be a reduction in the average water depth relative to the existing condition for 20 years. For the high sea level rise scenario there would be no reduction in the average water depth relative to the existing condition. As sea level rises water depth can be expected to increase accordingly throughout the swamp. Because in-swamp management is a feature of all alternatives there are considerable WVA benefits in the first 20 years as a result of those features, and the difference in AAHUs between alternatives is minimized.

The benefits of the Recommended Plan (Alternative 2) in terms of Average Annual Habitat Units (AAHUs) for low, intermediate, and high sea level rise estimates indicates 6,741, 6,421, and 5,459 AAHUs, respectively (Table 3 in **Appendix K**). A comparison of these values indicates that the low sea level rise AAHU value is 5% greater than the intermediate sea level rise AAHU value and the high sea level rise AAHU value is 15% less than the intermediate sea level rise AAHU value.

The WVA does not show a distinction (or change in suitability indices) between habitat classes and between FWP and FWOP for basal area because throughout most of the project area is considered to be within the optimal range for basal area to support wildlife habitat. Because of these factors, alternative evaluations have placed an emphasis on stand structure and water regime. The project area is semi-permanently flooded and future-with-project modeling projections indicates that the flooding regime within most of the project area will return to pre-project conditions by target year 20 as a result of relative sea level rise. However, hydrologic flow will be improved and will provide additional benefits by increasing forest stand vigor, accretion, water quality and back flow prevention (Gary Shaffer, personal communication, October 2009).

Monitoring for adaptive management, including water levels, salinity, and accretion rates will provide data to better identify/quantify influence areas and how water, sediments and nutrients move through the system and within each hydrologic unit. These data as well additional topographic data in the swamp can be incorporated in to the hydrologic models in support of adaptive management activities and modification of the diversion operation plan (refer to the Monitoring and Adaptive Management Plan in **Appendix I**). As the project is further refined in the PED phase as well as through adaptive management thereafter, state and federal agency coordination will be continued to fully and adequately address any changes that could impact accretion rates, water quality, fish and wildlife, threatened or endangered species, essential fish habitat, bald eagles, and nesting bird colonies. Consultation with USFWS and NMFS will be reinitiated if and when warranted.

3.8.3 Construction and Economic Uncertainties

Construction and engineering design uncertainties include diversion flow control as a function of variability in the Mississippi River, amount of sedimentation in the transmission canal, the type and amount of contaminants in the diverted water, the level of erosion control needed, structural and geotechnical issues related to berm improvement and placement of water control structures, high groundwater during construction, the need for special construction equipment and construction techniques in and near the swamp, and maintenance needs. These uncertainties will be addressed in final design. Uncertainties that will be considered during actual construction phase include identification/location of and avoidance of nesting bird colonies and bald eagle nests. Coordination with the appropriate regulating agencies will minimize disruption to area avifauna. Construction will also be subject to obtaining all necessary permits to work in the area and construction timing will consider migration and nesting seasons. Economic (cost) uncertainties include embankment quantities, geotechnical results (incomplete), detailed designs for control structures, pricing (including localized effects), price trends, and inflation. These uncertainties are accounted for through conservative design and cost estimating including contingencies coupled with a 25 percent project scope contingency. These construction and economic uncertainties can, to some extent, be reduced in the future through additional data collection and analysis and through adaptive management practices.

Because the project relies upon the St. James Parish drainage system to convey freshwater from the Mississippi River to the swamp the potential impacts of the project on flooding was analyzed. The results of the analysis determined that the construction of the gaps in the existing St. James drainage system will provide connectivity allowing flow to pass through the drainage system and into the swamp without increasing the risk of flooding. There are no inhabited structures in close proximity to the project influence area. According to modeling conducted during the study no flooding impacts are anticipated. A more extensive modeling effort and additional flow monitoring will be performed part of the PED process. The additional modeling and monitoring will provide additional data to determine the exact water surface elevations to verify and refine the operation plan of the diversion as necessary to assure that flood stages are not adversely affecting properties.

3.8.4 Real Estate Uncertainties

Some uncertainty exists with the ability to ensure that the projected project benefits are attained and maintained in the absence of further restrictions on land use within the project benefits areas. The portion of the Maurepas Swamp that is part of the project is owned by the Louisiana Department of Wildlife and Fisheries (LDWF). The LDWF has established procedures for granting permits for exploratory activities on its WMAs. Exploratory activities, if permitted, could have some localized adverse impacts on the project benefits area. However, it is our opinion that exploration would be highly unlikely given that there are no active wells within the project area and that the major mineral interest owner is a conservation foundation. Further risk assessment and analysis will be conducted together with identification of approaches that may be appropriate to manage identified risks.

3.9 Implementation Requirements

3.9.1 Schedule

Table 3-12 presents the steps and milestones required to complete the feasibility report, obtain project approvals, authorization of construction, final design and construction. The TSP/NER plan can be implemented with existing authorities. Following completion of a report of the Chief of Engineers with a positive recommendation for the project, provided that the Chief completes his report before December 31, 2010, the project would be eligible for construction funding. The project is expected to begin Pre construction Engineering and Design in late 2010 and begin construction in 2012. See Table 3.12. The project would be considered for inclusion in the President's budget based on: national priorities, magnitude of the Federal commitment, economic and environmental feasibility, level of local support, willingness of the non-Federal sponsor to find its share of the project cost and the budget constraints that may exist at the time of funding. Once Congress appropriates Federal construction funds, the Corps and the non-Federal sponsor would enter into a project partnership agreement (PPA). The PPA would identify the Federal and non-Federal responsibilities for implementing, operating and maintaining the project. Project construction would begin following the certification of the real estate requirements. After construction, the Corps' acceptance from the contractor and notice of construction completion of the project (or a functional portion of the project) to the non-Federal sponsor would proceed or be concurrent with the delivery of an O&M manual and as-built drawings.

Table 3-12: Milestone Schedule

Milestones	Schedule
Final Report	August 2010
Division Engineer Notice	August 2010
Washington Level Review	August 2010
Execute Cost-Sharing Agreement for PED	September 2010
State and Agency Review	October 2010
Chief of Engineers Report	December 2010
Begin Preconstruction Engineering and Design	2010

ASA and OMB Review	2011
ASA Report to Congress	2011
Complete Design Documentation Report	2011
Complete Plans and Specifications	2011
Execute PPA	2011
Complete Real Estate Acquisition	2011
Advertise Construction	2012
Construction Start	2012
Complete Construction	2015
Turnover Project to Local Sponsor	2015
Initiate Monitoring and Adaptive Management	During PED
Complete Monitoring and Adaptive Management	2025

3.9.2 Implementation Responsibilities

The non-Federal sponsor shall, prior to implementation, agree to perform all of the local cooperation requirements and non-Federal obligations. Local cooperation requirements and non-Federal sponsor obligations include, but are not necessarily limited to:

a. Provide a minimum of 35 percent of total project costs as further specified below:

(1) Enter into an agreement which provides, prior to execution of the project partnership agreement, 25 percent of design costs;

(2) Provide, during the first year of construction, any additional funds needed to cover the non-Federal share of design costs;

(3) Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and

construct improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material that the Government determines to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the project;

(4) Provide, during construction, any additional funds necessary to make its total contribution equal to 35 percent of the total project costs allocated to the project;

b. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project;

c. Not use funds provided by a Federal agency under any other Federal program, to satisfy, in whole or in part, the non-Federal share of the cost of the project unless the Federal agency that provides the funds determines that the funds are authorized to be used to carry out the study or project;

d. Not use project or lands, easements, and rights-of-way required for the project as a wetlands bank or mitigation credit for any other project;

e. For as long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the project, or functional portions of the project, including mitigation, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and state laws and regulations and any specific directions prescribed by the Federal Government;

f. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the non-Federal sponsor of responsibility to meet the non-Federal sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

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

h. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive

Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

i. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

j. Agree that, as between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that would not cause liability to arise under CERCLA;

k. Prevent obstructions of or encroachments on the project (including prescribing and enforcing regulations to prevent such obstruction or encroachments) which might reduce ecosystem restoration benefits, hinder operation and maintenance, or interfere with the project's proper function, such as any new developments on project lands or the addition of facilities which would degrade the benefits of the project;

l. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as would properly reflect total costs of construction of the project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

m. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5), and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

n. Comply with all applicable Federal and state laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army," and all applicable Federal labor standards and requirements, including but not limited to 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying, and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c et seq.); and

o. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way necessary for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

3.9.3 Cost Sharing

The State of Louisiana, acting through the Coastal Protection and Restoration Authority of Louisiana (CPRA), will be the non-Federal sponsor for the LCA Small Diversion at Convent/Blind River Project. In November 2008, the USACE and CPRA executed a single Feasibility Cost-Share Agreement covering six Louisiana Coastal Area near-term plan elements listed in Section 7006(e) of the Water Resources Development Act of 2007. The six features each underwent a separate feasibility analysis and environmental compliance analysis culminating in a single master feasibility document. The cost-share during the feasibility phase was 50% Federal and 50% non-Federal. However, the individual elements have been divided so that each entity had lead responsibility for preparing three of the six report components. At the end of the feasibility phase the total cost for all elements will have been shared on a 50/50 basis, yet for work on each individual element during the feasibility phase the ratio of funds expended by either the Federal or non-Federal sponsor will be higher depending upon their level of responsibility. CPRA had the technical planning lead for this particular LCA project element.

Following the feasibility phase, the cost share for the planning, design and construction of the project will be 65% Federal and 35% non-Federal. The CPRA must provide all lands, easements, rights-of-way, utility or public facility relocations, and disposal areas (LERRDs) required for the project. Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) of the project would be a 100% CPRA responsibility.

Under current law, authority for the non-Federal sponsor to receive credit for construction activities is limited. Section 7007(a) of WRDA 2007 authorizes the Secretary to credit, "toward the non-Federal share of the cost of a study or project under this title the cost of work carried out in the coastal Louisiana ecosystem by the non-Federal interest for the project before the date of the execution of the partnership agreement for the study or project." In addition, section 7007(a) incorporates the requirement of section 221 of the Flood Control Act of 1970, as amended, (42 U.S.C. 1962d-5b) that the Government and non-Federal sponsor must enter into a separate agreement for any work that will be carried out prior to execution of the partnership agreement. In other words, work undertaken by the non-Federal sponsor prior to (but not after) execution of the project partnership agreement (PPA) is eligible for credit subject to execution of a separate agreement covering such work before it is undertaken. For design work that the non-Federal sponsor proposes to undertake, the Design Agreement will serve as the required separate agreement. For construction work that the non-Federal sponsor proposes to undertake, an In-Kind Memorandum of Understanding will be required. Opportunities to enter into an In-Kind MOU for construction activities will depend on the schedule for entering into the PPA for a project.

Section 7007(d) provides that credit afforded under section 7007 that is in "excess" of the non-Federal cost share for a study or project authorized in Title VII of the Water Resources Development Act of 2007 may be applied toward the non-Federal cost share of any other study or project under that title. "Excess" credit will be applied only toward another study or project involving the same sponsor. In addition, "excess" credit will be applied within project phases (i.e., study to study, design to design, and construction to construction). At this time, it is anticipated that that there are limited opportunities for the application of "excess credit" from other Title VII projects toward these projects.

Table 3-13 below provides the distribution of cost for the fully funded project cost estimated. The estimate includes contingencies based on a risk and uncertainty analysis using the Crystal Ball computer program, price escalation to October 2011, and inflation to the midpoint of construction. According to the MCACES cost estimate developed, the total costs of constructing the Recommended Plan is $123,140,000. The Federal cost-share for construction of the Recommended Plan would be $80,041,000 and the non- Federal cost share would be $43,099,000. Operation and maintenance costs will be $462,000 annually and the cost to dredge sediments from the transfer canal will be $2,200,000 annually.

Operation and maintenance activities will include (but are not limited to) starting and stopping the diversion(s), routine equipment and instrument maintenance, corrective equipment and instrument maintenance, and gap and culvert cleaning. The annual estimated cost for operation and maintenance activities is $462,000.

Annual maintenance dredging or de-silting is anticipated to remove sediments deposited in the Transmission Canal during operation of the diversion system. The Mississippi River carries a significant suspended solids load. It is expected that the flow diverted into the diversion operation will have the same characteristics, and will cause a reduction in Transmission Canal volume due to sediment accumulation.

The project is not anticipated to induce shoaling on the Mississippi River. However, if further analysis determines that the project increases maintenance dredging requirements for the Mississippi River, Baton Rouge to the Gulf of Mexico, Project by inducing shoaling, the incremental costs of any additional maintenance dredging would also be a 100-percent non-Federal responsibility.

Periodically major project components may have to be repaired, rehabilitated, or replaced. The annual cost for repair, rehabilitation, and replacement is $92,000.

The total annual cost for OMRR&R is $2,754,000. During the PED phase of the project there will be Value Engineering reviews to look at all aspects of the project to reduce the Operation and Maintenance costs along with capital costs to optimize the life cycle cost of the project.

Table 3-13: Cost Sharing

ITEM	FEDERAL	NON-FEDERAL	TOTAL (Rounded)
LERRDs to be acquired		$4,040,000	$4,040,000
Facility/Utility Relocation		$14,060,000	$14,060,000
Highway		$1,820,000	$1,820,000
Railroad		$2,090,000	$2,090,000
Subtotal Real Estate		$22,010,000	$22,010,000
Construction	$77,610,000		$77,610,000
Planning, Engineering, & Design	$5,812,500	$1,937,500	$7,750,000
Construction Management	$9,150,000		$9,150,000
Subtotal Construction	$94,510,000		$94,510,000
Adaptive Management	$6,620,000		$6,620,000

Subtotal 65/35 Cost Share	$99,192,500	$23,947,500	$123,140,00
Adjustment for 65/35 Cost	($19,151,500)	$19,151,500	
TOTAL FIRST COST*	$80,041,000	$43,099,000	$123,140,00
PERCENT OF FIRST COST	65%	35%	
Annual Operation & Maintenance	$0	$462,000	$462,000
Annual Repairs, Replacement and Renewal	$0	$92,000	$92,000
Annual maintenance dredging	$0	$2,200,000	$2,200,000

** Represents fully funded cost including interest during construction*

3.9.4 Environmental Commitments

A summary of the environmental and related commitments made during the planning process and incorporated into the proposed project plan is as follows.
Mitigation measures are proposed to reduce or avoid impacts that would otherwise occur as a result of the implementation of the preferred alternative. These commitments would be implemented by construction contractors or management authorities. Some commitments, such as monitoring, would continue beyond completion of construction of facilities.

Throughout the planning process for the proposed project, efforts have been made to avoid impacts where practicable. If avoidance was not possible, then mitigation measures have been developed to reduce the level of impact. The Recommended Plan will impact 53 acres (21ha) of wetlands with construction of the Romeville diversion canal. The wetlands that will be impacted are not part of Maurepas Swamp that will be improved. The improvement of 21,369 acres (8,648 ha) of baldcypress-tupelo swamp that are in various stages of deterioration, will mitigate for the wetland impacts resulting from construction of the Romeville diversion canal.

Other management practices would be employed during construction activities to minimize environmental effects and would be included in construction specifications. Many of these measures are required in order to comply with Federal, State, or local laws and regulations, regardless of whether they are specifically identified in this document. Project implementation will comply with all relevant Federal, State, and local laws, ordinances, regulations, and standards during the implementation of the preferred alternative. Implementation of the environmental commitments for the proposed project will be documented to track the completion of the environmental commitments.

Environmental Commitments:

- Ensure that construction contractors limit ground disturbance to the smallest feasible areas.
- Use accepted erosion control measures during construction.
- To minimize disturbance to bald eagles and other raptors nest searches will be conducted up to three-quarters of a mile of proposed activities prior to construction to avoid active nests. Appropriate protective measures will be implemented to avoid or minimize nest disturbance if active nests are found.
- Contact pipeline and gas well companies prior to construction activities to identify and avoid existing hazards.
- Construction contractors will use and implement measures contained in erosion control guidelines and BMPs to control soil erosion from construction areas.
- Construction contractors will implement measures to control fugitive dust during construction.
- Implement a program to compensate for losses of archaeological sites (if any) that would occur as a result of construction and operation of the proposed project.

Formal consultation was conducted on the pallid sturgeon in compliance with ESA of 1973. A Biological Opinion (**Appendix A**) was received on September 23, 2010 from the USFWS outlining the following Reasonable and Prudent Measures and Terms and Conditions:

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures (RPMs) are necessary and ***appropriate*** *to minimize the incidental take of pallid sturgeon by entrainment through the small diversion at Convent/Blind River.*

1. *Gate operations should minimize velocity through the structure by maximizing the open cross-section, especially at Mississippi River stages of 6 feet Mean Sea level or less (equates to velocities at the culvert face of 7.2 fps or less).*
2. *Any gate operation that would significantly increase or decrease the velocity (change greater than 500 cfs) should be implemented over several hours to allow fish sufficient time to migrate back to the river or swim away from the structure.*
3. *Once the end of the annual discharge period is reached minimal gate openings should be maintained for several days to allow passage of any sturgeon that may have emigrated downstream.*

4. The downstream edge of the culverts should have a slope to act as a ramp and/or sufficient erosion protection that would prevent scour from forming a vertical ledge greater than 6 inches at the downstream end of the culvert.
5. In channel refuge consisting of several submerged wing dikes (or similar structures) on both banks should be constructed no further downstream than 75 feet from the structure. Minimal spacing between the structures should be 10 feet but can be moved to account for scour. The maximum suggested height is 24 inches, but the length extending into the channel is not yet determined.
6. The downstream side walls should be angled towards the culverts so they will guide fish back into the culverts at lower velocities.
7. The two outer most culverts should have fish passage baffles constructed on the floor of the culverts.
8. Monitoring to determine take and to reduce potential take by returning pallid sturgeon to the river should be undertaken

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Corps shall execute the following terms and conditions, which implement the RPMs described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. Manuals (or other similar documents) written to guide the daily operations and maintenance activities of the diversion should be written in cooperation with the Service. Any proposed changes to such document would require re-initiation of consultation under Section 7 of the ESA.
2. Detailed design of wing dikes and the scour protection to prevent development of a vertical ledge should be coordinated with the Service. After construction annual inspection (i.e., measurements) should be taken at the downstream edge of the culvert to determine need to for maintenance. If maintenance is required funding should be immediately requested.
3. Design of downstream side walls and detailed design of the fish passage baffles should be coordinated with the Service.
4. Three days of sampling effort will be made each quarter. Sampling will consist of at minimum utilizing otter trawls, gillnets (i.e., 27.4 meter by 1.8 meter, six mesh panel ranging from 23 to 76 centimeters), and trotlines (61 meters long with 60 dropper lines at 0.9 meter intervals using 2/0 hooks baited with worms). Up to eight trotlines will be fished on the bottom overnight and two gillnets will also be fish overnight. All procedures and protocols for handling sturgeon should be followed and are available at: www.fws.gov/mountain-praire/endspp/protocols/PallidSturgeonHandlingProtocol2008B.pdf

All pallid sturgeon captures should be measured and tagged according to the protocol; if permitted and when feasible, ageing and endoscopy to determine sex and reproductive stage should also be conducted. All pallid sturgeon captured should be returned to the Mississippi River as soon as practicable. The number and size of each pallid sturgeon caught by date and gear type *should be provided to the Service. Unsuccessful sampling efforts should also be reported by date and gear type.*

Upon locating a dead or injured pallid sturgeon that may have been harmed or destroyed as a direct or indirect result of the proposed project, the Corps and/or contractor shall be responsible for notifying the Service's Lafayette, Louisiana, Field Office (337/291-3100) and the LDWF's Natural Heritage Program (225/765-2821). Care shall be taken in handling an injured sturgeon to ensure effective treatment or disposition and in handling dead specimens to preserve biological materials in the best possible state for later analysis. Disposition of dead sturgeon is also addressed in the protocols.

3.9.5 Financial Requirements

It is expected that the CPRA will have the capacity to provide the required local cooperation for the Recommended Plan. A project schedule and cost estimate will be provided to the CPRA so that it may develop a financing plan. A standard cost share percentage of 65% Federal and 35% non-Federal would be applied to the total first cost of the project, including the value of LERRDs, pre-construction engineering and design and construction features.

Section 7007(b) of WRDA 2007 provides that "The non-Federal interest may use, and the Secretary shall accept, funds provided by a Federal agency under any other Federal program, to satisfy, in whole or part, the non-Federal share of the cost of the study or project if the Federal agency that provides the funds determines that the funds are authorized to carry out the study or project." If the Mineral Management Services determines in writing that funds it provides to the non-Federal sponsor under the Energy Policy Act of 2005 (Coastal Impact Assistance Program - CIAP) and the Gulf of Mexico Energy Security Act of 2006 (GOMESA) are authorized to be used to carry out the Small Diversion at Blind River project, the non-Federal sponsor can use those funds toward satisfying its local cooperation for the project, including the non-Federal sponsor's acquisition of Lands, Easements, Relocations, Rights of-way and Disposals (LERRDs) required for the project.

By letters dated July 2, 2009 and December 18, 2009, the Minerals Management Service and the USACE established a process for the Minerals Management Service to provide its written determination regarding the acceptability of the use of CIAP funds for LCA studies, projects, and programs. That process provides that the Minerals Management Services' written determination for a specific study, project, or program will take the form of the grant award document for that activity.

3.9.6 Views of Non-Federal Sponsor

As demonstrated in its August 9, 2010 letter of support for the LCA WRDA Section7006 (e)(3) projects, the CPRA has expressed the desire to implement and sponsor the LCA Small Diversion at Convent/Blind River project in accordance with the items of local cooperation that are set forth in Section 3.9.2 and subject to the discussion provided in Sections 3.9.3 and 3.9.5. In addition, CPRA supports the Recommended Plan (TSP/NER-Alternative 2) since this plan best meets the screening criteria; would accomplish the planning objectives, and goals; is cost-effective and is a best-buy, and would reverse the trend of deterioration in the southeast part of the Maurepas Swamp. Specifically, Alternative 2 would improve over 21,000 acres of baldcypress-tupelo swamp that are in various stages of deterioration.

The State of Louisiana fully supports the project. The state recognizes that the USACE's position is that section 7007 does not authorize credit for work carried out after the date of a partnership agreement. However, the state disagrees with the USACE position and intends to continue to seek a change in law that would allow in-kind contribution credit for work carried out after the date of a Project Partnership Agreement and that would allow for such in-kind contributions credit to carry over between LCA Program components (i.e., “excess” credit for work undertaken after signing of the project partnership agreement for one project may be carried over for credit to another project). Nevertheless, while the state is of the opinion that its view is consistent with the authority and Congressional intent under WRDA 2007, the state fully intends to proceed with the project under the Corps’ interpretation of current law and to meet all non-Federal financial and other obligations outlined by the USACE in this report until such time as the law is changed.

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4.0 AFFECTED ENVIRONMENT*

This chapter describes the location, climate, geomorphic and physiographic setting, and historic and existing conditions for the following important resources: soils and water bottoms; hydrology [including flows and water levels, sedimentation and erosion, water quality, and groundwater]; vegetation resources; wildlife and habitat; fisheries; aquatic resources; EFH; threatened and endangered species; cultural and historic resources; aesthetics; recreation; and socioeconomic and human resources [including displacement of population and housing, employment, business, and industrial activities, availability of public facilities and services, transportation, infrastructure, environmental justice, water use and supply, navigation, land use socioeconomics (i.e. agriculture, forestry, and public lands), man-made resources (i.e., oil, gas, and utilities, and flood control and hurricane protection), and natural resources (i.e., commercial fisheries)]. In addition, the characterization of air quality, noise, and hazardous, toxic, and radioactive waste (HTRW) in the study area are presented.

A resource is considered important if it is recognized by statutory authorities including laws, regulations, Executive Orders (EO), policies, rules, or guidance; if it is recognized as important by some segment of the general public; or if it is determined to be important based on technical or scientific criteria. The following sections discuss historic and existing conditions of each important resource occurring within the study area, with the area of interest expanded to include Lake Maurepas where relevant.

More detailed descriptions of climate, geomorphic and physiographic setting and important resources is provided in the 2004 programmatic environmental impact statement for the Louisiana Coastal Area (LCA), Louisiana, Ecosystem Restoration Study (LCA PEIS 2004). Consistent with 40 CFR Parts §§1500.4 (j) and 1502.21 pertinent and applicable information from the LCA PEIS is incorporated by reference. The content of the material incorporated by reference will be briefly described for context.

4.1 Environmental Setting of Study Area

4.1.1 Location

The Study Area for this project is included as portions of the Mississippi River Deltaic Plain within coastal southeast Louisiana in the Upper Sub-Basin of the Lake Pontchartrain Basin. Located approximately equidistant between Baton Rouge and New Orleans, Louisiana, St. James Parish contains most of the Study Area, but the northwest portion of the distribution area extends into Ascension Parish. With regards to ecological communities, the Study Area is within the Mississippi Alluvial Plain (Level III) Inland Swamp (73n) and Southern Holocene Meander Belts (73k) (Level IV) ecoregions (Daigle et al. 2006). The Study Area includes the proposed construction footprint (intake locations and transmission canals) and distribution area.

4.1.2 Climate

Consistent with 40 CFR Parts §§1500.4 (j) and 1502.21 description of the climate provided in the LCA PEIS (2004) is hereby incorporated by reference. The climate of the Study Area is subtropical marine with long humid summers and short moderate winters. Long-term, daily precipitation data (1930-present) within the vicinity of the Study Area reveal an average annual rainfall of 60.49 inches (153.65 cm) with a low of 40.48 inches (102.82 cm) and a high of 93.15 inches (236.60 cm) (NOAA 2009: station id 2534). Across years, rainfall is relatively evenly split between months (NOAA 209) though the Study Area is subject to periods of both drought and flood, and the climate rarely seems to truly exhibit "average" conditions (MsCIP 2008).

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. Historical data from 1899 to 2008 indicate that 31 hurricanes and 41 tropical storms made landfall along the Louisiana coastline during this period (NOAA 2009). The 2005 hurricane season brought the most substantial hurricane damage to the Study Area in recent history, with the arrival of Katrina and Rita. Hurricane Gustav, while much smaller and less intense, brought additional damage to the region with landfall on September 1, 2008, that was further exacerbated by subsequent impacts from Hurricane Ike landfall on September 13, 2008.

Wetland loss as a result of Hurricanes Katrina and Rita was over one third of the total wetland losses predicted by the Coast 2050 Report to occur over the next half-century (LCWCRTF and WCRA 1999). Barras (2006) estimated a total of 217.0 square miles (562.1-km^2) of wetland loss from the 2005 hurricanes. Within the Pontchartrain Basin, about 12,160 acres (4,921 ha) of wetlands were converted to open water, with marshes incurring the greatest losses (Barras 2006). Inland, forested wetlands were least affected with negligible wetland losses detected for this region and, specifically, within the Study Area (Wicker 1980; Barras et al. 1994; Barras et al. 2003; Morton et al. 2005).

4.1.3 Geomorphic and Physiographic Setting

The geomorphic and physiographic setting is technically significant because geologic conditions can place constraints on the nature, design, and location of the proposed action, as well as influence the impacts that the proposed action would have on other important resources. Over long, geologic time scales and across an extended region, coastal processes have affected and continue to influence the Study Area. Riverine processes, occurring at smaller spatial scales and over shorter time periods, are the predominant contemporary forces that shape the geomorphic and physiographic setting of the Study Area. The co-occurrence of these processes has been further influenced by human modifications. A description of how these processes define the geomorphic and physiographic setting of the Study Area is included in the following sections. Consistent with 40 CFR Parts §§1500.4 (j) and

1502.21, description of the geomorphic and physiographic setting provided in the LCA PEIS (2004) is hereby incorporated by reference.

USGS Open File Report 02-206, Environmental Atlas of the Lake Pontchartrain Basin (Penland et al. 2002), describes the geomorphology and geologic history of the Lake Pontchartrain Basin and is herein referenced for the discussion that follows. Formation of the Lake Pontchartrain Basin began approximately 20,000 years before present in the late Wisconsin glaciation of the Pleistocene Epoch. Climatic warming and the subsequent melting of glaciers caused a rapid rise in sea level from its lowstand (18,000 years before present) to its highstand (3,000 to 4,000 years before present)—a period known as the Holocene Transgression. As sea level rose, incised river valleys eroded into and beveled the adjacent Pleistocene uplands. After sea level reached its highstand, a sequence of events occurred that was critical to the formation of the basin and the estuarine system present today: the development of the Pine Island barrier shoreline trend resulted in the creation of Lakes Pontchartrain and Maurepas; the St. Bernard delta complex built out from the alluvial valley onto the continental shelf and buried the Pine Island barrier trend; and the Mississippi River abandoned (2,000 years before present) the St. Bernard delta complex for the Lafourche and later returned to the Modern delta complex (1,000 years before present).

The Lake Pontchartrain Basin is divided into three distinct, geomorphic regions: the Pleistocene Terraces Region to the north of Lake Maurepas, Pontchartrain, and Borgne; the Mississippi River Deltaic Plain Region to the south of the lakes; and the Marginal Deltaic Basin Region, which includes the lakes and surrounding wetlands. The Study Area for the Small Diversion at Convent / Blind River project is within the Maurepas Swamp Area—the westernmost portion of the Marginal Deltaic Basin. Lake Maurepas and the surrounding wetlands compose this geographic area.

Further description of the St. Bernard delta complex, within which the Study Area lies, is provided by the USGS Open File Report 98-36 (1998). The St. Bernard delta complex, the oldest within the Mississippi Deltaic Plain Region, is a distinct physiographic unit that was formed by Mississippi River deposits between 700 and 4,700 years ago. The most prominent features are the vast expanses of fresh, intermediate, brackish, and salt marsh. The majority of the remaining surface features are comprised of inland swamp, tidal channels, shallow lakes and bays, natural levee ridges along active and abandoned distributaries, sandy barrier islands and beaches. The St. Bernard delta complex began receiving Mississippi River deltaic sediments from the middle to late Holocene. The first deltaic deposits to enter the area were homogenous prodelta clays. This was followed by the deposition of interdistributary bay deposits as the Mississippi River and its distributaries prograded. The deposits were finer sediments (silty clay and clay) that were transported away from the distributary channel and settled out of suspension as interdistributary deposits.

Depositional environments within the Study Area include point bar, natural levee, and inland swamp, in order of decreasing area. Point bars line the Mississippi River, forming the batture, and were developed through lateral channel migration of the river, cutbank formation and collapse, followed by the deposition of sand and silt on the opposite convex bank (Fisk, 1947; Flores et al. 1985; Galloway and Hobday, 1983). Floods historically deposited sand and silt adjacent to the river and formed natural levees along the Mississippi River that grade towards the inland swamp (Farrell, 1989; Flores et al. 1985; Galloway and Hobday, 1983). The distribution area, and thus most of the Study Area, consists of inland swamp described as low-lying, very flat, poorly drained areas bounded by natural levees or low terraces (Saucier, 1994).

4.1.3.1 Coastal and Riverine Processes

Disruption of the Deltaic Cycle

The geologic development of coastal Louisiana is closely related to shifting Mississippi River courses (Coleman et al. 1998). Description of the deltaic cycle including delta advancement and abandonment, deltaic geomorphology, and biologic diversity and delta switching is provided in the 2004 programmatic environmental impacts statement for the LCA Ecosystem Restoration Study (LCA PEIS; USACE 2004). In more recent geologic history, the Mississippi River has changed its course several times over the last 7,000 years, spurring the development of the Mississippi River Deltaic and Chenier Plains. Recognition that the Deltaic and Chenier Plains are formed by an orderly progression of events related to shifting Mississippi River courses led to the identification and characterization of the deltaic cycle. The deltaic cycle is a dynamic and episodic process alternating between periods of delta building and the subsequent landward retreat of deltaic headlands as deltas are abandoned, reworked, and submerged by marine waters.

Since European settlement of Louisiana in the eighteenth century, humans have exerted a major influence on many of the key elements controlling the deltaic cycle. Construction of levees along the Mississippi River's banks and other flood control and flow modifications, which culminated under the Mississippi River and Tributaries Project (1928), have channelized the river's path of flow. The prevention of overbank flooding from the Mississippi River into the study area reduced the introduction of nutrients and sediment, decreased primary productivity and accretion, and transitioned the deltaic cycle from delta advancement to abandonment (e.g., Kesel, 1989; Boesch et al. 1994; Day et al. 2000). Whereas riverine freshwater inflows dominate the regressive or constructional phase of the deltaic cycle, delta abandonment and degradation is dominated by marine processes (Roberts, 1997). Reduction of the natural delta-building processes allowed relative sea level rise (RSLR) and erosion to dominate the coastal Louisiana landscape. Other flood control (e.g., drainage canals) and infrastructure (e.g., roads, railways, and oil and gas pipelines) projects have altered the hydrology of coastal wetlands and exacerbated degradation processes.

Biological Diversity and Delta Switching

The deltaic cycle of growth, abandonment, and degradation is paralleled by the cycle of biological diversity and productivity, with a slight time lag in the latter **(Figure 4-1).** At the early degradation phase of delta development, the biodiversity/productivity cycle is at its highest, with an accompanying peak in primary plant productivity and fishery productivity. In this stage, ecosystems produce an excess of organic material, some of which is exported seaward where it sustains major energetic pathway, provides the basis for various trophic webs, and supports coastal fisheries (Odum, 1980; Day et al. 1989). As the delta degradation phase continues, biological diversity / productivity also eventually declines. The elimination of overbank flooding from the Mississippi River and flood control modifications within the study area have promoted the degradation of forested wetlands within this area. Apparent symptoms of degradation include extremely low rates of primary productivity and tree growth, as well as high rates of tree mortality (Shaffer et al., 2003).

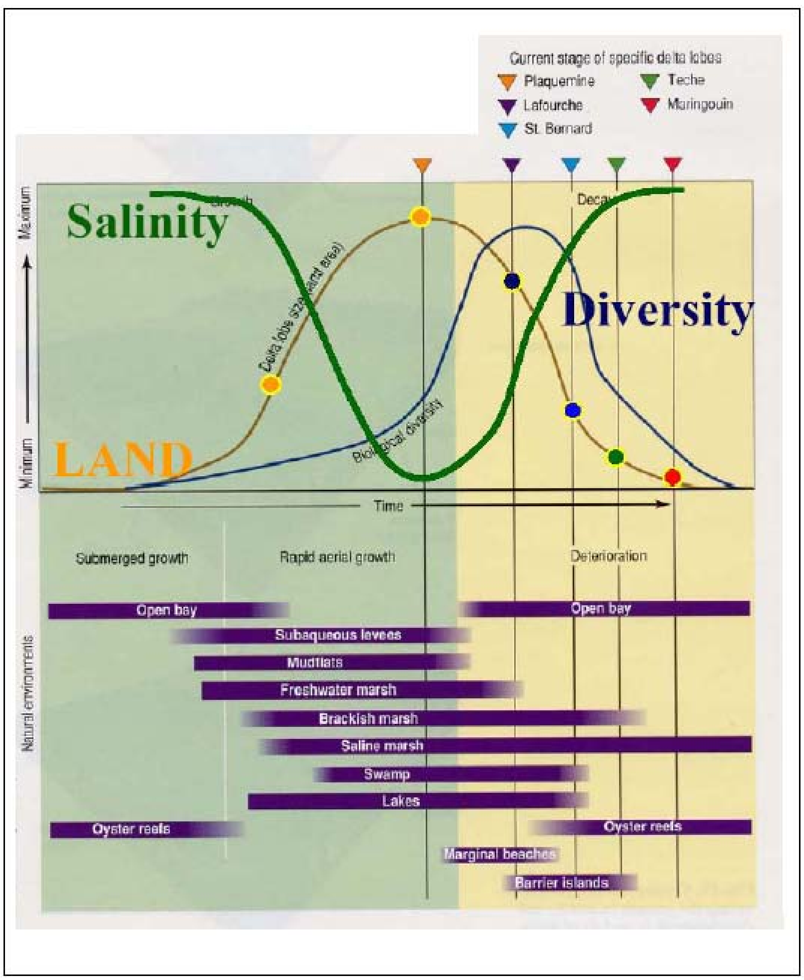

Figure 4-1. Relationship between the deltaic cycle and biological productivity and diversity (from LCA FPEIS, 2004).

Relative Sea Level Rise
The entire Louisiana coastal zone is experiencing relative sea level rise (RSLR). RSLR, or local mean sea level rise, is defined here as the net effect of numerous processes that result in the downward displacement of the land surface relative to sea level. Major processes contributing to RSLR in the study area include eustatic sea level rise, compaction of Holocene deposits (subsidence), and human modifications. The compaction of Holocene deposits is considered the primary contributor to RSLR in the Louisiana coastal plain, where regional rates are unprecedented elsewhere in the country (Terzaghi 1943; Roberts 1985).

Hydrologic Uncertainties

The hydraulic and hydrologic modeling results presented in the analysis to date have been developed with the best available information on historical hydrology, existing topography, sea level rise, subsidence, and accretion, however, each of these factors, alone or in combination, is subject to uncertainties which could pose risks to the hydraulic and ecological functionality of the project. The uncertainties are discussed below:

Topography: All modeling to date has been completed using best available topographic and bathymetric data, in combination with available engineering plans to define channel cross-sections, roadway culverts, and surface storage areas. The available topographic data coupled with field reconnaissance provided sound definition of major hydrologic and hydraulic features for use in the development models. The model calculations that rely on topographic input such as estimates of water depths, residence times, and propensity of water to flow in assumed directions are limited in their resolution.

Future hydrology: The period of record used for extended analysis covered the period from 1989 through 2004. During this period, it appears that extended dry conditions that would support cypress germination and sapling survival occurred only every 5 to 6 years. The frequency at which conditions in the future may support growth cannot be accurately forecasted based only on this available data record. What can be inferred from the analysis is that careful flow management within the system can facilitate periodic hydrologic conditions that would support tree re-growth, but favorable ecological factors will also need to be present for this desired outcome.

- **Relative Sea Level Rise:** The basis for estimating relative sea level rise and associated impacts to the project are based on multiple components that all contain some elements of uncertainty as discussed below: Relative sea level rise consists of eustatic sea level rise and subsidence.
    - **Eustatic Sea level rise:** USACE estimates for 50-year eustatic sea level rise (without the relative impacts of subsidence or accretion) range from 0.28 feet to 2.00 feet. This is a very broad range, as it coincides generally with the magnitude of normal water level

fluctuations in the swamp. Future conditions for this project used the intermediate eustatic sea level rise estimate of 0.67 feet (coupled with subsidence for a relative rise of 1.90 feet).

- **Subsidence:** Future subsidence rates used in this project, per USACE guidance, were 7.5 mm per year. This corresponds to 1.23 feet over a 50-year period. This is based on the measured local increase in sea level over 50 years (9.20 mm/yr) minus the global eustatic rate of sea level rise (1.7 mm/yr). Coupled with the intermediate value of eustatic sea level rise, this yields a relative sea level rise of 1.90 feet over a 50-year period. However, the range of 50-year relative sea level rise estimates when subsidence is included is still very broad: 1.51 – 3.23 feet. Further uncertainty is introduced when considering the subsidence value alone. For example, the Amite River Project used a subsidence estimate of 8.5 mm/year, selected from an estimate range of 4 mm/yr to 20 mm/year based on projects and limited research available for the region. Shaffer et al. 1992 cited (Turner and Cahoon, 1987) and presented a subsidence rate of 7.5 mm/yr for the Atchafalaya Delta region.
- **Accretion:** Estimates of future accretion rates are not included in the projections of future relative sea level rise. The Amite River Project identified a range of 5 mm/year to 25 mm/year of accretion, with an intermediate estimate of 12 mm/year. Over a 50-year period, this range translates into 3.28 feet of uncertainty with respect to accretion alone. The intermediate rate of 12 mm/year translates into 1.97 feet over 50 years, which would roughly offset the relative sea level rise of 1.90 feet (eustatic sea level rise plus subsidence).
- **Combined Effects:** Using ranges applied to the Blind River project and also developed for the Amite River project, the cumulative 50-year effects of uncertainty with respect to eustatic sea level rise, subsidence, and accretion are as follows, using combinations of extreme values:
  - **Highest Estimated Relative Sea Level Rise:**

    Maximum Eustatic Rise + Maximum Subsidence – Minimum Accretion

    2.00 ft + 3.28 ft – 0.82 ft = **4.46 feet**
  - **Lowest Estimated Relative Sea Level Rise:**

    Minimum Eustatic Rise + Minimum Subsidence – Maximum Accretion

    0.28 ft + 0.66 ft – 4.1 ft = **-3.16 feet**

The total range, then, of cumulative effects of land and sea changes is approximately 7.62 feet, which represents a large range of potential future conditions, especially considering that the range spans almost equally in opposing directions. Relative sea rise conditions that result in a relative sea level reduction will not pose risk to the project, while increases in relative sea level could impact project performance. The use of intermediate values for all factors produces an estimated relative sea level rise is -0.07 feet, representing a condition in which accretion effectively offsets the combined effects of subsidence and eustatic sea level rise.

Using intermediate values from available regional estimates of each contributing factor (eustatic sea level rise, subsidence, and accretion) suggest that relative sea level rise over 50 years will not produce the adverse hydrologic impacts to project performance that were analyzed. Analysis results developed for Alternative 2 are presented in this report and utilized relative sea level rise for three projections; low, medium and high.

Hydraulic modeling was not completed with explicit representation of accretion and sedimentation (in order to offer conservative "worst case" estimates). The relative rise has been applied in the modeling analysis at the downstream boundary condition, specifically the water level in Lake Maurepas, and the primary impact it has on model results is increased backflow of Lake water into the swamp, and a greater need for diverted water in future years to overcome the backflow.

However, it is conceivable that the water levels in the Mississippi River (upstream boundary condition and flow input for this project) could also be affected by combined effects of eustatic sea level rise and changes in sediment load. This is important because the flow rating curves developed for the gravity-based diversion structure are based on the differential head across the system, not just on the water level in the Mississippi River. If downstream water level rises in Lake Maurepas but Mississippi River water levels are largely unchanged, the physical ability to divert water could be diminished.

Specific forecasts of future water elevation trends in the Mississippi River near the study area are not readily available, so the analysis presented herein should be evaluated with the following considerations:

- If the Mississippi River water level does not change appreciably in the future, total diversion capacity could be diminished based on the assumptions guiding the application of sea level rise estimates to Lake Maurepas (less differential head across the system, and correspondingly lower diversion flows). As stated elsewhere, if intermediate projections for all contributing factors to relative sea level rise are applied together, the net effect could be almost negligible (counterbalancing effects). Hence, while there is the potential that rising relative sea level coupled with stationary river level could reduce diversion throughput, there is some uncertainty with these projections.

- If the Mississippi river water level rises in future decades, it should improve the ability to divert water to the Blind River system when compared to stationary water level in the river.

It is uncertain which of these scenarios is more likely to occur, and to what degree. Therefore, the project team has evaluated the effects of the different phenomena in sensitivity analyses. The worst case for diversion project performance would be higher levels in Lake Maurepas that do not appreciably affect the Mississippi River. This case would effectively reduce the gravity head gradient from the diversion to the Maurepas Swamp system and increase the need for more diverted flow to provide equal swamp restoration and flushing benefits.

The following two factors were used in deciding how to estimate the design level upstream boundary conditions in future decades:

- Intermediate (medium) projections of relative sea level rise, accounting for eustatic changes, subsidence, and accretion, suggest that the relative rise could be practically negligible.
- If relative sea level does change appreciably, it might be inferred that backwater elevations in the Mississippi River could also increase, if not in direct proportion, somewhat commensurately.

Significant uncertainty in each contributing factor provides the possibility for relative sea rise conditions that could affect the performance of the project. The sea level rise scenarios that were evaluated are considered to be conservative, since they account for eustatic rise and subsidence, but not for accretion. Uncertainty associated with relative sea level rise can be reduced with the collection and incorporation of additional information during subsequent project phases to better define local subsidence and probable accretion rates. In addition, adaptive management strategies should continue to be incorporated into the planned project in order to minimize potential impacts of relative sea and land elevations in the future. As additional information becomes available consideration of future conditions will continue to be refined during project design and to facilitate adaptive management after construction.

In the analyses performed, the use of intermediate values for eustatic sea level rise, subsidence, and accretion produces an estimated relative sea level rise representing a condition in which accretion effectively offsets the combined effects of subsidence and eustatic sea level rise. This suggests that that relative sea level rise will not produce adverse hydrologic impacts in project performance.

Human modifications to hydraulics and hydrology can substantially influence relative sea level (White and Tremlay, 1995; Fielding et al. 1998; Morton et al. 2002; Turner, 2004 Morton et al. 2005; Gonzáles and Törnqvist, 2006). An important anthropogenic contributor to RSLR is the drainage of wetlands for agriculture, flood protection, and development (Turner, 2004). Forced drainage lowers the groundwater table, which accelerates the compaction and oxidation of organic material. Recent studies have suggested that subsurface fluid withdrawals (e.g., oil and gas extraction) also promote RSLR, but the magnitude of its contribution is not well understood (Fielding et al. 1998; Morton et al., 2002; Morton et al., 2005). Within the study area, the elimination of freshwater, sediment, and nutrient inputs from the Mississippi River have significantly contributed to RSLR by decreasing accretion rates (primary productivity and sediment input) and soil strength (Shaffer et al. 2003). An increased duration and depth of flooding further decreases primary productivity and accelerates the rate of RSLR. With sediment inputs and organic accumulation from high primary productivity, coastal wetlands can maintain their surface elevation despite sea level rise (Baumann et al. 1984; Delaune et al. 2004).

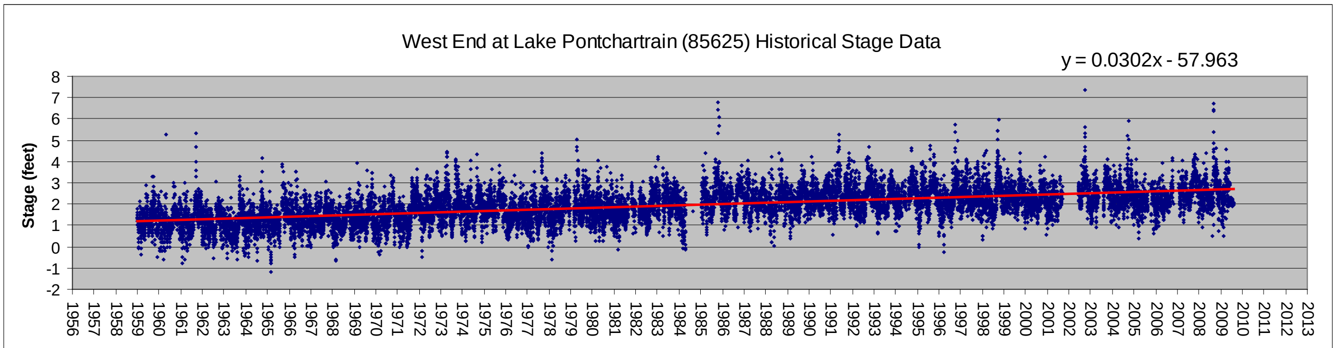

Figure 4-2: Historical stage data and trend analysis for West End at Lake Pontchartrain gauge.

4.2 Significant Resources

4.2.1 Soils and Waterbottoms

4.2.1.1 Soils

Soil resources are institutionally significant under the following statutes and memoranda: the Council on Environmental Quality (CEQ) memorandum of August 11, 1980, entitled "Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act (NEPA)"; Executive Order 11990 – Protection of Wetlands; and Agriculture and Food Act of 1981 (Public Law 97-98), which includes the Farmland Protection Policy Act (Public Law 97-98; U.S.C. 4201 *et seq*.). This resource is technically significant because it is a critical element of coastal habitats and supports vegetative growth and open-water benthic productivity. This resource is publicly significant because of the high value the public places on agricultural production, wildlife and fisheries supported by the soils in the area.

Historic Conditions

Within coastal areas, soils construct a critical abiotic component of ecosystems, affecting biogeochemical processes, species composition, productivity, and other factors essential to ecosystem integrity and functioning (Brady and Weil, 2002; Anderson and Lockaby, 2007). Pedogenesis, the development of soil, is dependent on the interaction of soil forming factors: the five factors include parent material, climate, topography or landscape position, biological factors, and time (Jenny 1994). Existing soil types in the study area are associated with depositional events from historic deltaic processes (USACE, 2009). From 1932 to 1990, the Coast 2050 reports the loss of approximately 1,600 acres of soil resources through shoreline erosion and direct removal in the Amite / Blind River Mapping Unit (LCWCRTF and WCRA, 1999).

Existing Conditions

Soil resources within the Study Area include both hydric and non-hydric soils (NRCS, 2007). Hydric soils are characteristic of wetlands, and as such are predominant. The accumulation of organic material in the surficial soil horizon is evident across most of the Study Area due to slow decomposition under anaerobic, water saturated conditions. Shaffer et al. (2003) noted atypically low soil bulk densities for Maurepas Swamp (0.05-0.15 g/cm3), that are more typical of fresh and intermediate marshes (e.g., Hatton, 1981). Interstitial soil pH was slightly acidic, typical of organic soils with low bulk densities, and higher bulk densities were found in areas receiving agricultural and other runoff (Shaffer et al. 2003). Low bulk densities and high organic matter content likely result from insufficient sediment input since the leveeing of the Mississippi River.

According to the Natural Resources Conservation Service (NRCS), most of the Study Area consists of mucky clay / muck of the Barbary association soil series. Adjacent pedons that extend into the distribution area from the landward periphery include the Mhoon silty clay loam, the Schriever clay, and the Schriever association frequently flooded soil series, in decreasing order respectively.

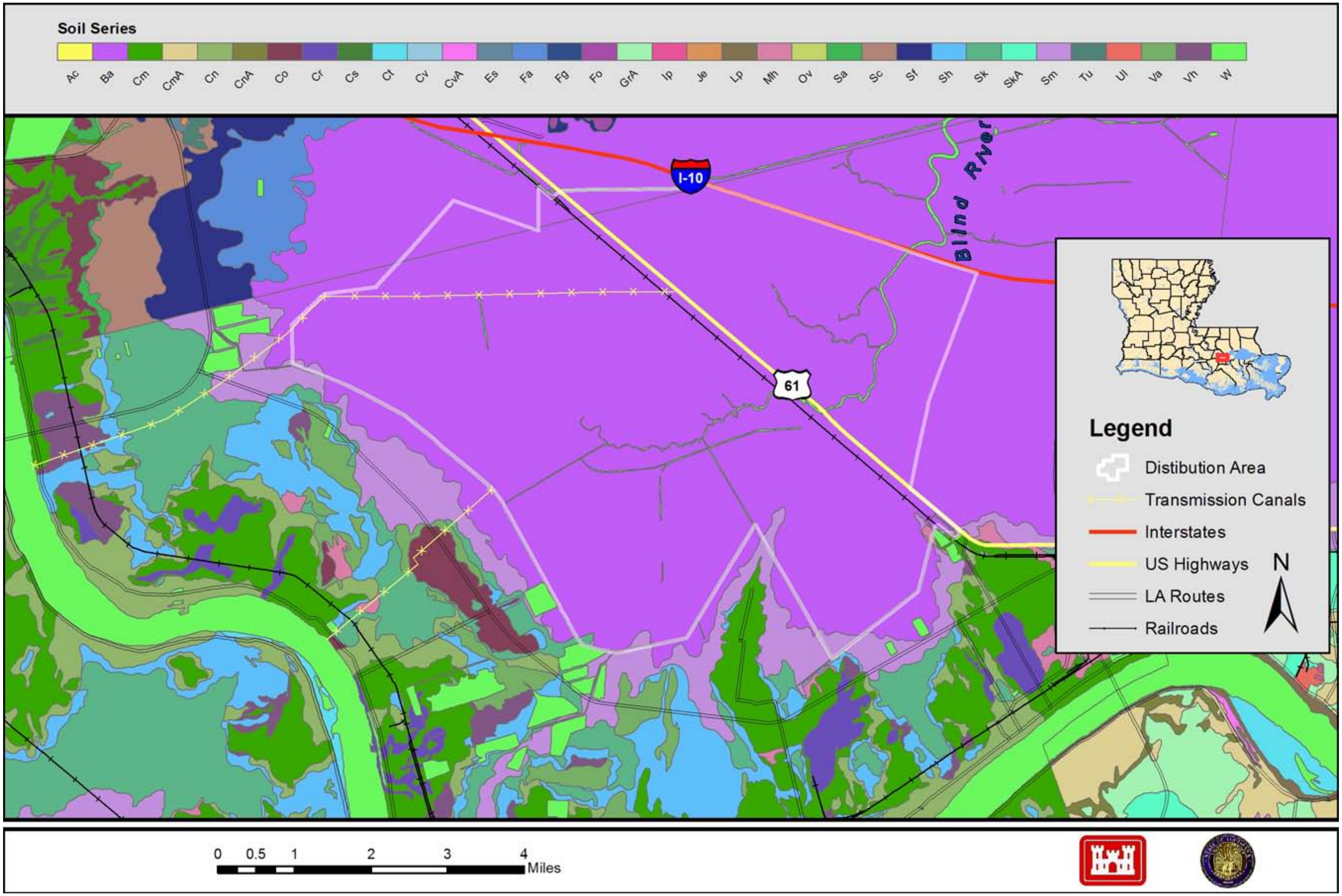

Figure 4-3: Map of soil series within the study area (USGS, 2007).

Table 4-1: Soil series characteristics within the project distribution area as described by the NRCS (2007).

BLIND RIVER STUDY AREA SOIL RESOURCES

Parameter		Barbary association (Ba)		Mhoon silty clay loam (Mh)		Schriever clay (Sk)		Schriever association frequently flooded (Sm)		Cancienne silt loam (Cm)			Cancienne silty clay loam (Cn)			Carville fine sandy loam, sandy variant (Co)	Schriever silty clay loam (Sh)		Vacherie fine sandy loam, sandy variant (Va)		Vacherie silt loam (Vh)	
Area	Outfall	22,057.7 (97.85%)		14.1 ac (0.06 %)		12.7 ac (0.06 %)		181.2 ac (0.80 %)		0.5 ac (<0.01 %)			--			--	--		--		--	
	T1	22.7 ac (15.65 %)		7.7 ac (5.32 %)		32.1 ac (22.16 %)		8.7 ac (6.00 %)		5.5 ac (3.81 %)			7.3 ac (5.06 %)			33.3 ac (23.02 %)	10.7 ac (7.37 %)		10.3 ac (7.13 %)		--	
	T2	14.5 ac (7.80 %)		--		62.8 ac (33.67 %)		48.4 ac (25.97 %)		10.0 ac (5.34 %)			--			--	17.5 ac (9.36 %)		--		31.4 ac (16.83 %)	
Depth (in)		0-10	10-80	0-14	14-60	0-6	6-60	0-6	6-60	0-12	12-52	52-80	0-12	12-52	52-80	0-60	0-6	6-54	0-27	27-60	0-20	20-60
Sand		1-3 %	1-3 %	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Silt		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Clay		--	60-95	27-45	14-39	40-60	60-90	40-60	60-90	14-27	14-39	14-41	27-39	14-39	14-41	0-18	27-35	60-90	4-17	40-65	10-18	40-65
Organic Matter		30-70 %	2.0-2.5 %	0.5-2.0 %	0.0-0.5 %	0.5-4.0 %	0.0-0.5 %	0.5-4.0 %	0.0-0.5 %	0.5-4.0	0.5-1.0	0.5-1.0	0.5-4.0	0.5-1.0	0.5-1.0	0.5-3.0	0.5-4.0	0.0-0.5	0.5-2.0	0.0-0.5	0.5-2.0	0.0-0.5
Texture		Mucky clay, muck	Clay, mucky clay	Silty clay loam	Clay loam, silty clay loam, silt loam	Clay	Clay	Clay	Clay	Silt loam	Loam, silty clay loam, silt loam	Stratified very fine sandy loam to silty clay	Silty clay loam	Loam, silty clay loam, silt loam	Stratified very fine sandy loam to silty clay	Fine sandy loam	Silty clay loam	Clay	Fine sandy loam	Clay, silty clay	Silt loam	Clay, silty clay
Shrink / Swell Potential		low		moderate		very high		very high		moderate			moderate			low	very high		very high		very high	
Water Regime	Drainage	very poor		poor		poor		poor		somewhat poor			somewhat poor			somewhat poor	poor		somewhat poor		somewhat poor	
	Flooded	frequently		no		rarely		frequently		no			no			no	rarely		no		no	
	Ponded	frequently		no		no		no		no			no			no	no		no		no	
	Hydric Soil	yes		yes		yes		yes		no			no			no	yes		no		no	
Slope		0-1 %		0-1 %		0-1 %		0-1 %		0-1 %			0-1 %			0-1 %	0-1 %		0-3 %		0-1 %	
Landform		swamps		Flood plains		Backswamps		Backswamps		Natural levees			Natural levees			Natural levees	Backswamps		Natural levees		Natural levees	
Taxonomy		Very-fine, smectitic, nonacid,hyperthermi-c Typic Hydraquents		Fine-silty, mixed, superactive, nonacid, thermic Fluvaquentic Endoaquepts		Very-fine, smectitic, hyperthermic Chromic Epiaquerts		Very-fine, smectitic, hyperthermic Chromic Epiaquerts		Fine-silty, mixed, superactive, nonacid, hyperthermic Fluvaquentic Epiaquepts			Fine-silty, mixed, superactive, nonacid, hyperthermic Fluvaquentic Epiaquepts			Coarse-silty, mixed, superactive, calcareous, hyperthermic Fluventic Endoaquepts	Very-fine, smectitic, hyperthermic Chromic Epiaquerts		Coarse-stily over clayey, mixed over smectitic, superactive, nonacid, hyperthermic Aeric Fluvaquents		Coarse-silty over clayey, mixed over smectitic, superactive, nonacid, hyperthermic Aeric Fluvaquents	

T1 - Romeville Transmission Pathway, T - 2 Sunshine bridge transmission pathway. Source: Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/ accessed [04/16/2009].

Prime and Unique Farmlands
In an effort to identify the extent and location of important farmlands, the NRCS, in cooperation with other interested Federal, state, and local government organizations, has inventoried land that can be used for the production of the Nation's food supply. The Farmland Protection Policy Act (1981) establishes regulatory protection for prime and unique farmlands and those of statewide or local importance so as to "minimize the impact Federal programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses."

Prime farmland is defined as "land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion" (7 U.S.C. 4201(c)(1)(A)). Farmland areas not deemed "prime" but recognized as "unique" are also provided federal regulatory protection. Unique farmlands include "land other than prime farmland that is used for production of specific high-value food and fiber crops . . . [and which is capable of] sustained high quality or high yields of specific crops . . . [under] acceptable farming methods" (7 U.S.C. 4201(c)(1)(B)). Authority is also provided for the protection of "farmland, other than prime or unique farmland, that is of statewide or local importance as determined by the appropriate State or unit of local government agency or agencies, and that the Secretary determines" (7 U.S.C. 4201(c)(1)(C).

Of the soil resources within the study area, the NRCS (2007) lists several series as "Prime and Other Important Farmlands": Cancienne silt loam, Cancienne silty clay loam, Carville fine sandy loam, sandy variant, Mhoon silty clay loam, Schriever silty clay loam, Schriever clay, Vacherie fine sandy loam, sandy variant, and Vacherie silt loam. Hydrologic conditions and regulatory statutes may prevent some of these areas from functioning to this capacity. Review of affected soil resources is being conducted through coordination with NRCS input regarding Prime and Unique Farmlands.

4.2.1.2 Water Bottoms
These resources are institutionally significant because of the national Environmental Policy Act of 1969; the Coastal Zone Management Act; and the Estuary Protection Act. Louisiana Revised Statute 41:1701 defines state water bottoms as "[t]he beds and bottoms of all navigable waters and the banks or shores of bays, arms of the sea, the Gulf of Mexico, and navigable lakes" and establishes the management and protection of the resources. These resources are technically significant because 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.

Historic Conditions
Detrital pathways are important to biotic cycling of organic matter in deepwater swamps (Mitsch and Gosselink, 2000). Depending on the extent of anaerobic

conditions of the water bottom, cycling and decomposition of organic matter can be impeded. In swamps adjacent to lakes and rivers, the export of organic matter can be significant (Mitsch and Gosselink, 2000) compared to swamps with low flow through conditions. These anaerobic conditions can lead to net losses of nitrogen due to denitrification. Sediments and water bottoms can be a sink for phosphorus. When mobilization of sediments from water bottoms is low, net export of phosphorus from swamps is generally low (Mitsch and Gosselink, 2000). Historically, the water bottoms in the study area provided an outwelling of organic matter (Odum, 1980) and a sink for phosphorus and nitrogen that supported the health of downstream ecosystems in Lake Maurepas and Blind River (e.g., Richardson, 1985; Lane et al. 2003). Cessation of near annual Mississippi flood events into the distribution area limited the capacity of these functions and the fulfillment of these services.

Existing Conditions

Water bottoms in the study area include the Blind River, parish canals, and open water areas. Lake Maurepas, the Mississippi River, and the Blind River are designated as a state water bottoms. Because of the stagnant conditions, the loss of sediment inputs reduced primary productivity, and limited consolidation, net phosphorus and organic matter export from the swamp is likely low. Therefore, support for dependent systems downstream (e.g., Lake Maurepas) is likely limited and substantially reduced from historic levels.

4.2.2 Hydrology

This resource is institutionally significant because of the National Environmental Policy Act of 1969; Clean Water Act; 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.

The study area is situated within the Lake Pontchartrain Basin, a 9,700-square-mile (25,122-square-km) area encompassing sixteen parishes that is among the largest estuarine ecosystems on the Gulf coast and in the United States. The Pontchartrain Basin contains three major estuarine lakes—Maurepas, Pontchartrain, and Borgne—that cover a total of 965 square miles (2,500 km^2) and lie within a five-parish region. Water drains into rivers and bayous throughout the basin, making its way to the Gulf of Mexico via a series of large open water bays. These bays and associated lakes comprise a large, shallow estuary where freshwater from rivers and bayous mixes with the salty waters of the Gulf. This expanse of open water is fringed by swamps and marshes. In addition to the ecosystem and habitat value provided by the lakes, swamps, and marshes, the Pontchartrain Basin provides a major recreational and commercial resource for the people of Louisiana.

4.2.2.1 Flow and Water Levels

Lower Mississippi River

Historic Conditions

Over geologic history, the course of the Mississippi River has changed several times through the delta-switching process. Formation of a new delta lobe occurred roughly once every 1,000 years in response to changes in the flow path of the Mississippi River into the Gulf over the past 5,000-6,000 years; the modern delta consequently consists of smaller delta complexes formed over the past 8,000 years (Fisk 1944; Frazier 1967; Penland and Boyd, 1985; Autin et al., 1991, Saucier 1994). Major distributaries over this period have included Bayous Lafourche, Terrebonne, Des Families, Barataria, and to a lesser extent, the Atchafalaya River (USACE 2000).

Historically, the Lower Mississippi River was prone to frequent spring floods that caused catastrophic damage and loss of life post-settlement (Davis 1993, USACE 2009). Federal flood control and navigation measures that began in earnest with the authorization of the Mississippi River and Tributaries Project by the Flood Control Act of 1928 have since regulated the river's stage and flow and mitigated damage (USACE 2009). Further description of these measures is provided in **Section 4.2.15.12, Flood Control and Hurricane Protection**. These actions have channelized the Lower Mississippi River and prevented the abandonment of the current flow path. Operation of the Old River Control Structure (ORCS) has strictly regulated Mississippi River flows since 1977 to prevent capture by the Atchafalaya River: thirty-percent of flows are allocated to the Atchafalaya and seventy-percent to the Mississippi River (USACE 2009).

Discharge rates for the Lower Mississippi River have been measured by the USACE at an approximate frequency of two times per week below the ORCS at Tarbert Landing, Mississippi, and are presented for January 1, 1978, through December 31, 2008, in **Figure 4-4**. **Figure 4-5** and **Figure 4-6** display annual and monthly discharge trends over this time period.

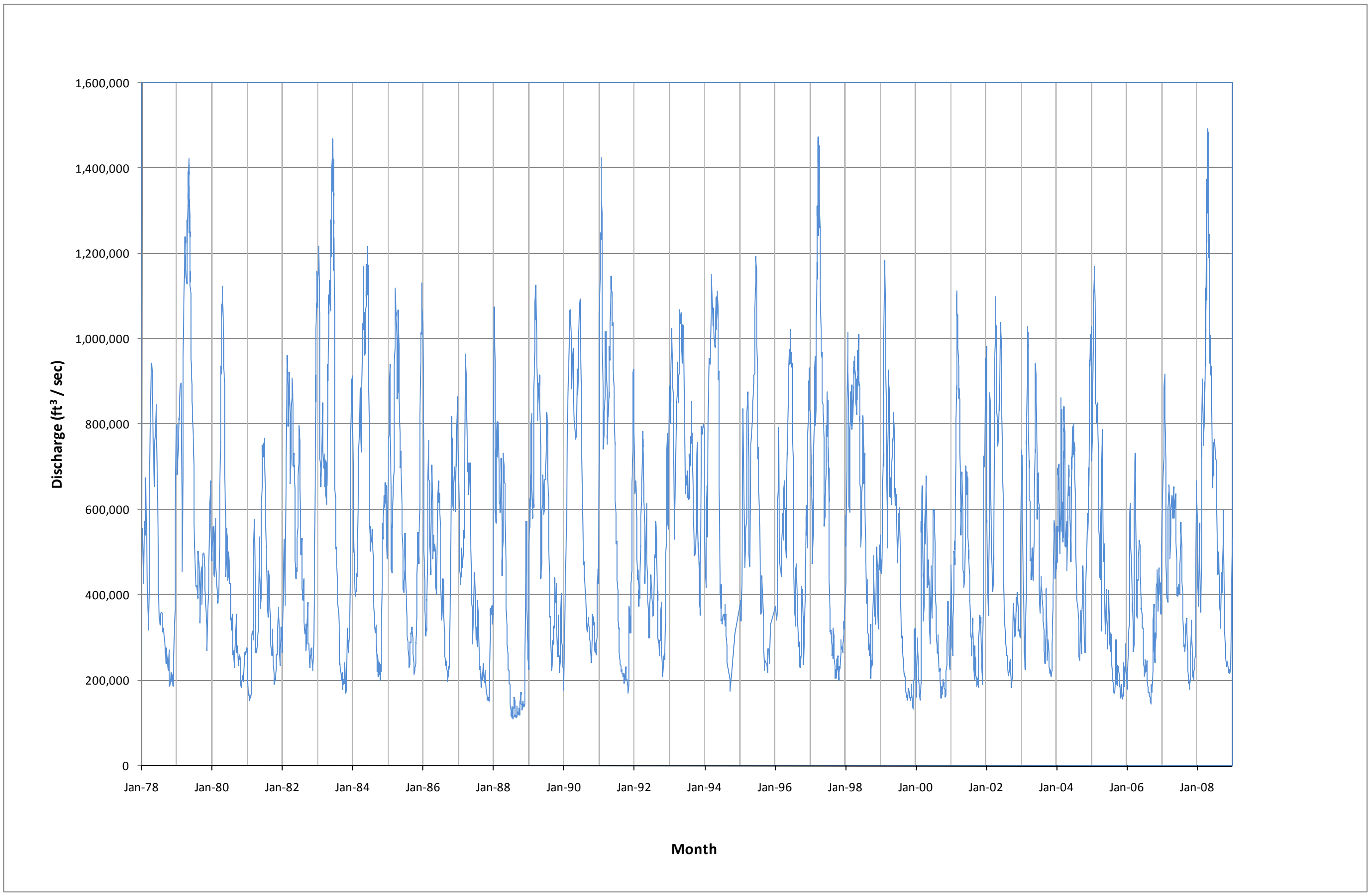

Figure 4-4: Lower Mississippi River discharge ($ft^3\ sec^{-1}$) at Tarbert Landing, MS, from January 1, 1978, to December 31, 2008 (USACE 2009).

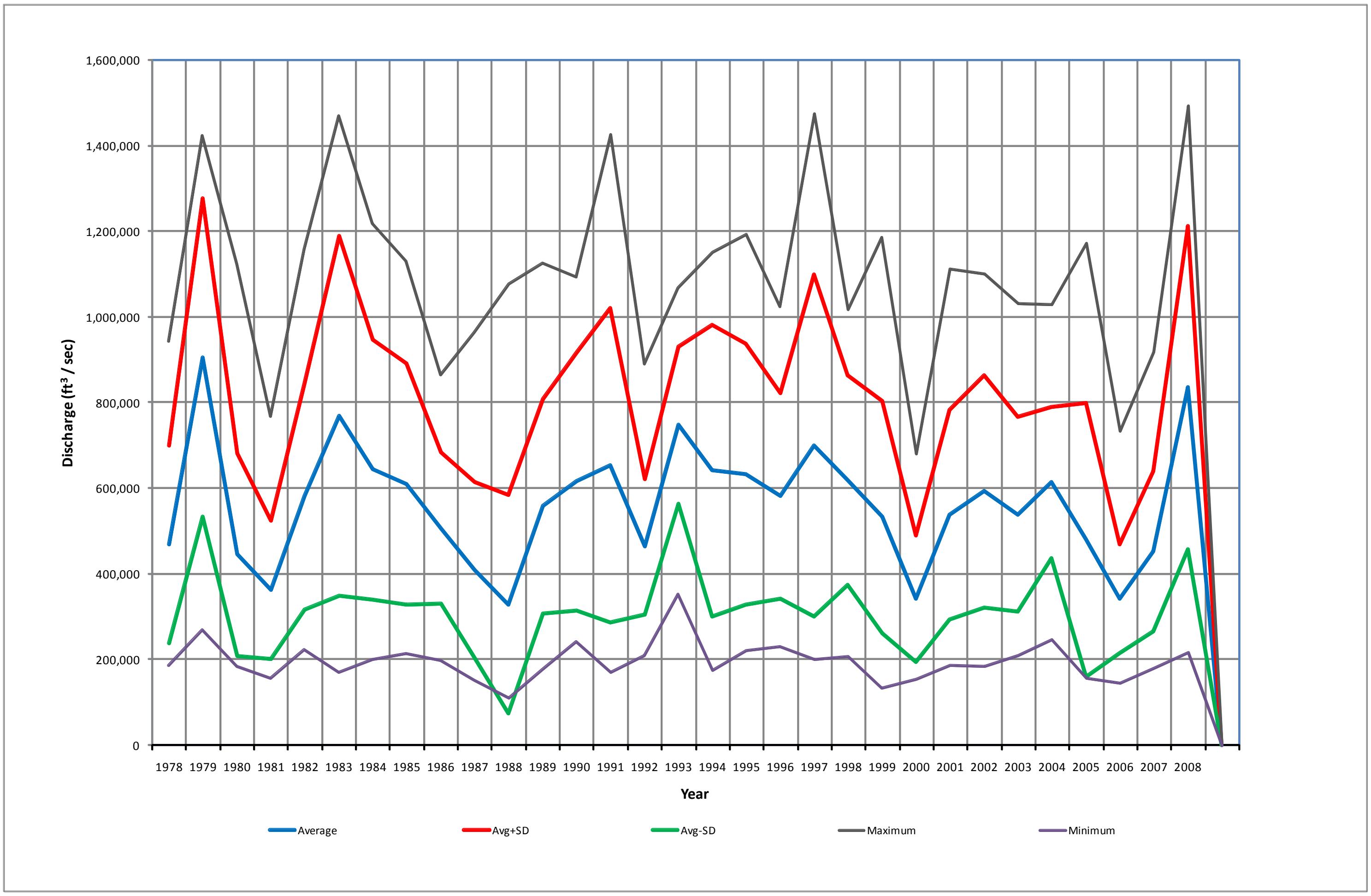

Figure 4-5: Lower Mississippi River discharge (ft3 sec-1) annual trends at Tarbert Landing, MS, from January 1, 1978, to December 31, 2008 (USACE 2009).

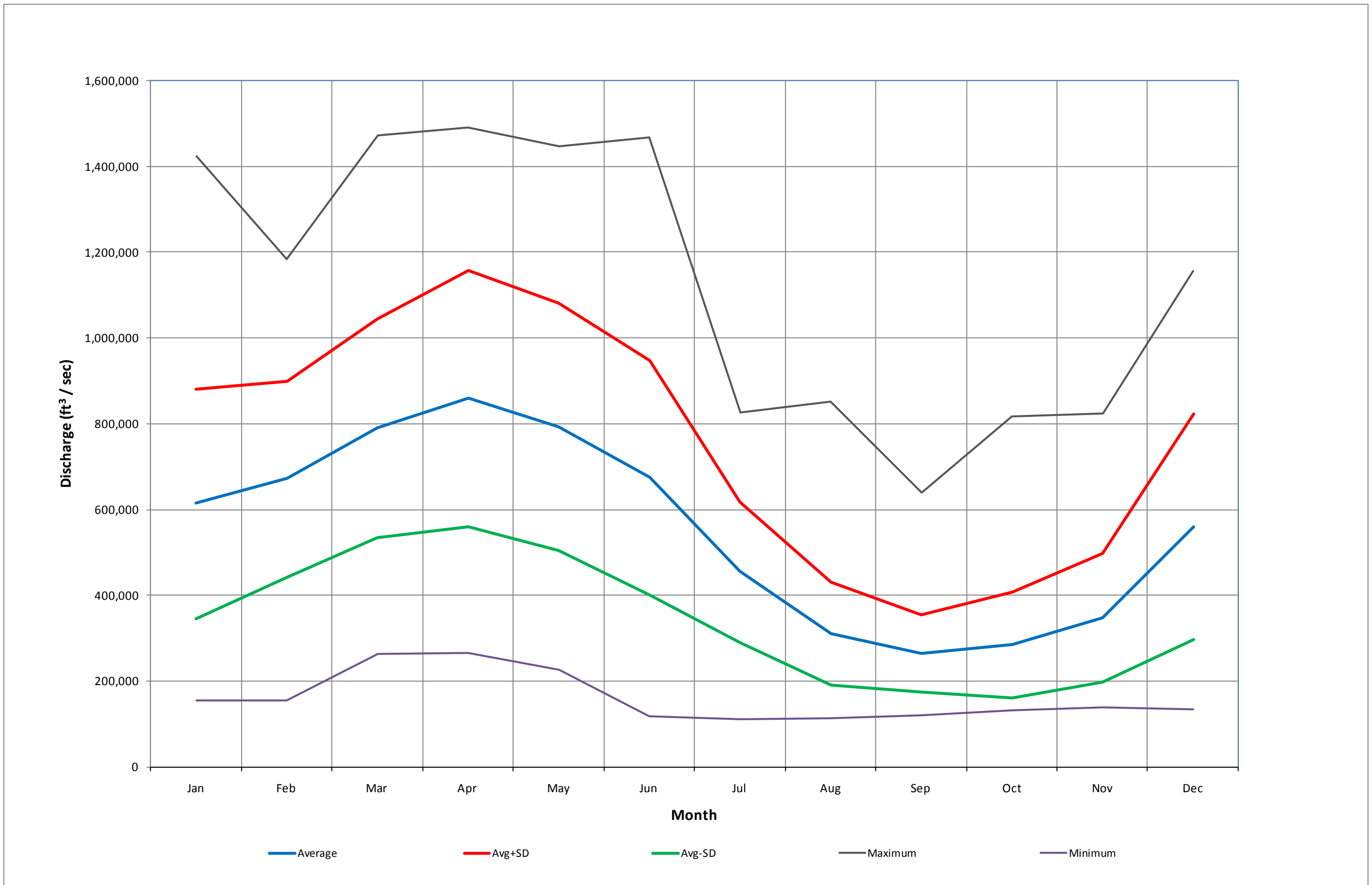

Figure 4-6: Lower Mississippi River discharge (ft3 sec-1) monthly trends at Tarbert Landing, MS, from January 1, 1978 to December 31, 2008 (USACE, 2009).

Stage, or river water level, data was developed for the Mississippi River at the proposed Romeville diversion location over the same time period by linear interpolation from two sets of existing gauge data from above and below this location: the College Point Landing Gauge (Gauge # 01240) and the Donaldsonville Gauge (Gauge # 01220) (USACE, 2009). **Figure 4-7** depicts daily average stage for the Lower Mississippi River at Romeville from January 1, 1978 to December 31, 2008.

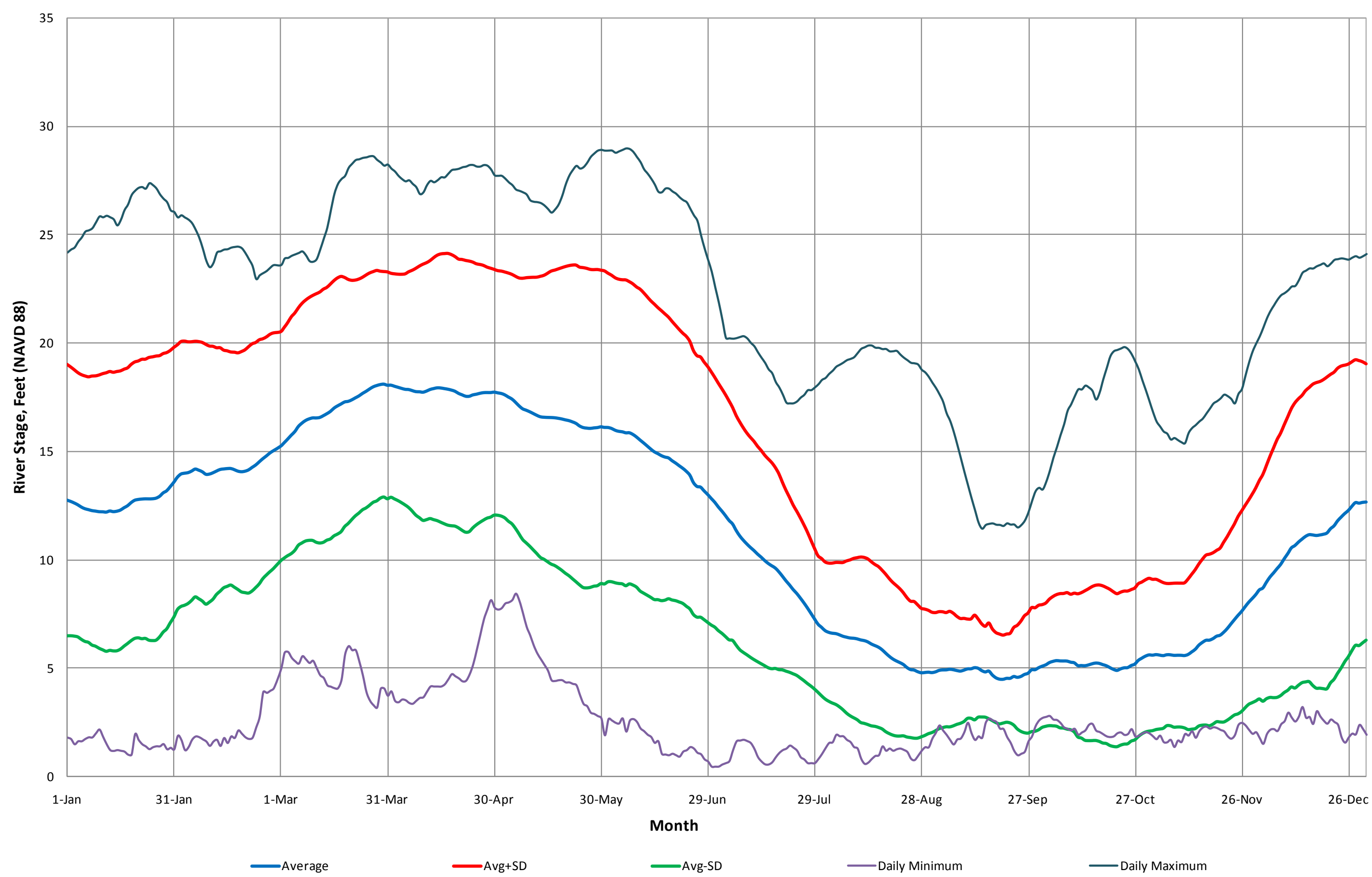

Figure 4-7: Lower Mississippi River daily stage (feet NAVD 88) trends at Romeville, LA, from January 1, 1978 to December 31, 2008 (USACE, 2009).

Existing Conditions

Flood control measures and flow management have resulted in relatively consistent flows and water levels in the Lower Mississippi River from 1978 to present in the Study Area. The flow and water level of the Lower Mississippi River are directly related and exhibit a seasonal pattern that is presumably linked to snowmelt runoff and spring rains. High flows and water levels are characteristic of spring months (March 1–May 31), while low flows and low water levels are typical from mid-summer to mid-fall (August 16 – November 15).

Based on data from 1978 to 2008, the average annual, spring, and summer-fall stages of the river at Romeville are 11.32 $\pm$ 7.03, 17.13 $\pm$ 5.99, and 5.16 $\pm$ 3.07 ft NAVD88 (Mean $\pm$ SD), respectively. Over this period, the average annual, spring, and summer-fall discharge rates at Tarbert Landing are 566,123 $\pm$ 306,846, 813,333 $\pm$ 283,377, and 283,925 $\pm$ 113,984 cfs (Mean $\pm$ SD), respectively. Stage and flow are more variable in the spring than summer-fall months. Other factors influencing the stage and flow of the Lower Mississippi River in the Study Area are astronomical and meteorological tides, which have the greatest effect during periods of low stage and flow (USACE 2000). Astronomical tides have been observed as far upstream as the head of ship navigation in Baton Rouge, Louisiana. Strong south and southeasterly winds can cause rapid rise and northwesterly winds rapid decline in the river's stage (USACE, 2000).

Blind River and Maurepas Swamp

Historic Conditions

The study area is located in the Lake Maurepas Watershed of the Pontchartrain Basin. Historic surface flow within the basin was generally from west to east, towards Lake Pontchartrain. According to historic maps and records, hydrologic conditions of the study area were primarily influenced by the conveyance of surface runoff and precipitation as sheetflow across the forested wetlands and into the headwaters of Bayous des Acadiens—now known as Blind River. Bayous Conway and New River captured drainage from the west, conveying it eastward into Bayous des Acadiens as channel flow. To the north and northwest of the study area, hydrology was dominated by the Amite River, which flows into Lake Maurepas, and its distributaries, the Little Amite and Bayou Chene Blanc, which flowed southeast to their confluence with Bayous des Acadiens.

Prior to extensive human modification, overbank flow of the Mississippi River during spring floods and tidal inflow—through Pass Manchac, into Lake Maurepas, and southwest to the study area—significantly influenced the hydrologic conditions. Overbank flows from the Mississippi river brought nutrients, sediment, and freshwater that promoted productivity and sustained the health of the swamp ecosystem. As floodwaters receded, surface flows traveled eastward as sheetflow into existing channels and subsequently Lake Maurepas.

Some uncertainty surrounds the historic frequency of flooding events in the study area due to the natural variability of these events and limited historic record. Lopez (2003) estimated that flooding of the Mississippi River historically occurred once every 3.5 years in the Lake Pontchartrain Basin. Between 1799 and 1931, the frequency of major flood events for the Mississippi River was approximately every 2.8 years (Gagliano and van Beek, 1970), with twenty-three flood years recorded below Baton Rouge from 1849 to 1927 (Vogel 1930). Anecdotal accounts indicate that before the mechanization of cypress logging in the area (pre-1890), transportation of downed timber was often accomplished by floating logs out of the swamp when the water level typically peaked in June (Mancil 1972). This suggests that pre-levee spring flooding extended into the early summer.

Construction of artificial levees along the Mississippi River began in the Pontchartrain Basin in 1812 and by 1895 had completely severed the connection of the basin to the river during flood events (Davis, 2000; Lopez 2003). Additional flood control projects and developments have further disrupted the natural hydrology of the study area: these have included the Mississippi River and Tributaries Project (1928); the Amite River and Tributaries Project (1956); oil, gas, and utilities lines; active and abandoned railways; private and public roads; lateral drainage ditches; parish drainage canals and spoil banks; and other projects. Further discussion is provided in **Sections 4.2.16.4, 4.2.16.7, 4.2.16.11, and 4.2.16.12.**

Existing Conditions

Flows and water levels in the Study Area differ substantially from historic conditions due to isolation from Mississippi River floods in conjunction with further human modifications. Flow directions in general correspond to historic patterns for the Study Area and vicinity. However, drainage features have altered the rates at which runoff and tidal inflow enter and leave the Blind River, adjoining channels, and adjacent swamp. The hydrologic effect of these modifications is variable and dependent on location within the Study Area. Most of the contributing watersheds are hydrologically "flashy" as runoff to the Study Area occurs very quickly after rainfall events and very little precipitation is lost to evapotranspiration or groundwater seepage in the contributing watersheds (Day et al. 2004).

A wide range of climate conditions (including tropical depressions, storms and hurricanes) within the Study Area provides the potential for hydrologic conditions ranging from extreme flooding to extended drought. Since the construction of the Mississippi River flood control levees, Maurepas Swamp and Blind River have been virtually cut off from periodic overflows from the River that brought freshwater, sediment and nutrients to the swamp. With minimal soil building and moderately high subsidence rates, there has been a net lowering of ground surface elevation, so that now the swamps are persistently inundated.

Based on the strong correlation between lake and swamp water levels, the observed doubling of flood durations from 1955 to present at Pass Manchac (Thomson et al. 2002) coupled with lower swamp than lake elevations (Shaffer et al., unpubl. data) suggests that the duration of inundation within the Study Area has drastically increased over the last fifty years. A limited ability to drain and persistent flooding characterize the existing hydrology in the swamp, which conflicts with historic drying cycles. The facilities described above such as drainage canals and roads and other utilities disrupt natural flow and drainage patterns. Short circuiting of the natural drainage patterns has created ponding and stagnant waters in some areas. The contribution and circulation of nutrients and sediments is minimal and limited under existing conditions.

Extensive modeling of hydrologic flow patterns in southwest Maurepas Swamp for an area to the northeast including a portion of the Study Area was conducted in support of CWPPRA Project PO-29, *Mississippi River Reintroduction into Maurepas Swamp* (Day et al., 2004; URS, 2007). Analysis examined physical hydrodynamic and hydrologic characteristics and trends for several factors under various conditions. Factors included precipitation, stage ranges, velocity, flow, water budget, tidal propagation, channel over-banking, and swamp circulation in relation to physical features. The results of these and other related investigations (Lee Wilson & Associates et al. 2001; Mashriqui et al. 2002; Penland et al. 2002) reveal regional trends applicable to the hydrology of the Study Area, which include the following:

- Lake Maurepas stage exerts a significant influence (backflow) on water levels within Blind River and adjoining channels. When the swamp stage is less than the lake stage the potential for backflow exists.
- Propagation of astronomical tides decreases with distance from Lake Maurepas shoreline; is often absent from smaller channels and the swamp; and is overwhelmed by meteorological tides.
- Meteorological tides related to storm events and winds have a pronounced affect on stage and flows and exhibit seasonal and daily variability. Storms and prevailing winds from the southeast in the summer and early fall raise water levels in the swamp as they push Gulf water into the system. Continental fronts with prevailing winds from the northeast in the winter often lower swamp water levels as they push water out of the system towards the Gulf.
- Precipitation and runoff have small influences on the stage and flows of Blind River.
- Overbank flooding and flow through existing berm gaps from Blind River and adjoining channels into the swamp is dependent on river stage levels in relation to river bank and existing berm elevations.

CRMS stations have been established by the LADNR and USGS to monitor both the individual effectiveness of wetland restoration projects and the cumulative effects of all projects statewide. Site-specific parameters recorded relate to vegetation and hydrology and include salinity, water temperature, conductivity, and water level, among others. Two stations are located within the distribution area: one internal to the swamp (CRMS 65 along a north-south pipeline) and the other (CRMS 5167) along Conway Canal to the north of US Highway 61.

An apparent trend is greater fluctuation in hydroperiod and drawdown at higher elevations along canals relative to more stable water levels and extended inundation at interior swamp locations. The attenuation of storm surges both along canals and into the swamp is suggested by spikes in water levels caused by Hurricane Ike in September 2008.

Installation of piezometers throughout the interior swamp south of US Highway 61 is being completed as part of this study to supplement existing swamp water level data. A multi-directional flow gauge with water quality sensors that collects hourly data has also been installed on the Blind River near US Highway 61. Preliminary data depicts multi-directional flow patterns and suggests that flow direction under low flows may reverse at hourly intervals while flow direction may be sustained over several days during higher flow velocities. Long-term data over variable conditions will provide a better understanding of flow and water levels within the Study Area.

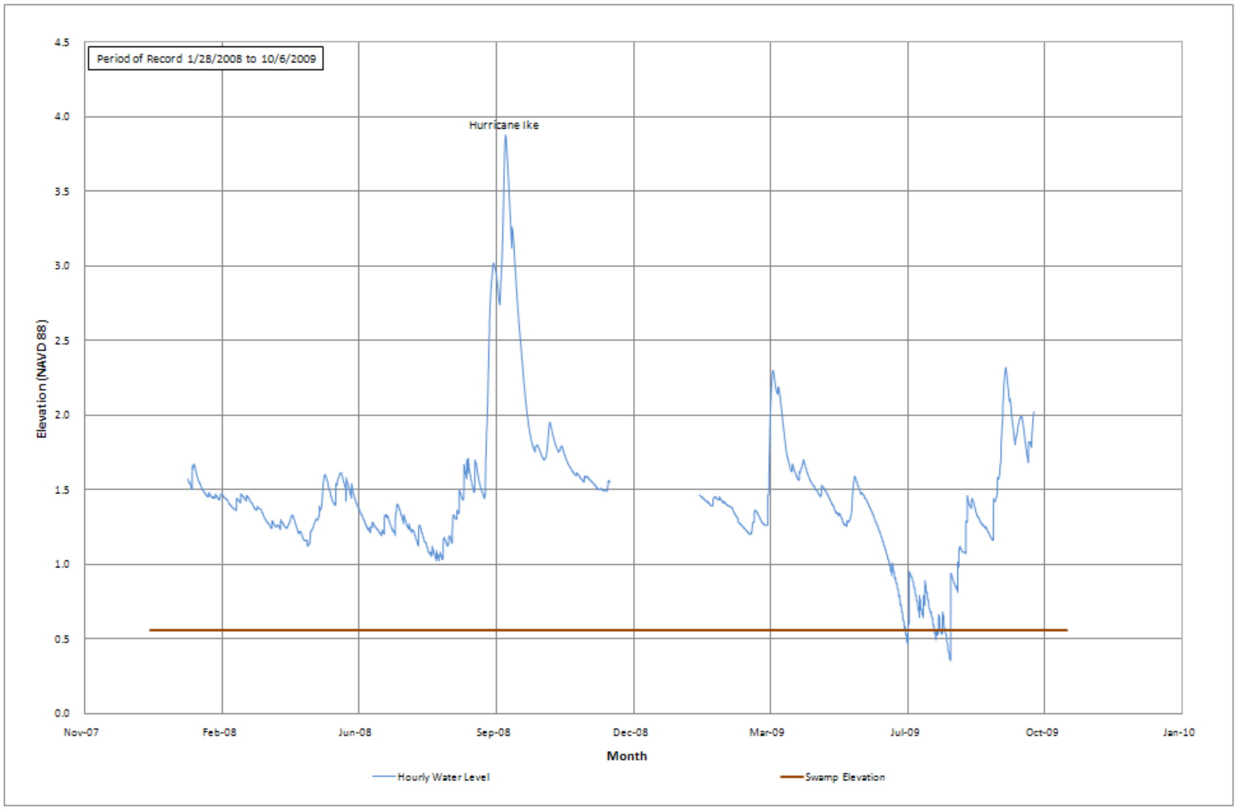

Figure 4-8: CRMS 65 hourly water level data in relation to swamp elevation (NAVD 88) from January 28, 2008, to October 6, 2009 (LA DNR, 2009).

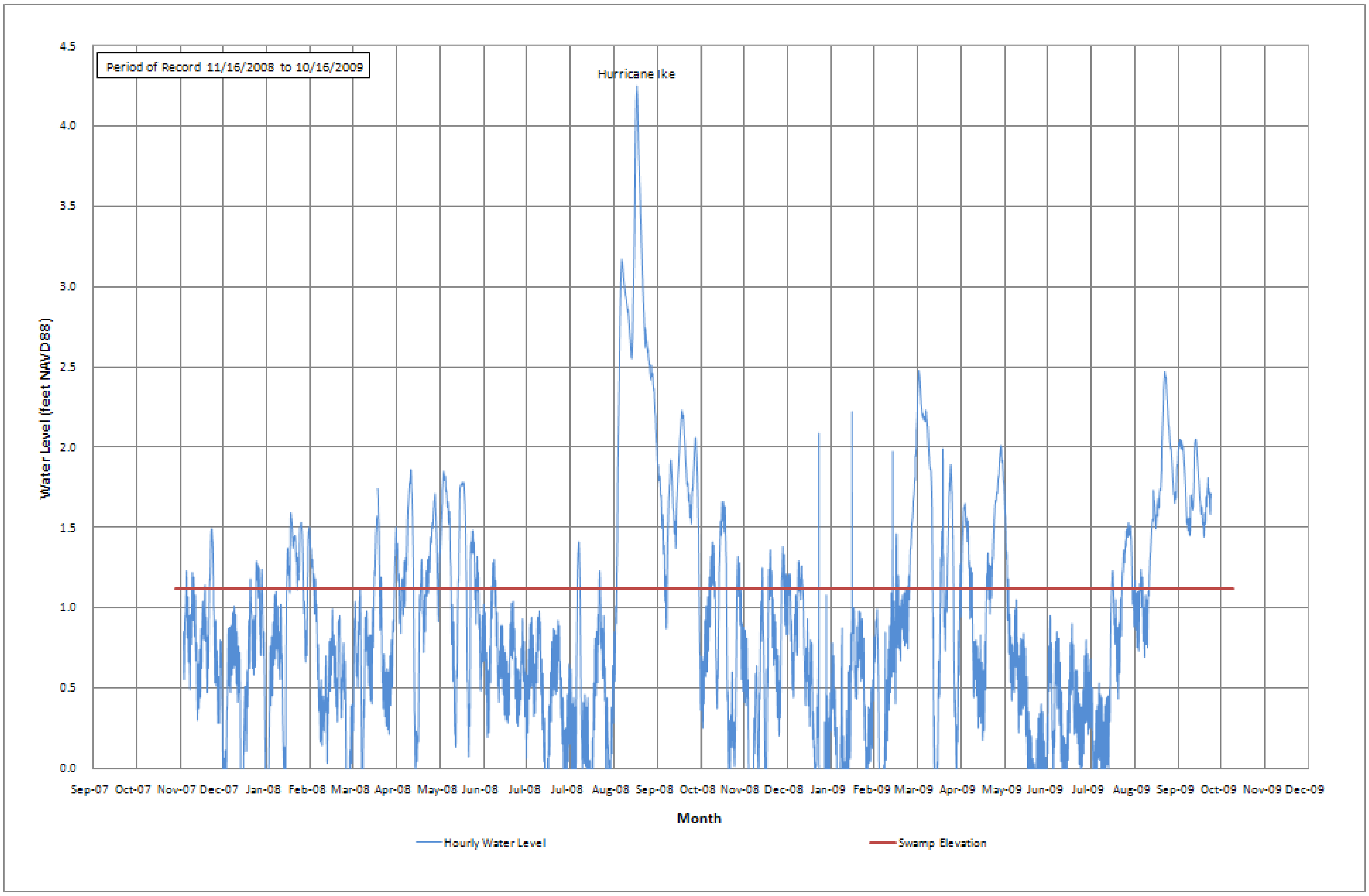

Figure 4-9: CRMS 5167 hourly water level data in relation to swamp elevation (NAVD 88) from November 16, 2008, to October 16, 2009 (LA DNR 2009).

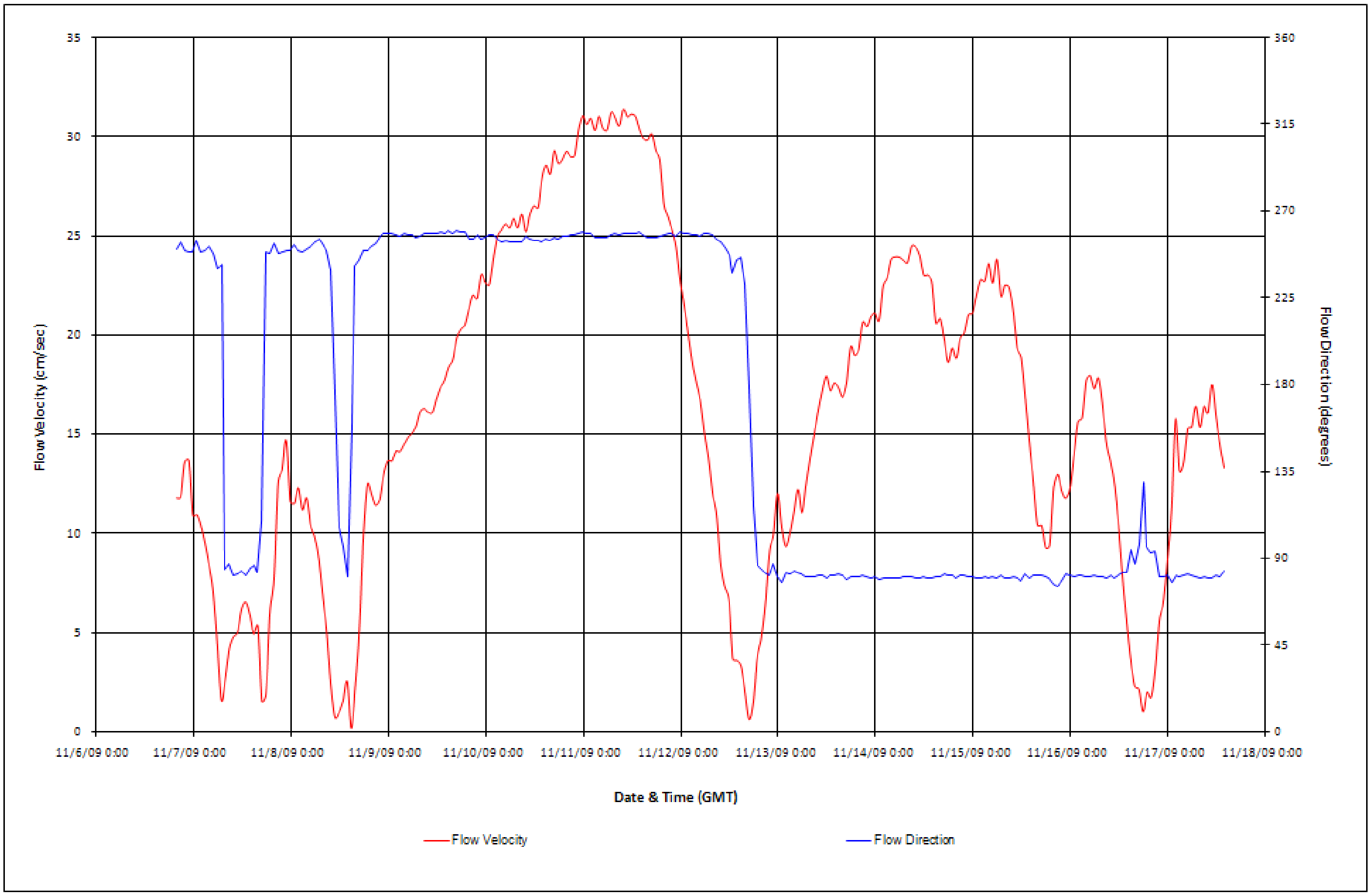

Figure 4-10: Blind River flow velocity and flow direction near U.S. Highway 61 measured hourly from November 6 to November 17, 2009.

Lake Maurepas

Historic Conditions

Limited information exists regarding the hydrology of Lake Maurepas prior to the separation of the Pontchartrain Basin from overbank flows of the Mississippi River and basin wide drainage modifications. Based on the physiography of the region, the dominant influence of elevation on flow, and an understanding of historic flow patterns and processes in comparable systems, predictable differences in the hydrology of Lake Maurepas can be reconstructed with high certainty. Overbank flows into the Pontchartrain Basin from the Mississippi River during spring flood events resulted in a significant increase of freshwater input into the system. These pulsed events would have reduced the influence of lake stages on hydrologic conditions in southwest Maurepas Swamp and contributed to the outwelling of organic material, the enhanced productivity and diversity of biotic resources, and the freshening of Lake Maurepas (Odum, 1980; Day et al. 1989).

Existing Conditions

Located to the northeast of the Study Area, Lake Maurepas is a 90 mi2 (233 km^2) shallow estuarine water body that receives tidal inflow from Lake Pontchartrain to the east and freshwater input from tributaries to the north, west, and southwest. Freshwater input occurs primarily during spring runoff through the Tickfaw and Blind Rivers and the Amite River Diversion Canal, having combined average flows less than 3,400 cfs (Lee Wilson & Associates, 2001). These rivers are prone to brief high-intensity flood events as a result of meteorological conditions that contribute the majority of freshwater and sediment that enters Lake Maurepas. Tidal flow passes between Lake Maurepas and Lake Pontchartrain through Pass Manchac and exhibits diurnal and seasonal fluctuation.

Because current water levels in the Study Area are primarily influenced by lake stages, a stage analysis for Lake Maurepas was performed as part of this study. The USACE maintains a gauge at Pass Manchac near Ponchatoula, LA (Gauge # 85420), that has daily stage data for a period of record from July 1955 to August 2005. Water levels at this location are representative of the stage in the east end of Lake Maurepas. Stage analysis was performed for a 30-year period (January 1, 1975 – December 31, 2004). Since this location is tidally influenced, the stage readings are for different parts of the tide, ranging from high to low tide. Tidal signatures make the determination of annual trends difficult and less pronounced. Subtle trends indicate that for a given year the stage for Lake Maurepas is bimodal: it generally rises in the spring, then falls during summer, rises in the fall, and again falls to low levels in the winter. Other analyses have detected a similar trend for the station (Keddy et al. 2007). Limited hourly stage data is available for part of 2009 (April 27, 2009 to the present). Based on this short term data, average tide heights are 0.4 $\pm$ 0.2 feet (0.1 $\pm$ 0.1 meters) (Mean $\pm$ SD).

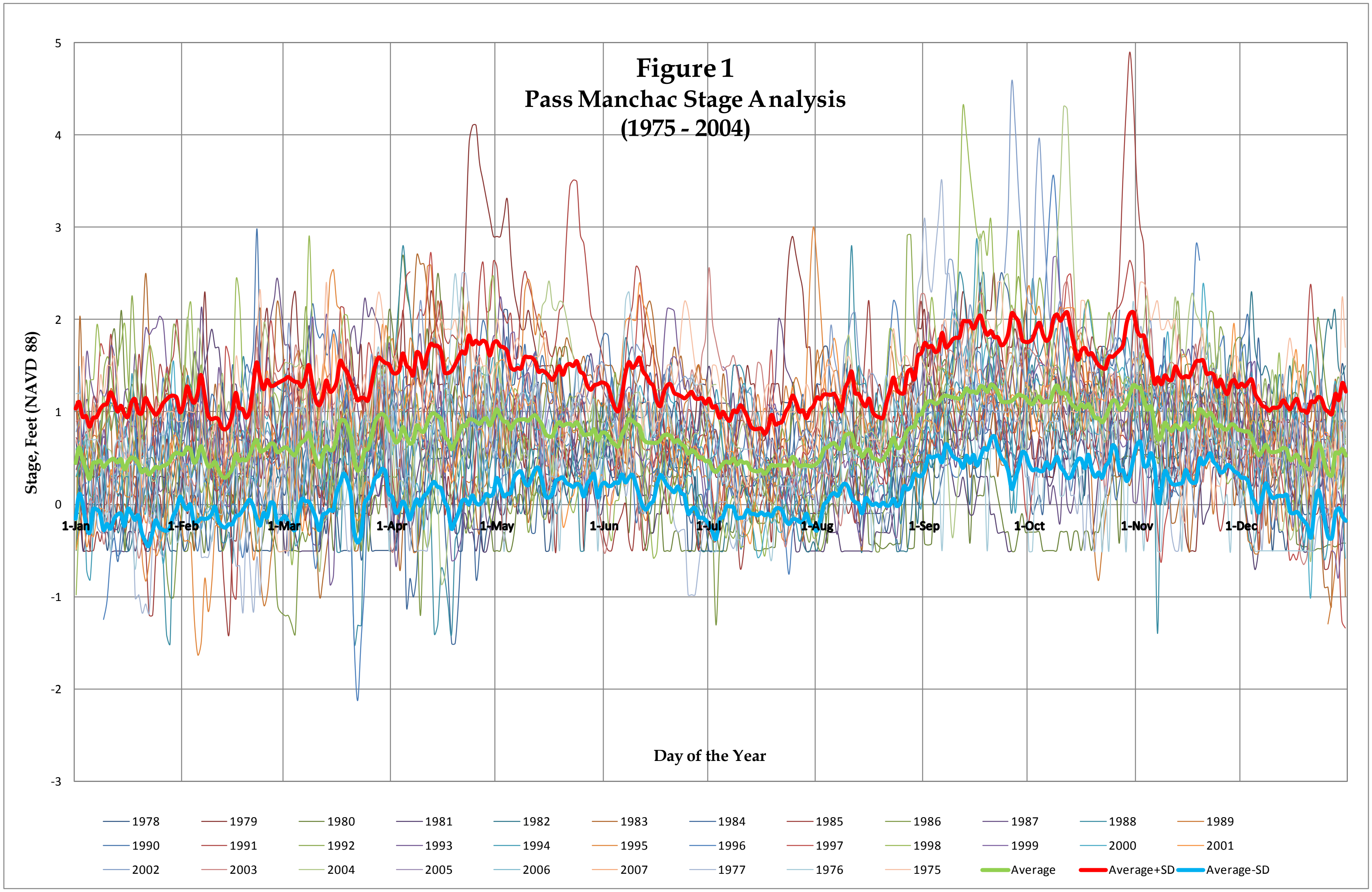

Figure 4-11: Pass Manchac daily stage analysis for 1974 to 2004.

4.2.2.2 Sedimentation and Erosion

Sediment quality is defined as the suitability of the habitat for supporting designated uses, including, but not limited to, benthic fauna and emergent wetland plants. Storm events, flowing water, and other factors can potentially re-mobilize sediments. Aquatic sediments are essential in maintaining the structure (assemblage of organisms) and function (processes) of aquatic ecosystems. Sediment quality is important due to the role that sediments play in supporting community productivity. The productivity of green plants, algae, and bacteria build on the foundation of food webs upon which higher aquatic organisms depend. Sediments provide important habitats for epibenthic (live on sediments) and infaunal (live in sediments) invertebrates and demersal fish, which represent important food sources for amphibians, reptiles, fish, birds, and mammals. In addition, many fish and amphibian species utilize sediments at different life cycle stages for the purposes of spawning, incubation, refuge, and over-wintering (LDEQ, 2005).

Lower Mississippi River

Historic Conditions

Extensive research and data exist on the historic and existing sediment dynamics of the Lower Mississippi River. Historically, the Lower Mississippi River transported extremely high sediment loads to the Gulf in association with deltaic processes. When it was a classical meandering alluvial river that was aggrading its channel throughout much of its length, the suspended sediment and bed loads of the Mississippi River have been estimated to have been as high as 270 x 106 m^3/hr (353 x 106 yd^3/hr) and 130 x 106 m^3/yr (170 x 106 yd^3/yr), respectively (Kesel et al. 1992). The Lower Mississippi River has experienced significant changes in sediment transport dynamics over its more recent history, with a general trend of decreased sediment transport from historic to present times. Kesel (1988) estimated a 43 percent reduction in sediment loading from historic (prior to 1900) to predam periods (1930-1952) and a 51 percent decline from predam to postdam periods (1963-1982). Increased land development along the Mississippi River during the 1800s would have contributed to higher sediment loading, and thus this period may provide an inappropriate reference time frame for long-term trend analysis (USACE 2000). Consequently, there is uncertainty as to how current sediment loads of the Lower Mississippi River compare to historic levels.

Existing Conditions

The USGS station at Tarbert Landing, Mississippi, maintains an extended record of sediment data for the Lower Mississippi River Period of record for daily measurements extends from 1975 to present. Sediment loading patterns suggest that daily-suspended sediment loads are above average from January through May and below average from August through November (USGS 1999, 2009). Based on water year 2002 through 2008, the average daily measured suspended sediment load at this location was 334,000 tons/day; the daily measured suspended sediment load varies from 39,000 to 119,000 tons/day (USGS 2009). The sand to silt ratio of suspended sediment is typically 20% sand to 80% silt (USGS 1999). Mashriqui and Kemp (1996) reported the mean sediment load of the Mississippi River at Tarbert Landing to be 226 mg/L, of which about 26% was sand, with silts and clays each contributing between 30% and 40%.

Blind River and Maurepas Swamp

Historic Conditions

Flood events historically delivered sediments, nutrients, and freshwater from the Mississippi River into Maurepas Swamp. Though the volume and sediment load of floodwaters is uncertain, what is certain is that sediment delivery was adequate to offset subsidence and to support the development of an old growth baldcypress-tupelo forest. Furthermore, it is apparent that the severance of its hydrologic connectivity with the Mississippi River, in accompaniment of other drainage alterations, has resulted in reduced sediment delivery and the consequent subsidence of Maurepas Swamp.

Existing Conditions

Several sampling efforts have been recently conducted to determine sediment loads in Maurepas Swamp. Examining these, the total suspended solids (TSS) concentrations collected monthly were similar from April 2000 to June 2001 (mean: 16 mg L^{-1}; range: 4 – 101 mg L^{-1}) as for April 2002 to May 2002 (mean: 15 mg L^{-1}; range: 1 – 58 mg L^{-1}) (Day et al. 2001, Day et al. 2004). Furthermore, stations located around Lake Maurepas exhibited the highest TSS concentrations, which was likely due to re-suspension of bottom sediments due to high wave energy. The TSS concentrations were considerably less than those in the Mississippi River which generally range between 200 and 300 mg L-1.

The Blind River is listed on the 2006 303(d) list of impaired water bodies due to impairment from excess sediments, extending from its headwaters to its distribution into Lake Maurepas (LDEQ 2006). In accordance with EPA mandate, Total Maximum Daily Loads (TMDLs) must be developed for sediments and nutrients for Blind River by 2011.

4.2.2.3 Groundwater

Historic Conditions

An overview of the historic condition of groundwater resources in southern Louisiana is provided by LCA FPEIS (2004), and consistent with 40 CFR Parts §§1500.4 (j) and 1502.21, description of this resource is hereby incorporated by reference. Southern Louisiana historically has had very abundant fresh groundwater supplies. Saltwater encroachment due to groundwater extraction has and continues to threaten the viability of groundwater resources nearer the coast. Three major aquifer systems are present in the coastal areas of Louisiana: the Southern Hills (Chicot Equivalent), Chicot, and Mississippi River Alluvial aquifer systems—the former two of which are designated sole source aquifers (EPA, 2008). The study area lies within the Mississippi River Alluvial aquifer.

A general description of the aquifer system is provided by the "Mississippi River Alluvial Aquifer Summary, Baseline Monitoring Program, FY 2005" in Appendix 8 of *The Triennial Summary Report for the Water Quality Assessment Division of the Louisiana Department of Environmental Quality* (LDEQ, 2006). The Mississippi Alluvial Aquifer consists of poorly to moderately well sorted sediment that generally decreases in size from coarse sand and gravel in lower portions to fine to medium-grained sand near the top and is confined by layers of silt and clay. Hydraulic connectivity is maintained with the Mississippi River and its adjacent streams, which results in groundwater levels that fluctuate with precipitation trends, river stage, and seasonality. Across the aquifer, water levels are typically within 30 to 40 feet of ground surface with groundwater movement occurring via downgradient seepage towards rivers and streams. Direct infiltration of precipitation, lateral and upward movement of water from adjacent and underlying aquifers, and overbank stream flooding all contribute to aquifer recharge. Natural discharge events include seepage into the Mississippi River and streams, but stages exceeding groundwater levels often allow aquifer recharge. Hydraulic conductivity varies between 10 to 530 feet day^{-1} (3 to 161 m day^{-1}). The aquifer thickness of the freshwater interval ranges from 50 to 500 feet (15 to 152 m), and the maximum depths of occurrence of freshwater range from 20 to 500 feet (6 to 152 m) below sea level.

Existing Conditions

Under the Federal Safe Drinking Water Act, EPA established maximum contaminant levels (MCLs) for pollutants that may pose a health risk in public drinking water. An MCL is the highest level of a contaminant that EPA allows in public drinking water. EPA has defined non-enforceable secondary standards in taste, odor, or appearance guidelines.

The LDEQ Baseline Monitoring Program determines and monitors the quality of groundwater in major aquifers statewide as a Clean Water Act activity. Groundwater wells are sampled every three years for water quality parameters, inorganics (total metals), nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, polychlorinated biphenyls, and field parameters. Under this program, the sampling of 24 wells in 2005 indicates that the Mississippi Alluvial aquifer exhibits the poorest water quality characteristics of any of the fourteen aquifers or aquifer systems monitored (LDEQ, 2006). Analysis supporting this determination include the presence of methyl-t-butyl ether (MTBE)—a volatile organic compound with no primary MCL—at one well; the production of extremely hard groundwater; and exceedance of the primary MCL for arsenic at five wells and secondary standards for 43 parameters (LDEQ, 2006). No pesticides or PCBs were detected at this time. Comparison of historic data collected every three years from 1996 to 2005 indicates increases in color, sulfate, barium, and iron; decreases in chloride; and fluctuations in average values for turbidity, nitrate-nitrite, arsenic, and zinc (LDEQ, 2006).

The need for a groundwater and seepage model for the project was considered to determine the flux of water from the Mississippi River to the Swamp. After analysis of the subsurface soils between the River and the Swamp and additional analysis on the data collected from the flow monitor installed on the Blind River for this project, it was determined that seepage and groundwater transmission was negligible in this area. The determining factors were: 1. Flow rates on the Blind River without rainfall events are non-existent. The tidal action shows nearly equal flows upstream and downstream due to the rising and falling of the tide. 2. Geotechnical data collected indicate the soil permeability between the River and the Swamp is very low so that transmission of flow is nil (**Appendix L**). 3. Field visits to the site on numerous occasions indicate very dry conditions between the River and the Swamp so any groundwater recharge mentioned previously is in aquifers far below the level of the Swamp.

4.2.3 Water Quality and Salinity

This resource is institutionally significant because of the National Environmental Policy Act of 1969; the Clean Water Act; the Coastal Zone Management Act; and the Estuary Protection Act. This resource is technically significant because the water quality supports most physical, chemical, geological, and biological processes throughout the entire estuarine system. This resource is publicly significant because the public demands clean water and healthy wildlife and fisheries for recreational and commercial use.

4.2.3.1 Lower Mississippi River

Historic Conditions

Historic and current water quality issues for rivers and streams in coastal Louisiana include the transport of nutrients, pesticides, synthetic organic compounds, trace elements, suspended sediment, and bacteria. The Louisiana Department of Health and Hospitals coordinates with the LDEQ, the LDWF, and the Louisiana Department of Agriculture and Forestry to issue water body advisories aimed at protecting the public's health.

The USGS maintains water quality stations on the Mississippi River both upstream and downstream of the potential diversion locations. The West Baton Rouge station is located north of the proposed diversion locations. Water quality data have been collected approximately monthly from 2004 to 2009 with a few data points in 1993 and 1975. During this time period the average total nitrogen concentration was 2.34 mg/L with a minimum and maximum of 1.1 and 4.0 mg/L, respectively. Total phosphorus concentrations ranged from 0.1 to 0.41 mg/L with an average of 0.23 mg/L. Downstream of the diversion locations at the Belle Chase station, the period of record includes approximately monthly data from 1977 to 1997 and 2006 to 2009. The average total nitrogen concentration during this time was 2.26 mg/L with a minimum and maximum of 0.47 and 4.5 mg/L, respectively. Total phosphorus concentrations ranged from 0.06 to 0.51 mg/L with an average of 0.22 mg/L.

The LDEQ also operated two ambient water quality stations on the Mississippi River near Lutcher, Louisiana, that were sampled approximately monthly over their period of record: LDEQ station 0081 (1969-1990) and LDEQ station 0321 (1991-1995). Ambient water quality samples were analyzed for alkalinity, chloride, color, dissolved oxygen, fecal coliform, hardness, pH, salinity, specific conductance, sulfate, total dissolved solids, total suspended solids, turbidity, water temperature, nitrate/nitrite, total kjeldahl nitrogen, phosphorus, total organic carbon. Metals and VOCs were analyzed approximately quarterly. Metals analyzed include arsenic, cadmium, chromium, copper, lead, mercury, and nickel. VOCs include 1,1,1-trichloroethane, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethane,1,2-dichloropropane, 2-chlororthylvinyl ether, benzene, bromodichloromethane, bromoform, bromomethane, carbon tetrachloride, chlorobenzene, chloroethane, chloroform, chloromethane, cis-1,3-dichloropropene, dibromochloromethane, ethylbenzene, methylene chloride, tetrachloroethene, toluene, trans-1,2-dichloroethene, trans-1,3-dichloropropene, trichloroethene, and vinyl chloride. The data from these two stations was combined and the summary statistics are presented in Table 4-2.

Table 4-2: Lower Mississippi River summary water quality data recorded at LDEQ station 0081 (1969-1990) and LDEQ station 0321 (1991-1995) (LDEQ, 2009).

Parameter	Mean	Minimum	Maximum	LDEQ Water Quality Criteria Based on Designated Use
Alkalinity (mg/L)	106.4	9.4	168	NA
Chloride (mg/L)	26.66	5	220	75
Color (PCU)	22.7	5	110	NA
Dissolved Oxygen (mg/L)	8.2	0.1	13	5
Fecal Coliform (COL/100mL)	626	20	5400	400 (May 1 – Oct 31)/ 2,000 (Oct 31 – April 30)
Hardness (mg/L as CaCO3)	149.6	53	211	NA
pH (SU)	7.41	6.18	8.88	6.5 - 9.0
Salinity (ppt)	0.82	0.01	1	NA
Specific Conductance (μmhos/cm)	387.86	162	600	NA
Sulfate (mg/L)	49.3	12.7	96	120
Total Dissolved Solids (mg/L)	268.56	14	536	400
Total Suspended Solids (mg/L)	107.8	1	426	NA
Turbidity (NTU)	67.68	3.5	510	NA
Water Temperature (°C)	18.48	0.1	32	32
Nitrate/Nitrite (mg/L)	1.326	0.08	2.8	NA
Total Kjeldahl Nitrogen (mg/L)	0.92	0.02	3.08	NA
Phosphorus as P (mg/L)	0.2234	0.02	0.59	NA
Total Organic Carbon (mg/L)	5.55	1	29.4	NA
				LDEQ Toxic Substance

				Criteria for Freshwater	
Metals (µg/L)				Acute	Chronic
Arsenic	6.829	0.3	334	339.8	150
Cadmium	0.7	0.1	9	15, 67	0.62, 1.76
Chromium	9.37	0.1	63.7	NA	NA
Copper	14.18	0.1	243	10, 35	7, 22
Lead	5.407	0.1	67.5	30, 138	1.2, 5.31
Mercury	0.225	0.05	1.6	2.04	0.012
Nickel	6.594	0.09	45.3	788, 2,495	88,279

NA indicates "Not Available"
Based on hardness values of 50 and 200 mg/L"

Existing Conditions

Current water quality data for the Mississippi River is not available from the LDEQ station at Lutcher, Louisiana. The closest LDEQ ambient water quality station with current data is approximately 22 miles up valley from the proposed diversion locations at Plaquemine, Louisiana (LDEQ station 0053). Ambient water quality samples were analyzed approximately monthly for alkalinity, chloride, color, dissolved oxygen, fecal coliform, hardness, pH, salinity, specific conductance, sulfate, total dissolved solids, total suspended solids, turbidity, water temperature, nitrate/nitrite, total kjeldahl nitrogen, phosphorus, total organic carbon. Metals and VOCs were analyzed approximately quarterly. Metals analyzed include arsenic, cadmium, chromium, copper, lead, mercury, and nickel. Summary statistics of data from this station from 2006 to 2009 are presented in **Table 4-3.**

Table 4-3: Lower Mississippi River summary water quality data recorded at LDEQ station 0053 (2006-2009) near Plaquemine, Louisiana (LDEQ, 2009).

				LDEQ Water Quality Criteria
Parameter	**Mean**	**Minimum**	**Maximum**	**Based on Designated Use**
Alkalinity (mg/L)	120.5	86.9	161	NA
Chloride (mg/L)	32.4	16.9	55	75
Color (PCU)	23	5	110	NA
Dissolved Oxygen (mg/L)	9.2	5.7	13	5
Fecal Coliform (COL/100mL)	76	1	5400	400 (May 1 – Oct 31)/ 2,000 (Oct 31 – April 30)
Hardness (mg/L as CaCO3)	168	116	211	NA
pH (SU)	6.4	4.8	8.88	6.5 - 9.0
Salinity (ppt)	0.19	0.01	1	NA
Specific Conductance (µmhos/cm)	41.9	299	600	NA
Sulfate (mg/L)	269	26.1	96	120
Total Dissolved Solids (mg/L)	269	185	536	400
Total Suspended Solids (mg/L)	97.4	10	426	NA

Parameter	Mean	Minimum	Maximum	LDEQ Water Quality Criteria Based on Designated Use	
Turbidity (NTU)	67.38	7.9	510	NA	
Water Temperature (ºC)	16.9	2.46	32	32	
Nitrate/Nitrite (mg/L)	1.326	0.64	2.8	NA	
Total Kjeldahl Nitrogen (mg/L)	0.92	0.28	3.08	NA	
Phosphorus as P (mg/L)	0.2234	0.08	0.59	NA	
Total Organic Carbon (mg/L)	5.55	3.8	29.4	NA	
				LDEQ Toxic Substance Criteria for Freshwater	
Metals (µg/L)				Acute	Chronic
Arsenic	1.5	0.1	60.7	339.8	150
Cadmium	0.025	0.02	0.03	15, 67	0.62, 1.76
Chromium	0.14	0.1	0.23	NA	NA
Copper	2.03	1.51	3.09	10, 35	7, 22
Lead	0.079	0.02	0.16	30, 138	1.2, 5.31
Mercury	NA	NA	NA	2.04	0.012
Nickel	1.78	0.08	3.57	788, 2,495	88, 279

NA indicates "Not Available"

Based on hardness values of 50 and 200 mg/L.

The closest LDEQ ambient water quality station with data on mercury levels for fish in the Mississippi River is station 1131 near Donaldsonville, LA. In 2001, a total of 35 fish were sampled including species of catfish and drum. Mercury concentrations in fish ranged from 0.01 to 0.52 mg/L with an average of 0.75 mg/L.

Data on mercury levels in sediment are available from the Baton Rouge station (LDEQ station 3580) and from the Donaldsonville station (LDEQ station 1131). Both stations were sampled only once: the Baton Rouge station in 2007 and the Donaldsonville station in 2001. Sediment mercury concentrations were 12.58 µg/kg and 10.0 µg/kg, respectively.

4.2.3.2 Blind River and Maurepas Swamp

Historic Conditions

The LDEQ maintains an ambient water quality station on the Blind River at the US Highway 61 bridge (LDEQ station 0117). The period of record for this station is from 1978 to 1998 during which an average of eight samples per year were taken.

Summary statistics for this data are present in **Table 4-4**. The mean concentrations of chloride, sulfate, total dissolved solids and temperature were below the LDEQ numeric criteria. The pH values observed during this time were within the numeric criteria range of 6 to 8.5 standard units. Mean dissolved oxygen (DO) was slightly higher than the numeric criteria value of 3.0 mg/L.

Existing Conditions

There are seven categories for water use as identified under the Louisiana Administrative Code (LAC) Title 33 Part IX. Primary contact recreation (PCR) includes activities such as swimming, water skiing, tubing, snorkeling, skin diving, and other activities that involve prolonged body contact with water and probable ingestion. Secondary contact recreation includes fishing, wading, and recreational boating, and other activities that involve only incidental or accidental body contact and minimal probability of ingesting water. Fish and wildlife propagation (FWP) includes the use of water by aquatic biota for aquatic habitat, food, resting reproduction, and cover, including indigenous fishes and invertebrates, reptiles, amphibians, and other aquatic biota consumed by humans. Outstanding natural resource waters (ONR) include those that are specified under LAC 33:IX.1123. These ONR are designated for preservation protection, reclamation, or enhancement of wilderness, aesthetic qualities, and ecological regimes.

Within the study area, the Blind River from the headwaters to the ARDC is identified by the LDEQ as water body subsegment 040403. The designated uses assigned for this subsegment are PCR, secondary contact recreation (SCR), FWP, and ONR. Based on the LDEQ 2006 Integrated Report both the PCR and SCR designated uses were fully supported, while FWP and ONR were not supported. The suspected causes of impairment for the FWP designated use were mercury, nitrate/nitrite, non-native aquatic plants, total phosphorus (TP), and turbidity. The suspected sources for mercury were listed as atmospheric deposition and unknown sources. Site clearance (land development or redevelopment) and flow alterations from water diversions were listed as the suspected sources for nitrate/nitrite, DO, and TP. The suspected causes of impairment for the ONR designated use were sedimentation/siltation and turbidity, which are believed to be caused by site clearance.

Table 4-4: Blind River summary water quality data recorded near U.S. Highway 61 bridge (LDEQ station 0117) from 1978 to 1998 (LDEQ, 2009).

				LDEQ Water Quality Criteria
Parameter	**Mean**	**Minimum**	**Maximum**	**Based on Designated Use**
Alkalinity (mg/L)	59.6	11.6	115	NA
Chloride (mg/L)	80.4	5.4	610	250
Color (PCU)	75	20	160	NA
Dissolved Oxygen (mg/L)	3.2	0.2	8.5	3
Fecal Coliform (COL/100mL)	712	20	24000	400 (May 1 – Oct 31)/

Parameter	Mean	Minimum	Maximum	LDEQ Water Quality Criteria Based on Designated Use	
				2,000 (Oct 31 – April 30)	
Hardness (mg/L as CaCO3)	79.9	11	226.6	NA	
pH (SU)	6.75	6	8.35	6 -8.5	
Salinity (ppt)	0.79	0.01	8	NA	
Specific Conductance (μmhos/cm)	379	88	1950	NA	
Sulfate (mg/L)	13	2	64.8	75	
Total Dissolved Solids (mg/L)	277	72	1210	500	
Total Suspended Solids (mg/L)	34.7	4	310	NA	
Turbidity (NTU)	28.1	2	480	NA	
Water Temperature (°C)	21	6.5	31.9	30	
Nitrate/Nitrite (mg/L)	0.17	0.01	2.28	NA	
Total Kjeldahl Nitrogen (mg/L)	1.25	0.24	2.76	NA	
Phosphorus as P (mg/L)	0.27	0.06	0.76	NA	
Total Organic Carbon (mg/L)	13.3	0.5	22.1	NA	
				LDEQ Toxic Substance Criteria for Freshwater	
Metals (μg/L)				Acute	Chronic
Arsenic	3.66	0.1	30	339.8	150
Cadmium	0.68	0.1	7.4	15, 67	0.62, 1.76
Chromium	3.9	0.1	84.2	NA	NA
Copper	35.7	0.1	1025.5	10, 35	7, 22
Lead	6.8	0.1	76.4	30, 138	1.2, 5.31
Mercury	0.19	0.05	1.3	2.04	0.012
Nickel	4.1	0.09	15	788, 2495	88, 279

Baseline water quality data for the Blind River and areas of Maurepas Swamp north of the study area from Lee Wilson Associates 2001 and Day et al. 2004 were compiled in the *Phase I Assessment of Potential Water Quality and Ecological Risk and Benefits from a Proposed Reintroduction of Mississippi River Water into Maurepas Swamp* (Battelle 2005).

LDEQ data on mercury levels in fish, vegetation, and sediment is available from four ambient water quality stations on the Blind River. These stations (117, 156, 235, and 538) include a period of record from 1996 to 2008. A total of 417 fish were sampled including species of bass, bowfin, catfish, drum, crappie, and buffalo. Mercury concentrations in fish ranged from 0.001 to 2.27 mg/L with an average of 0.51 mg/L. A total of ten vegetation samples were taken from Spanish moss. Mercury concentrations in vegetation ranged from 0.001 to 0.18 ppm with an average of 0.07 ppm. The average concentration of mercury in sediment measured from the four stations ranged from 41.77 to 520 µg/kg with an average of 208 µg/kg.

While the best available data were used to establish existing conditions for water quality within the study area, the installation of piezometers throughout the interior swamp south of US Highway 61 was completed as part of this study and data from these stations is being collected to supplement existing swamp water quality data. A multi-directional flow gauge with water quality sensors that collects hourly data has also been installed on the Blind River near US Highway 61 and data is currently being collected from that gauge. Long-term data over variable conditions will provide a better understanding of flow and water quality fluctuations within the Study Area.

4.2.3.3 Salinity

Lower Mississippi River

Historic Conditions

Salinity data for a brief period of record is available from the LDEQ for a station on the Mississippi River south of Lutcher, Louisiana, which is approximately eight miles down valley from the proposed diversion locations. The period of record for this station includes thirteen observations between 1994 and 1995 and one observation in 1991. During this time the salinity levels ranged from 0.1 to 1 ppt with an average of 0.82 ppt. A longer period of record is available for specific conductance at this location. While conductance is a measure of the ability of water to transmit an electrical current, it is proportional to the amount of solids in solution. Specific conductance has been used as an indicator of salinity (Giovannelli 1980). Approximately monthly specific conductance readings from 1966 to 1995 are available for this station. During this time, the specific conductance ranged from 162 to 600 µmhos/cm with an average of 388 µmhos/cm.

Existing Conditions

The availability of recent salinity data is limited for the Mississippi River near the diversion locations. The nearest LDEQ station with a current period of record for salinity is approximately 22 miles up valley from the proposed diversion locations at Plaquemine, Louisiana. From 2006 to 2009, salinity ranged from 0.01 to 0.3 ppt with an average of 0.19 ppt at this location, and specific conductance ranged from 299 to 578 µmhos/cm with an average of 423 µmhos/cm. These values are similar to historic data observed downstream at the LDEQ Lutcher station.

Blind River, Maurepas Swamp, and Lake Maurepas

Historic Conditions

Over the past 6,000 to 7,000 years, the salinity of the study area has shifted with the major deltaic meandering of the Mississippi River. Modern efforts to control flooding and improve navigation have involved numerous bank stabilization, channel alignment, dredging, lock, dam, levee, and spillway projects on the Mississippi River. Flood control measures and infrastructure installations (e.g., pipelines, roads, and railways) have also altered the hydrology of coastal Louisiana wetlands. Together, human modifications to hydrology have significantly affected the salinity within Maurepas Swamp, Blind River, and Lake Maurepas by reducing freshwater input and increasing tidal inflow of more saline waters. However, a general trend across the Lake Pontchartrain Basin is decreasing salinity inland from east to west as saline water from the Gulf mixes with freshwater inputs.

Historically, overbank flooding of the Mississippi River into the study area delivered freshwater, nutrients, and sediments. Freshwater diluted tidal inflow and limited backflow of saline water through Pass Manchac into Lake Maurepas, the Blind River, and Maurepas Swamp. Sediments and nutrients supported primary productivity and accretion, offsetting the effects of RSLR. The construction of levees along the Mississippi River eliminated overbank flooding, which had direct and indirect effects on salinity within the study area. Tidal inflow through Pass Manchac became more strongly correlated with salinity fluxes in the study area. Decreased accretion and productivity increased RSLR and consequently promoted the backflow of saline waters from Lake Maurepas. The construction of parish drainage canals and installation of pipelines exacerbated these effects by increasing the conveyance of more saline waters into Maurepas Swamp.

Throughout the Pontchartrain Basin, the opening of the Mississippi River Gulf Outlet (MRGO)—a 76-mile navigation channel that connects the City of New Orleans with the Gulf of Mexico—resulted in increased tidal connectivity and saltwater intrusion. Tate et al. (2002) examined the effects of MRGO on salinities in the basin and found that the mean monthly salinity for all months increased at Pass Manchac following partial completion of MRGO in 1963: the 1963 to 1977 period average salinity (1.6 ppt) was 0.4 ppt higher than the 1951 to 1963 period average (1.2 ppt).

Salinity fluxes in the study area have been historically related to both tidal and meteorological events. Thomson et al. (2002) observed high intra- and inter-annual variability in salinity levels at Pass Manchac from 1951 to 2000, with the average salinity typically ranging from slightly above 0 to 3.5 ppt (**Figure 4-12**). Unprecedented salinity levels, however, were observed during the three-year drought from 1998 to 2000 (**Figure 4-13**). Salinity levels reached 12 ppt at Pass Manchac and 6 ppt across Lake Maurepas at the entrance of Blind River in October of 2000 (Lee Wilson & Assoc. et al., 2001; Lane et al. 2002; Lane et al. 2003). A similar spike was observed within the interior of southeastern Maurepas Swamp, where salinity levels reached 5 and 4 ppt in channels and shallow wells, respectively (Lee Wilson & Assoc. 2001, Shaffer et al. 2003). In addition to infrequent drought events, pulses of higher salinity waters have been characteristic of late summer and early fall and are often associated with tropical storm events in the Gulf (Thomson et al. 2002, Shaffer et al. 2003, Day et al. 2004).

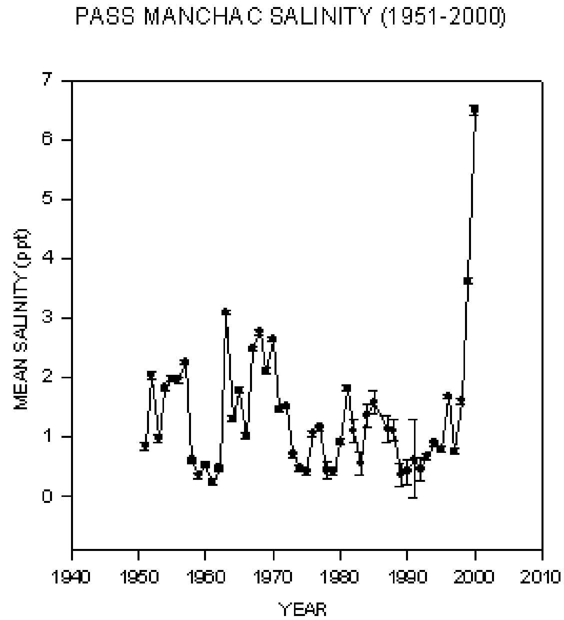

Figure 4-12: Mean salinity at Pass Manchac: 1951 to 2000 (from U.S. Army Corps of Engineers, New Orleans District).

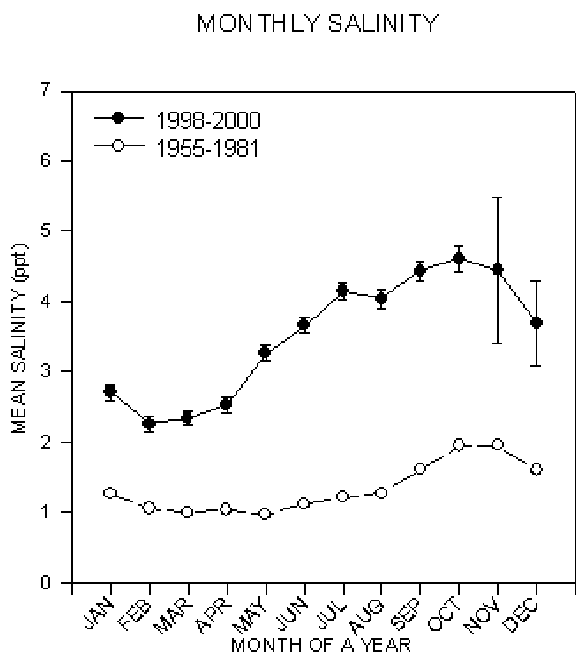

Figure 4-13: Mean annual and monthly salinity at Pass Manchac 1955 to 1981 and during the 1998 to 2000 drought (from U.S. Army Corps of Engineers, New Orleans district).

Periodic pulses of higher salinity tidal inflow have had detrimental impacts on plant communities. Persistent saltwater intrusion events observed in 1999 and 2000 caused over ninety-seven percent mortality of tens of thousands of baldcypress seedlings that were planted in the northwestern portion of Maurepas Swamp (Lee Wilson & Assoc. 2001). Nearer Lake Maurepas, where salinity pulses had a greater effect, mortality of both understory and overstory plants resulted due to elevated salinity. Previously forested baldcypress-tupelo habitats have transitioned to open marsh in some areas (Shaffer et al. 2003). Although these pulses are typically infrequent and short-lived, salts may persist in the soil at levels detrimental to plants for several years, as observed in Maurepas Swamp following the 1998 to 2000 drought (Shaffer et al., 2005; personal communication, Dr. Gary Shaffer, 2009).

Existing Conditions

Established by the LDNR and USGS to monitor both the individual effectiveness of wetland restoration projects and the cumulative effects of all projects statewide, two CRMS sites are located within the study area. Data were accessed through the Strategic Online Natural Resources Information System (SONRIS) (LDNR, 2009). Hourly salinity readings from CRMS 65 were available from January 28 to December 1, 2008. During this time period, the average salinity at this site was 0.24 ppt with a maximum of 0.33 ppt and a minimum of 0.12 ppt. The period of record for salinity readings at CRMS site 5167 extended from November 6, 2007 to February 9, 2009. Over this time period, the average salinity was 0.25 ppt with a maximum of 1.35 ppt and a minimum of 0.06 ppt.

Additional static salinity readings were taken at numerous locations within the study area during site visits in the summer and fall of 2009. The average salinity levels recorded in July, 2009, at eight locations along the Blind River and canals south of Highway 61 was 0.37 ppt. In August 2009, salinity levels were recorded at ten locations within the distribution area south of US Highway 61. The average salinity at this time for these stations was 0.30 ppt with a maximum of 0.72 ppt and a minimum of 0.13 ppt. Salinity levels recorded during these site visits in 2009 are similar to those previously observed at the CRMS stations within the study area.

Lane et al. (2003) collected salinity readings monthly from April to October during the 2000 drought at sixteen locations in southern Maurepas Swamp and Lake Maurepas. Sample sites were chosen based on hydrological boundaries, with the inclusion of the Amite and Blind Rivers; Hope Canal and Dutch Bayou waterways; Reserve Canal; and Lake Maurepas. General trends suggested in their study include higher salinities in the lake than the swamp and decreasing salinity eastward from the lake to Blind River from April through August. Over the period of study, salinity across stations averaged 3 practical salinity units (psu) but ranged from 0 to 12 psu and reached 5 psu at all locations at some time. Practical salinity units approximate salinity concentrations measured in parts per thousand. In the spring and summer, infrequent precipitation and runoff allowed the Amite and Blind Rivers to incur lower salinity influx than elsewhere. However, salinity averaged 4.5 psu across locations during September and October—a level detrimental to woody vegetation.

Day et al. (2004) recorded salinity readings monthly from April 2007 to May 2008 at nineteen locations within Maurepas Swamp using site groupings consistent with Lane et al. (2003). Salinities during this period ranged from 1 to 7 psu in the Blind River upstream of the confluence of the Amite River Diversion.

Shaffer et al. (2003) observed a trend of decreasing salinity levels in the swamp between Lake Maurepas and the Mississippi River with increasing distance from the lake. However, this trend was not evident for stations measured along Blind River itself. At interior sites along Blind River, salinities recorded in wells were generally less than 2 ppt.

Salinity data is available from 1982 to 1998 from a LDEQ station located on the Blind River at US Highway 61. During this period of record, salinity ranged from 0.1 to 8 ppt with an average of 0.8 ppt. Approximately monthly specific conductance data is available at this station from 1978 to 1998. During this time, specific conductance ranged from 84 to 2,100 µmhos/cm with an average of 391µmhos/cm.

4.2.4 Air Quality

This resource is institutionally significant because of the Clean Air Act of 1963, as amended, and the Louisiana Environmental Quality Act of 1983, as amended. Air quality is technically significant because of the status of regional ambient air quality in relation to the National Ambient Air Quality Standards (NAAQS). Air quality is publicly significant because of the desire for clean air and public health concerns expressed by many citizens. Consistent with 40 CFR Parts §§1500.4 (j) and 1502.21 description of the air quality resources provided in the LCA PEIS (2004) is hereby incorporated by reference.

Historic Conditions

The Clean Air Act Amendment of 1990 directed the USEPA to set NAAQS (40 CFR part 50) for pollutants considered harmful to public health and the environment. Federal air quality standards have been established for six pollutants termed criteria pollutants: carbon monoxides (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur oxides (commonly measured as sulfur dioxide [SO_2]), lead (Pb), particulate matter less than 2.5 micrometers (µm) in diameter ($PM_{2.5}$), and particulate matter no greater than 10 µm in diameter (PM_{10}).

Review of air quality monitoring data from January 1998 through December 2008 indicates that Ascension Parish was in nonattainment for the intervals 1998-2000 and 2003-2007 for O_3 (8-hour average) (EPA,2009b). Likewise, St. James Parish was in nonattainment for 1998-2000, 2003, and 2005-2007 for O_3 (8-hour average) (EPA, 2009b).

Ascension and St. James Parishes historically have had good to moderate air quality with infrequent days where air quality was unhealthy for sensitive groups and the general population (EPA, 2009a). Air quality in the surrounding metropolitan statistical areas (MSAs) has been historically more impaired than for these parishes and the study area therein (EPA, 2009a, b).

Existing Conditions
The Baton Rouge MSA is currently a nonattainment area for O_3 (8-hour average) (EPA, 2010). The class of nonattainment for the MSA is moderate, indicating that the area has a design value of 0.092-0.107 parts per million (ppm) for this pollutant.

Further analysis conducted by the Louisiana Department of Environmental Quality – Air Quality Division (LDEQ-AQD indicate no violations of state air quality standards at the monitoring stations nearest the study area in 2006 and 2007 (LDEQ 2006, 2007). Nearby stations include Convent, Dutchtown, French Settlement, and Garyville. Nonattainment for the Baton Rouge MSA is largely due to decreased air quality in the more immediate Baton Rouge area. Furthermore, air quality in Ascension and St. James Parishes was not in exceedance of NAAQS for criteria pollutants in 2008. These findings indicate that the existing air quality within the study area is generally good to moderate with infrequent days where air quality is unhealthy for sensitive groups and the general population.

4.2.5 Noise

Noise is institutionally significant because of the Noise Control Act of 1972 that declares the policy of the United States to promote an environment for all Americans free from noise that jeopardizes their health or welfare; and the Occupational Safety and Health Standards (29 CFR, part 1910) regarding protection against the effects of noise exposure. Noise is technically significant because noise can negatively affect the physiological or psychological well-being of an individual (Kryter, 1994) ranging from annoyance to adverse physiological responses, including permanent or temporary loss of hearing, and other types of disturbance to humans and animals, including disruption of colonial nesting birds. Noise is publicly significant because of the public's concern for the potential annoyance and adverse effects of noise on wildlife and humans.

Historic Conditions
Limited information exists regarding historical noise exposure within the study area. Presumptively, increases in noise exposure occurred within the study area following the construction of transportation infrastructure within and surrounding the study area, and subsequent forestry activities. After which, it is presumed that noise exposure reflected trends in traffic related to activities that occurred in and proximal to the study area.

Existing Conditions
Noise is typically associated with human activities and habitations, such as operation of commercial and recreational boats, water vessels, air boats, and other recreational vehicles; operation of machinery and motors; and human residential-related noise (air conditioner, lawn mower, etc.). However, the proposed study area is a remote and uninhabited swamp. The noise from distant urban areas surrounding the study area has little if any impacts on the area. Frequent localized noises are related to train transit and vehicle traffic on railroads and highways within and adjacent to the study area. Noise generated by recreational outboard motorboat operation is also common, with airboat operation infrequent and restricted by the WMA.

4.2.6 Vegetation Resources

Coastal vegetation resources attain institutional significance through the following federal statutes: the Coastal Barrier Resources Act of 1982; the Coastal Zone Management Act of 1972; the Emergency Wetlands Resources Act of 1986; the Estuary Protection Act of 1968; the Fish and Wildlife Conservation Act of 1980; the Fish and Wildlife Coordination Act of 1958, as amended; the Migratory Bird Conservation Act; the Migratory Bird Treaty Act; the Endangered Species Act of 1973 (ESA); the Magnuson Fishery Conservation and Management Act 1990; the National Environmental Policy Act of 1969; the North American Wetlands Conservation Act; the Water Resources Development Acts of 1976, 1986, 1990, and 1992; and Executive Order 13186—Responsibility of Federal Agencies to Protect Migratory Birds. Coastal vegetation resources are technically significant because they are a critical element of the coastal habitats. In addition, coastal vegetation resources serve as the basis of productivity, contribute to ecosystem diversity, provide various habitat types for fish and wildlife, and are an indicator of the health of coastal habitats. Coastal vegetation resources are publicly significant because of the high priority that the public places on their aesthetic, recreational, and commercial value.

4.2.6.1 Wetland Vegetation

Historic Conditions
Prior to European settlement in the early eighteenth century and subsequent large-scale land modification, ninety percent of the wetlands in the Pontchartrain Basin were forested, baldcypress-tupelo swamp (Saucier, 1963). Southwest Maurepas Swamp was vegetated by an expanse of old growth, freshwater forested swamp that extended as far as 26 miles north from the Mississippi River to the Baton Rouge-Denham Springs fault line (LPBF, 2005). Baldcypress trees over 1,000 years old dominated the canopy (Mattoon, 1915) with water tupelo, ashes, and red maple also important (Conner and Day, 1976). Inland towards the Mississippi River, the swamp transitioned to bottomland hardwood forests at slightly higher elevations that constructed the lower portions of the natural levee (Kelley 1989, Shaffer et al. 1999). Typical tree species included laurel oak, water oak, swamp chestnut oak,

and other water-tolerant oaks, in addition to species such as sweetgum, sugarberry, water hickory, and American elm (Kelley 1989, Shaffer et al. 1999).

Forest clearing ensued after colonization to make way for homesites and agriculture as well as for building materials and commercial exploits (Robin 1966, Brasseux 1987, Daigle 1995). Extensive clearing of bottomland hardwood forest occurred more readily than clearing of the swamp due to the former's suitability for agriculture and the difficulty of harvesting in the deepwater characteristic of the latter (Shaffer et al. 1999). Nonetheless, small-scale timber harvests in Maurepas Swamp began as early as 1700 (Keddy et al. 2007). The advent of the pull-boat and mechanized harvesting techniques in the late 1880's allowed rapid expansion of these efforts (Mancil 1980, LPBF 2005). Commercial deforestation of the Pontchartrain Basin began in 1890 but continued only until 1938—at which time merchantable timber resources had been nearly exhausted (Lopez, 2003). Small-scale extraction of remnant trees continued after this time, with a pull boat logging along Blind River observed by Mancil (1980) as late as 1961. The effects of these land use impacts altered the old growth forest and are still visible in the secondary forest present today.

Vegetation communities of coastal Louisiana have been extensively mapped across an expansive area and over an extended period of record based on major association or habitat type (e.g. Penfound and Hathaway 1938; O'Neil 1949; Chabreck et al. 1968; Chabreck 1970, 1972b; Cowardin et al. 1979; Chabreck and Linscombe 1978, 1988; Visser et al. 1998, 1999, 2000; Chabreck et al. 2001). However, the differing classification and analysis methods between these studies limit any spatial assessment of habitat change within the study area during this period.

Referencing historic maps and current community characteristics, following widespread timber harvesting activities the study area has developed into a primarily baldcypress-tupelo forested wetland. Historic habitat types within the study area for selected dates from 1956 to 2000 are presented in Figure 4-15 and post hurricane Katrina in 2005 in Figure 4-16.

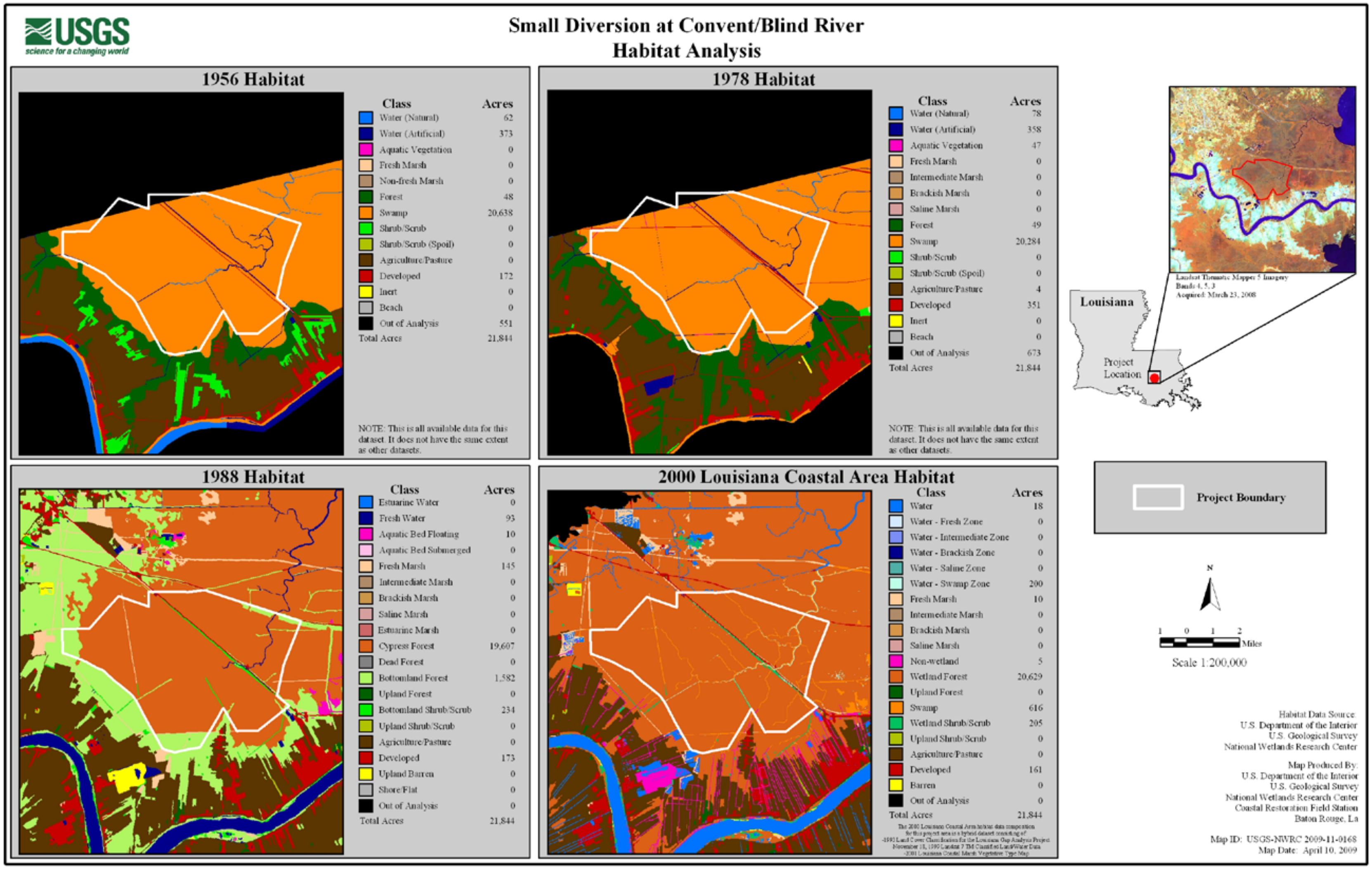

Figure 4-14: Habitat analysis in study area for years 1956, 1978, 1988, and 2000 (Wicker 1980; Barras et al. 1994;

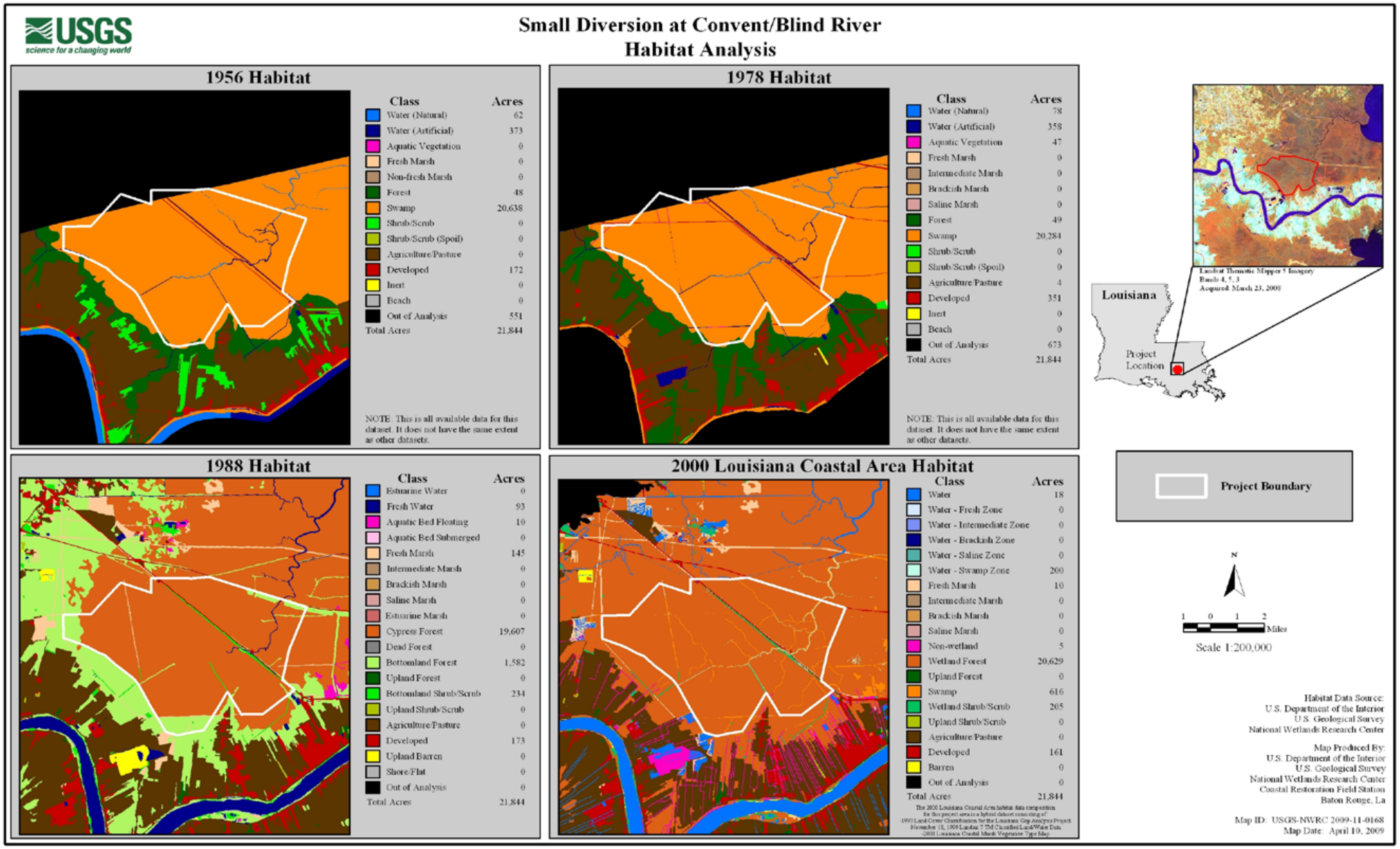

Figure 4-15: Habitat analysis for the project distribution area for 2005Existing Conditions

Existing Conditions

Community Types

Wetland Vegetation

Wetland vegetative habitat descriptions are based on field observations and are described in accordance with *The Natural Communities of Louisiana* (LNHP, 2009). Existing habitat types and respective acreages discussed below are based on the 1988 USGS National Wetlands Research Center (NWRC) map (USGS NWRC, 1999) and include aquatic bed floating vascular, bald cypress-tupelo swamp, bottomland hardwood forest, fresh marsh, and scrub-shrub swamp. Despite more recent mapping efforts, the 1988 USGS NWRC represents the most refined habitat classification to date for the Study Area with regards to spatial resolution and community taxonomy. Habitat structure has changed over time; however, bald cypress-tupelo swamp has remained the predominant habitat type, pre-dating human disturbance and persisting today. Table 4-5 describes wetland acreages by community type for the project distribution and transmission channels.

Table 4-5: Wetland community type acreages by location within the Study Area (USGS NWRC, 1999).

Community Type	Location		
	Distribution Area (ac)	Romeville Transmission (ac)	South Bridge Transmission (ac)
Aquatic Bed Floating Vascular	27.1	0.0	0.0
Bald cypress-tupelo	20,187.9	0.0	0.0
Bottomland Forest	1,614.4	91.0	117.6
Fresh Marsh	138.1	1.8	6.0
Scrub/Shrub swamp	253.1	0.2	0.0
Water	117.9	0.4	6.0

Aquatic Bed Floating Vascular

The Aquatic Bed Floating Vascular habitat (Cowardin et al. 1979) includes a diverse group of floating vascular plant communities that requires surface water for optimum growth and reproduction, preferring continuous or frequent flooding (see Table 4-7). Aquatic beds are easily moved by water currents or wind and include species that float freely either in the water or on its surface. This habitat type is found along the Blind River and the canals maintained by St. James Parish. Common species present include water lily, alligator weed, and duckweed.

Depending on the season and rainfall regime, duckweeds can dominate the canals forming dense mats several inches thick. Communities are frequently dominated by one or two species, though several species may coexist (LNHP 2009). The Louisiana Natural Heritage Program (LNHP 2009) characterizes aquatic bed floating vascular communities as highly productive habitat that serves as an important coastal ecosystem component through supplying oxygen, detrital material, and dissolved organic nutrients to the water and producing organic matter that is consumed by organisms. Further, these systems provide valuable habitat for numerous fish and wildlife species.

Bald cypress-Tupelo Swamp

Bald cypress-tupelo swamp is the most prevalent habitat type in the distribution area, comprising over ninety percent of the total area. Habitat assessment using the US Fish and Wildlife Service Wetland Value Assessment (WVA) methodology swamp Model determined that the majority of sampling sites were characterized by bald cypress and water tupelo as canopy dominants based on percent canopy composition and basal area. While bald cypress was the canopy dominant in a few locations, water tupelo was the predominant species across sites. Red maple and green ash were prevalent in the midstory in most areas. Further description of observed community characteristics is presented in **Appendix K**.

Occupying a landscape position slightly higher in elevation than fresh marsh but lower in elevation than bottomland hardwoods, bald cypress-tupelo swamp habitats are typically located along surface water channels and in back swamp depressions and swales. This habitat is inundated or saturated by surface water or groundwater on a nearly permanent basis throughout the growing season, except during periods of extreme drought (Penfound, 1952; Mitsch and Gosselink, 2000). Seasonal fluctuation of water level is typical (LNHP, 2009).

Bottomland Forest

This forest association is found at higher ground elevations than surrounding swamp habitats and is therefore inundated less frequently. Bottomland hardwoods are generally intolerant of inundation during the growing season (Putnam et al. 1960; Hodges 1997; Shaffer et al. 2000). Fluctuations in water level are more prevalent in the bottomland forest than bald cypress-tupelo swamp, with characteristic alternating wet/dry periods. Nutrient transport and organic matter deposition during flood events result in high productivity. Numerous distinct community types are recognized as bottomland hardwood forests, each associated with unique landforms, soils, and hydrologic regimes. Biogeographic separation of plant species within bottomland hardwoods is centrally dependent on soil oxygen availability which is related to various abiotic and biotic factors. Bottomland hardwoods provide habitat for many species of wildlife, such as white-tailed deer, grey squirrels, raccoons, and numerous bird species. These areas typically were the first to be cleared when logging in the area occurred.

Bottomland forests in the Study Area are most commonly found at topographically higher areas. As elevation increases from the swamp towards the natural levee, species assemblages transition from flood tolerant species characteristic of bald cypress-tupelo swamp to less flood tolerant bottomland hardwood species. Within the distribution area, these forests have undergone high mortality of less flood tolerant species (e.g, green ash) and appear to be transitioning towards bald cypress-tupelo swamp. Upgradient from the distribution area, the Romeville and South Bridge transmission canals also transect areas of bottomland forest. The batture—the area between the natural levee crest and the Mississippi River—is vegetated by bottomland forest characterized by pioneer species, such as black willow (*Salix nigra*), and frequent inundation during the spring and summer at higher river stages.

Fresh Marsh

This habitat type is typically located adjacent to intermediate marshes near the northern extent of coastal marshes. Floristic composition of fresh marshes is extremely heterogeneous within and between habitats based largely on the frequency and duration of flooding, as related to microtopography, which collectively influence species composition. Other factors regulating species distribution include substrate, current flow, salinity, competition, and allelopathy. Consequently, fresh marshes exhibit the highest species diversity of any marsh type, with as many as ninety-two plant species reported (LNHP 2009). Epiphytic and benthic algae are common autotrophic groups present, with much of this habitat consisting of floating marsh (flotant). Soil organic matter content is highest for fresh marsh in relation to all other marsh types. Fresh marsh supports the highest wildlife populations of any marsh type, providing overwintering habitat for many migratory waterfowl. Fisheries important to Louisiana's economy and ecology depend on fresh marsh for critical nursery areas, including such species as flounder, croaker, and juvenile brown and white shrimp. (LNHP, 2009).

Within the Study Area, fresh marsh habitat mainly consists of pipeline and powerline easements. While some of these easements have ditches, many of the easements are slightly elevated above the adjacent swamp and are thickly vegetated with grasses and forbs. These areas are usually saturated to the surface, and flooded only during higher water periods. Therefore, it is unlikely that fresh marshes within the Study Area currently provide nursery habitat for estuarine species. However, these fresh marshes would provide habitat for other wildlife species such as reptiles and amphibians.

Scrub/Shrub Swamp

Characterized as a low, flat freshwater swamp, scrub/shrub swamp vegetation includes large shrubs and small trees less than 35 feet in height. Landscape position includes depressional, semi-permanent pools and along slow flowing channels and streams where soils are flooded for extended periods. Dry periods are infrequent, occurring during summer months and often associated with drought events. This habitat is found along the Blind River and canals within the Study Area. It is also present along the edges of pipeline easements.

Table 4-6: Common plant species observed or likely to occur in the study area by habitat type.

Common Name	Scientific Name
<u>Aquatic Bed Floating Vascular</u>	
Alligator Weed*	*Alternanthera philoxeroides*
Big Floatingheart*	*Nymphoides aquatica*
Bladderworts	*Utricularia* spp.
Coontail*	*Ceratophyllum demursum*
Duckweeds*	*Lemna, Spirodella, Wolfia, and Wolfiellea* spp.
Fanwort	*Cabomba caroliniana*
Lemon Bacopa	*Bacopa caroliniana*
Mosquito Fern	*Azolla caroliniana*
Pondweeds	*Potamogeton* spp.
Southern Naiad	*Najas guadalupensis*
Spatterdock	*Nuphar luteum*
Water Hyacinth*	*Eichhornia crassipes*
Water Lettuce	*Pistia stratioites*
Water Lily*	*Nymphaea odorata*
Water Milfoil	*Myriophyllum* spp.
Water Shield	*Brasenia schreberi*
<u>Baldcypress-Tupelo Swamp</u>	
American Cupscale	*Sacciolepis striata*
Arrow Arum*	*Peltandra virginica*
Aster	*Symphyotrichum (aster)* spp.
Baldcypress*	*Taxodium distichum*
Bog Hemp*	*Boehmeria cylindrica*
Boxelder*	*Acer negundo*
Bulltongue Arrowhead*	*Sagittaria lancifolia*
Climbing Dayflower*	*Commelina diffusa*
Fox Clubmoss*	*Lycopodium alopecuroides*
Giant Cutgrass*	*Zizaniopsis miliacea*
Green Ash*	*Fraxinus pennsylvanica*
Japanese Climbing Fern*	*Lygodium japonicum*
Lizard's Tail*	*Saururus cernuus*
Maidencane*	*Panicum hemitomon*
Marsh Seedbox*	*Ludwigia palustris*
Pennywort*	*Hydrocotyle* spp.
Pickerelweed*	*Pontederia cordata*
Red Maple (swamp variant)*	*Acer rubrum* var. *drummondii*

Common Name	Scientific Name
Rough Horsetail*	*Equisetum hyemale*
Savannah Panicgrass*	*Phanopyrum gymnocarpon*
Sedges*	*Carex* spp.
Smartweed*	*Polygonum punctatum*
Soft Rush*	*Juncus effusus*
Southern Amaranth	*Amaranthus australis*
Southern Blue-flag Iris*	*Iris virginica*
Southern Swamp Lily*	*Crinum americanum*
Swamp Privet*	*Forestiera acuminata*
Three-way Sedge*	*Dulichium arundinaceum*
Walter's Millet*	*Echinochloa walteri*
Warty Sedge*	*Carex verrucosa*
Water Ferns*	*Salvinia* spp.
Water Horehound*	*Lycopus virginicus*
Water Tupelo*	*Nyssa aquatica*
<u>Bottomland Forest</u>	
American Elm*	*Ulmus americana*
American Sycamore*	*Platanus occidentalis*
Blackgum*	*Nyssa Sylvatica*
Black Willow*	*Salix nigra*
Cherrybark Oak*	*Quercus pagoda*
Laurel Oak*	*Quercus laurifolia*
Nuttalls Oak*	*Quercus nutalli*
Overcup Oak*	*Quercus lyrata*
Persimmon*	*Diospyros virginiana*
Red Maple*	*Acer rubrum*
Sugarberry*	*Celtis laevigata*
Sweetgum*	*Liquidambar styraciflua*
Water Hickory*	*Carya aquatica*
Water Oak*	*Quercus nigra*
<u>Scrub/Shrub Swamp</u>	
American Basswood*	*Tilia americana*
American Black Elderberry*	*Sambucus nigra* ssp. *canadensis*
Boston Swordfern*	*Nephrolepsis exaltata*
Boxelder*	*Acer negundo*
Buttonbush*	*Cephalanthus occidentalis*
Cattail*	*Typha* spp.
Chinese Privet*	*Ligustrum sinense*
Chinese Tallow Tree*	*Triadica sebifera*
Common Greenbrier*	*Smilax rotundifolia*
Deer Pea	*Vigna luteola*
Dwarf Palmetto*	*Sabal minor*

Common Name	Scientific Name
Great Ragweed*	*Ambrosia trifida*
Japanese Climbing Fern*	*Lygodium japonicum*
Marsh Fern*	*Thelypteris* spp.
Peppervine*	*Ampelopsis arborea*
Poison Ivy*	*Toxicodendron radicans*
Red Maple (swamp variant)*	*Acer rubrum* var. *drummondii*
Saltbush*	*Baccharis halmifolia*
Spikerush	*Eleocharis* spp.
Trumpet Creeper*	*Campsis radicans*
Wand Lythrum	*Lythrum lineare*
Wax Myrtle*	*Morella cerifera*
Willows*	*Salix* spp.

*Indicates observed in study area during field survey.

Ecological Condition

Based on the predominance of bald cypress-tupelo forest in the Study Area, this chapter describes the ecological condition of that forest type. Numerous studies indicate a trend of declining health in deepwater, bald cypress-tupelo forests throughout coastal Louisiana (Conner et al. 1981; Barras et al. 1994; Myers et al. 1995; Chambers et al. 2005), and the forests of the Study Area are no different. The forests exhibit numerous symptoms of stress that are regionally apparent in southwest Maurepas Swamp and are most evident in more degraded locations.

In forested swamps of the southeastern United States, recorded rates of aboveground primary productivity range from roughly 200 to 2,000 g m-2 yr-1 (e.g., Mitsch and Gosselink, 1993; Conner and Day, 1976; Conner and Buford, 1998). Over a five-year study in southwest Maurepas Swamp, however, Shaffer et al. (2003) observed average aboveground productivity of only 400-700 g m-2 yr-1—rates typically associated with wetlands that are nearly permanently flooded, nutrient limited, or exhibit limited flow (e.g., Schlesinger, 1978; Taylor, 1985; Mitsch et al. 1996; Megonigal et al. 1997; Conner and Buford, 1998). A comparison of site conditions suggests that rates at the upper end of this range may be typical for the Study Area.

Comparison with the structural characteristics of other bald cypress-tupelo forests further suggests stressed growing conditions in the Study Area. More so, field observations in the Study Area and research by Shaffer et al. (2003) in adjacent areas indicate that the forests support atypically low stem densities and basal areas for the community type. Existing conditions are comparable to those of impounded or continuously flooded forests (e.g., Conner et al. 1981; Dicke and Toliver, 1990; Conner and Day, 1992; Conner and Buford, 1998). Furthermore, high mortality rates—approximately two percent or less annually according to Shaffer et al.'s (2003) estimates—coupled with limited to no regeneration threaten the persistence of these forests. Throughout coastal Louisiana, increased mortality of less flood tolerant species due to increased flooding is a common trend (Conner et al. 1981; Shaffer et al. 2003).

Interacting stressors implicated in the degradation of forests in the Study Area are increased flood duration, stagnation, salinity, and nutrient limitations as well as top-down herbivore pressure. Across the Lake Pontchartrain Basin and coastal Louisiana in general, records indicate increasing flooding depths and duration (Conner and Day, 1988; Conner and Day, 1991; Thomson et al. 2002; Shaffer et al. 2003). Flooding results in both decreased aboveground net primary productivity (Megonigal et al. 1997) and the prevention of regeneration.

Bald cypress and water tupelo are among the most flood tolerant tree species in the Southeast (e.g., Hook 1984). Though, prolonged, deep flooding over an extended period may have detrimental effects on growth and survival (Penfound, 1949; Eggler and Moore, 1961; Harms et al. 1980; Brown, 1981; Kozlowski, 1984; Conner and Brody, 1989; Dicke and Toliver, 1990; Conner and Day, 1992; Stable et al. 1992; Yount et al. 1995). Where water levels fluctuate and pulsed flows occur, bald cypress-tupelo forests exhibit among the highest productivity rates for forested ecosystems (Brinson et al. 1981; Brown, 1981; Conner and Day, 1982; Brinson, 1990; Lugo et al. 1990; Conner, 1994).

Permanent flooding prevents the regeneration of bald cypress and water tupelo, whose seeds cannot germinate under water and hence require a dry period (Mattoon, 1915; DeMaree, 1932; DuBarry, 1963; DeBell and Naylor, 1972). Seeds remain viable for an extended period when submerged or buried (DeMaree 1932; Applequist, 1959; Middelton, 2000), and seed dispersal is primarily dependent on flows (Johnson, 1990; Wilhite and Toliver, 1990). When germination does occur, seedlings can only withstand complete submergence over short intervals, up to 45 days (Souther and Shaffer, 2000), and increased mortality occurs when seedlings are inundated for greater than two weeks (Brandt and Ewel, 1989). Consequently, water levels low enough and over adequate duration to allow germination and seedling growth to heights above subsequent flood stages are required for successful regeneration of bald cypress and tupelo (Conner et al. 1986; Chambers et al. 2005). The widespread failure of coastal Louisiana forests to regenerate in bald cypress was commonplace after commercial harvests in the early twentieth century due to increased impoundment (Mattoon, 1915; Conner et al. 1986). Similar impediments to regeneration remain in the Study Area today; their effects have been exacerbated by further hydrologic modifications and RSLR.

Swamps can survive short-term salinity pulses over several days to weeks (Allen et al. 1994; Campo, 1996; Conner et al. 1997; Kraus et al. 2007); however, salt stress due to increases in background levels and extended exposure during meteorological events (e.g., droughts and hurricanes) is a major factor influencing tree productivity and survival across coastal Louisiana and at all but the most interior sites in Maurepas Swamp (Pezeshki et al. 1990; Conner and Askew, 1992; Allen, 1992; McLeod et al. 1996; McCarron et al. 1998; Krauss et al. 2000; Shaffer et al. 2003; Effler et al. 2007). Together, flooding and salinity have a more detrimental effect on seedling growth and survival (Conner, 1994; Allen et al. 1996). Of the common tree species in the Study Area, bald cypress is the most salt tolerant. As salinity increases to approximately 1.2 ppt, tree species diversity decreases, and species such as water tupelo, green ash, and sweetgum are eliminated from some forests (Kraus et al. 2007). Red maple is slightly more salt tolerant but exhibits mortality at 2.5 ppt salinity (Kraus et al. 2007). At salinities above 1.8 ppt, only bald cypress remains dominant in natural settings (Kraus et al. 2007). The species is tolerant of salinities reaching 8 ppt, but is negatively affected by greater than 4 ppt salt content (Pezeshki et al. 1990; Conner and Askew, 1992; Conner, 1994; Pezeshki et al. 1995; Allen et al. 1996; Conner and Ozalp, 2002), and its natural range is less than 3-4 ppt (Harlow and Harrar, 1969; Chabreck 1972; Myers et al. 1995).

Additional stressors that impact forest health in the Study Area are nutrient limitations and herbivory. Overbank floods from the Mississippi River brought nutrient laden, sediment rich freshwater into the Study Area. Prevention of these floods has resulted in nutrient, specifically nitrogen, limitations (Lane et al. 2003; Effler et al. 2007). Herbivory also significantly influences forest health in the Study Area. Common defoliators of bald cypress and water tupelo are bald cypress leafroller (*Archips goyerana*) and forest tent caterpillar (*Malacosoma disstria*), respectively, with other minor pests (Chambers et al. 2005). The first recorded outbreak of bald cypress leafroller in Louisiana occurred in 1983 (Goyer and Lenhard, 1988; Goyer and Chambers, 1996). Regular outbreaks of forest tent caterpillar have been reported for Louisiana since 1948 (Nachod and Kucer, 1971). Nutria also negatively impact tree species regeneration (Meyers et al. 1995).

Based on field observations of forest structure within the Study Area trends observed through research in adjacent regions of Maurepas Swamp, and aerial photography (past and present), the Environmental Project Team developed a habitat condition map to spatially classify areas of swamp habitat according to degree of degradation. The classification scheme was in accordance with the approach used by Dr. Shaffer for other areas within Maurepas Swamp. Patches were discretely defined based on the relative period of time over which they would transition to fresh marsh: 20-30 years to marsh, 30-50 years to marsh, and greater than 50 years to marsh.

Figure 4-16 depicts the arrangement of these habitat condition classes across the distribution area. Acreages by condition class for the distribution area are presented in Table 4-7, with further description provided in the Wetland Value Assessment Report (**Appendix B & K**).

Table 4-7: Acreages by habitat condition class for the Study Area.

Habitat Condition Class	Acres
20-30 Years to Marsh	3,294
30-50 Years to Marsh	7,934
>50 Years to Marsh	10,140
Total	**21,368**

4.2.6.2 Upland Vegetation

Historic Conditions

Before colonization in the early eighteenth century, upland forests of white oaks, water oak, and hickories are reported to have grown in the study area on higher portions of the natural levee between the Mississippi River and the distribution area (Kelley 1989). The extent of upland vegetation increased significantly with drainage efforts. Timber harvests for revenue and to clear fields for agriculture and homesites converted much of the natural levee land cover from forests to agrarian fields.

Existing Conditions

Based on the USGS National Land Cover Database (2003) and remote verification, upland areas within the Study Area include lands in cultivation, pasture, developed, and shrub/scrub cover classes. Table 4-8 presents acreages by land cover class and location within the Study Area for upland areas.

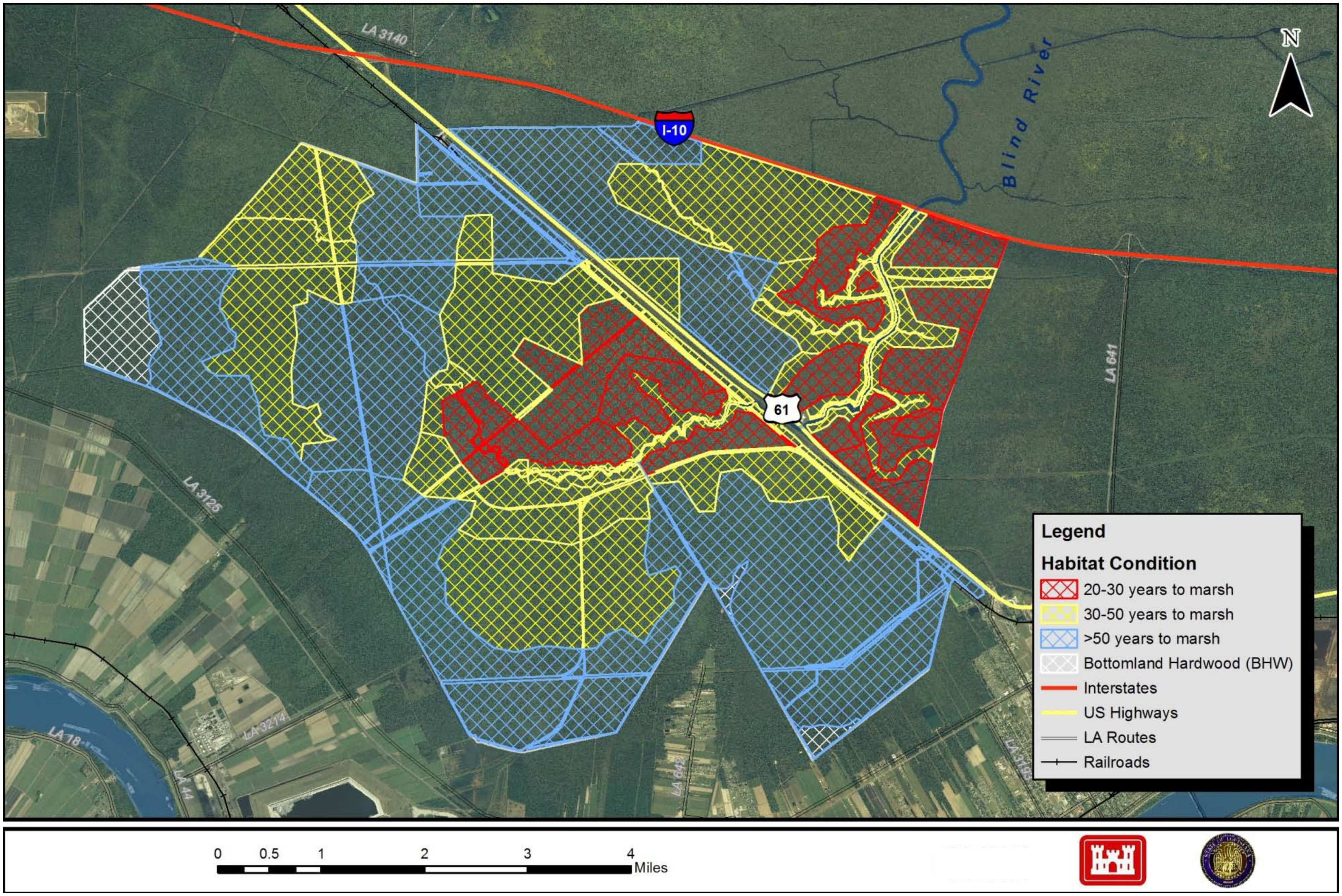

Figure 4-16. Habitat condition map for the Study Area.

Table 4-8: Upland vegetation by land cover class and Study Area location (USGS 2003).

Land Cover Class	Location		
	Distribution Area (ac)	**Romeville Transmission (ac)**	**South Bridge Transmission (ac)**
Cultivated Crops	1.3	85.8	68.1
Developed, Low Intensity	207.5	6.7	29.6
Developed, Medium Intensity	3.1	0.0	0.0
Developed, High Intensity	1.6	0.0	0.0
Pasture/Hay	8.0	0.2	0.0
Shrub/Scrub	0.0	0.9	3.3
Source: National Land Cover Database Zone 37B Land Cover Layer (USGS, 2003).			

4.2.6.3 Invasive Species - Vegetation

Historic Conditions

Federal mandate to "prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause" is provided under Executive Order 13112. Signed on February 3, 1999, the executive order created the National Invasive Species Council and charged this body with, among other tasks, overseeing its implementation.

Invasive plant species often increase and spread rapidly because the habitat into which they are introduced is free of insects and diseases that are natural controls in their native habitats (e.g., Keane and Crawley 2002). Habitats intrinsically vary in their vulnerability to invasion, with disturbance events increasing susceptibility. Picket and White (1985) define disturbance as the process by which an ecosystem is modified by an exogenous event (human or natural) to a condition that is not otherwise common for that ecosystem. By reducing competition, disturbance events facilitate the colonization and establishment of invasive species. The clearcutting of baldcypress, associated and subsequent canal construction/maintenance, levee construction and the severance of flood events, as well as tropical storms and hurricanes, all constitute disturbance events that have affected the study area.

Once established, invasive species negatively impact extant ecosystem function and structure. Through mechanisms such as competitive exclusion, these species alter the ability of native species to grow and reproduce, thus impacting the continuance of ecosystem services formerly provided. For example, invasive plant species may interfere with drainage and flood control, impede navigation and recreational activities, and degrade water and habitat quality (Westbrooks 1998). More so, invasive species frequently displace native species, often leading to their extinction (e.g., Sax et al. 2002).

Existing Conditions
In coastal Louisiana, Chinese tallow (*Triadica sebifera*), water hyacinth (*Eichhornia crassipes*), and hydrilla (*Hydrilla verticillata*) are well-known invasive plant species observed in the Study Area. More recently, common salvinia (*Salvinia minimai*), a floating aquatic fern, has colonized and established populations in the Study Area and often covers the parish drainage canals (LCA 2004, LACPR 2008). Alligator weed (*Alternanthera philoxeroides*) also grows in the canals and interior swamp of the Study Area. Chinese tallow and chinaberry (*Melia azerdarach*) are established on berms along the canals. Invasive plant species that were not observed in the Study Area but are confirmed within the Lake Maurepas Watershed and thus may likely be present in the Study Area include parrot feather (*Myriophyllum aquaticum*), wild taro (*Colocasia esculenta*), Brazilian waterweed (*Egeria densa*), and water lettuce (*Pistia stratiotes*) (Kravitz et al. 2005).

4.2.6.4 Rare, Unique, and Imperiled Vegetation

The following unique communities, nested within the broader vegetative habitats, are important in that they contribute to the extensive diversity of the coastal ecosystem, are the basis for its productivity, and are essential to the maintenance of its biodiversity. Overall, plant communities provide protection against substrate erosion and contribute food and physical structure for cover, nesting, and nursery habitat for wildlife and fisheries. Continued degradation and loss of existing wetland areas, in concert with the truncation of replenishing processes, will accelerate decline in the interdependent processes of plant primary productivity and vertical maintenance through accretion necessary to sustain the ecosystem.

The LNHP, administered by the LDWF, maintains a directory of over 6,000 occurrences of rare, threatened, or endangered species; unique natural communities; and other distinctive elements of natural diversity. Across the state, LNHP has identified 380 ecologically significant sites also included in the database. The LNHP database was queried for the occurrence of rare, unique, and imperiled vegetative communities within the Study Area. Of these, the presence of bald cypress-tupelo swamp was the only recorded occurrence. Additional unique communities known to occur in Ascension and St. James parishes and recorded in the Study Area by the 1988 NWRC habitat map and field inventory include bottomland hardwood forest and fresh marsh.

Bald cypress-tupelo Swamp (Rarity Rank S4/G3G5)

Despite the prevalence of bald cypress-tupelo forest in the Study Area, statewide estimates of swamp losses range from 25-50% of the original presettlement acreage, and old-growth forests are very rare statewide and regionally. Numerous inter-related and synergistic forces threaten the persistence and expansion of bald cypress-tupelo swamp. Threats include, but are not limited to, development activities; saltwater intrusion, subsidence, and hydrologic alteration; logging (where natural and artificial regeneration is prohibited or soil damage likely); chemical contamination; and invasive exotic species.

Bottomland Hardwood Forest (Rarity Rank S4/G4G5)

Throughout Louisiana, bottomland hardwood forests are found in all river basins. However, the current range has been significantly reduced, with loss estimated at 50-75% of its original presettlement acreage with old growth stands very rare. Historically, clearing of forests for agricultural production has been the primary cause of habitat fragmentation and destruction. Additional past and present threats include hydrologic alterations; construction of roads, utilities, and pipelines; and invasive exotic species.

Fresh Marsh (Rarity Rank S1S2/G3G4)

Although fresh marshes, as previously described, compose a large amount of the entire coastal marsh acreage, the LNHP ranks this community as imperiled because it has undergone the largest reduction in acreage of any marsh type over the past 20 years due to saltwater intrusion. Of the estimated 1 to 2 million acres of fresh marsh in Louisiana during presettlement times, only 25-50% of this habitat remains. Saltwater intrusion poses a significant threat to this habitat type, in addition to other factors

4.2.7 Wildlife and Habitat

This resource is institutionally significant because of the National Environmental Policy Act of 1969; the Coastal Zone Management Act; Estuary Protection Act; the Fish and Wildlife Coordination Act of 1958, as amended; the Migratory Bird Conservation Act of 1929, as amended; the Migratory Bird Treaty Act of 1918; the Endangered Species Act of 1973 (ESA), as amended; the Fish and Wildlife Conservation Act of 1980; the North American Wetlands Conservation Act; Executive Order 13186 Migratory Bird Habitat Protection; Migratory Bird Conservation Act; and the Marine Mammal Protection Act. Wildlife resources are technically significant because they are a critical element of the coastal ecosystem, they are an important indicator of the health of coastal habitats, and many wildlife species are important recreational and commercial resources. Wildlife resources are publicly significant because of the high priority that the public places on their aesthetic, recreational, and commercial value.

Beyond local and regional scales, the wildlife resources of Louisiana constitute a critical component of the nation's biodiversity reserve. Over forty percent of the vegetated, estuarine wetlands in the contiguous United States are in Louisiana, harboring a diverse assemblage of species dependent on this habitat. Further, the economic value of the ecosystem services provided by these systems is immense (Costanza et al. 1997). Louisiana's coastal wetlands provide important habitats for various life cycle stages for over 50 rare, threatened, and endangered species.

Table 4-9 shows the status, functions of interest, trends, and projections from 1985 through 2050 for avifauna, furbearers, game mammals, and reptiles within the study area (LCWCRTF & WCRA, 1999).

4.2.7.1 Birds

Historic Conditions

Coastal Louisiana's wetlands have historically supported an abundance of neotropical and other migratory and non-migratory avian species, such as rails, gallinules, shorebirds, wading birds, and waterfowl. Diving ducks, seabirds, rails, coots, and gallinules have historically preferred the open water habitats of Lake Maurepas and West Manchac Land Bridge, while wading birds have occurred in fresh swamp habitats, such as those found in the study area.

The LCWCRTF & WCRA (1999) reports that since 1985 most bird species and species groups have exhibited either increasing or stable populations in the study area (Table 4-10). Notable increases have been observed for bald eagles, wading birds, and other woodland residents, such as pileated woodpecker, Carolina chickadee, and belted kingfisher, in the Amite/Blind River Mapping Unit, which includes the study area.

Louisiana coastal wetlands also have historically served as essential stopover habitat for neotropical migratory birds on their annual migration route. Whereas bottomland hardwood forests provide critical breeding habitat for approximately 70 species of birds, diversity is lower in baldcypress-tupelo swamp forests (Kennedy 1977, Wakeley and Roberts 1996). Nonetheless, baldcypress-tupelo swamp forests support dense breeding populations of several neotropical migrants. Many of these species have undergone long-term population declines and are of regional conservation concern (Sauer et al. 2003). Within the study area, these species include northern parula (*Parula americana*), prothonotary warbler (*Protonotaria citrea*), and yellow-throated warbler (*Dendroica dominica*), of which the latter is of greatest concern (Kennedy 1977, Stouffer et al. 2005).

Multiple organizations have officially recognized the study area's importance as critical habitat for avian species. The Audubon Society named Maurepas Swamp an official Important Bird Area on May 12, 2007 based on its status as one of the largest contiguous tracts of wetland forest remaining in the Lower Mississippi River Alluvial Valley and its support of over 20,000 breeding pairs of yellow-throated warblers and 190,000 breeding pairs of northern parula and prothonotary warbler nests per year. The North American Waterfowl Management Plan (NAWMP), Gulf Coast Joint Venture (GCLV): Mississippi River Coastal Wetlands Initiative identified the coastal marshes and forested wetlands of the Lake Pontchartrain Basin as a key waterfowl wintering area (Wilson, 2002).

Table 4-9: Status, functions of interest, trends, and projections from 1985 through 2050 for avifauna, furbearers, game mammals, and reptiles within the study area (LCWCRTF & WCRA, 1999).

Mapping Unit	1988 Habitat		Avifauna															
	Type	% of Unit	Bald Eagle				Seabirds				Wading Birds				Dabbling Ducks			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Amite/Blind	FS	73	Ne	Hi	I	I		NH			Ne	Hi	I	Sy	Mu	Lo	Sy	Sy
	HF	21		NH				NH				NH			Mu	Lo	Sy	Sy
Lake Maurepas	OW	100	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy		NH			W	Lo	Sy	Sy
Tickfaw River Mouth	FS	53	Ne	Lo	Sy	Sy		NH			Ne	Hi	I	Sy	Mu	Lo	Sy	Sy
	HF	37		NH				NH				NH			Mu	Lo	Sy	Sy
West Manchac Land Bridge	OW	6		NH			Mu	Mo	Sy	Sy		NH			W	Lo	Sy	Sy
	FM	22		NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	W	Lo	D	D
	FS	61	Ne	Lo	I	I		NH			Ne	Hi	I	Sy	W	Lo	Sy	Sy
	HF	11		NH				NH				NH			W	Lo	Sy	Sy

Habitat Types: FS = Fresh swamp; HF = Hardwood Forest; OW = Open Water. Habitat types comprising less than 5% of unit are shown only if habitat type is particularly rare or important to wildlife.
Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo = Moderate Numbers; Hi = High Numbers.

Functions of Particular Interest: Ne = Nesting; St = Stopover Habitat; W = Wintering Area; Mu = Multiple Functions.

Trends (since 1985) / **Projections** (through 2050): Sy = Steady; D = Decrease; I = Increase; U = Unknown.

Table 4-9 (*continued*): Status, functions of interest, trends, and projections from 1985 through 2050 for avifauna, furbearers, game mammals, and reptiles within the study area (LCWCRTF & WCRA, 1999).

Mapping Unit	1988 Habitat		Avifauna (cont.)																			
	Type	% of Unit	Diving Ducks				Raptors				Rails, Coots, and Gallinules				Other Marsh / OW Residents				Other Woodland Residents			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Amite/Blind	FS	73		NH				NH				NH			Ne	Lo	Sy	Sy	Ne	Mo	I	Sy
	HF	21		NH				NH				NH				NH			Ne	Hi	I	D
Lake Maurepas	OW	100	W	Lo	Sy	Sy		NH			W	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH		
Tickfaw River Mouth	FS	53		NH			Mu	Mo	Sy	Sy		NH			Ne	Lo	Sy	Sy	Ne	Mo	I	Sy
	HF	37		NH			Mu	Hi	I	D		NH				NH			Ne	Hi	I	D
West Manchac Land Bridge	OW	6	W	Lo	Sy	Sy		NH			W	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH		
	FM	22	W	Lo	D	D	Mu	Lo	Sy	Sy	Mu	Lo	D	D	Ne	Hi	Sy	Sy		NH		
	FS	61		NH			Mu	Mo	I	Sy		NH			Ne	Lo	Sy	Sy	Ne	Mo	I	Sy
	HF	11		NH			Mu	Hi	I	D		NH				NH			Ne	Hi	I	D

Habitat Types: FS = Fresh swamp; HF = Hardwood Forest; OW = Open Water. Habitat types comprising less than 5% of unit are shown only if habitat type is particularly rare or important to wildlife

Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo = Moderate Numbers; Hi = High Numbers.

Functions of Particular Interest: Ne = Nesting; St = Stopover Habitat; W = Wintering Area; Mu = Multiple Functions.

Trends (since 1985) / **Projections** (through 2050): Sy = Steady; D = Decrease; I = Increase; U = Unknown.

Table 4-9 (*continued*): Status, functions of interest, trends, and projections from 1985 through 2050 for avifauna, furbearers, game mammals, and reptiles within the study area (LCWCRTF & WCRA, 1999).

Mapping Unit	1988 Habitat		Avifauna (cont.)								Furbearers											
	Type	% of Unit	Other Marsh/OW Migrants				Other Woodland Migrants				Nutria				Muskrat				Mink, Otter, and Raccoon			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Amite/Blind	FS	73	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	HF	21		NH			Mu	Mu	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
Lake Maurepas	OW	100	Mu	Mo	Sy	Sy		NH				NH				NH				NH		
Tickfaw River Mouth	FS	53	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	HF	37		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
West Manchac Land Bridge	OW	6	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	FM	22	Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	FS	61	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	HF	11		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy

Habitat Types: FS = Fresh swamp; HF = Hardwood Forest; OW = Open Water. Habitat types comprising less than 5% of unit are shown only if habitat type is particularly rare or important to wildlife

Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo = Moderate Numbers; Hi = High Numbers.

Functions of Particular Interest: Ne = Nesting; St = Stopover Habitat; W = Wintering Area; Mu = Multiple Functions.

Trends (since 1985) / **Projections** (through 2050): Sy = Steady; D = Decrease; I = Increase; U = Unknown.

Table 4-9 (*continued*): Status, functions of interest, trends, and projections from 1985 through 2050 for avifauna, furbearers, game mammals, and reptiles within the study area (LCWCRTF & WCRA, 1999).

Mapping Unit	1988 Habitat		Game Mammals												Reptiles			
	Type	% of Unit	Rabbits				Squirrels				Deer				American Alligator			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Amite/Blind	FS	73	Mu	Lo	D	D	Mu	Lo	Sy	D	Mu	Mo	I	D	Mu	Mo	I	I
	HF	21	Mu	Lo	D	D	Mu	Mo	Sy	D	Mu	Mo	I	S	Mu	Lo	Sy	Sy
Lake Maurepas	OW	100		NH				NH				NH				NH		
Tickfaw River Mouth	FS	53	Mu	Lo	Sy	D	Mu	Lo	Sy	Sy	Mu	Mo	I	D	Mu	Mo	I	I
	HF	37	Mu	Lo	Sy	D	Mu	Mo	Sy	Sy	Mu	Mo	I	S	Mu	Lo	Sy	Sy
West Manchac Land Bridge	OW	6		NH				NH				NH			Mu	Mo	I	I
	FM	22	Mu	Lo	D	D		NH			Mu	Lo	Sy	D	Mu	Mo	I	I
	FS	61	Mu	Lo	D	D	Mu	Lo	D	D	Mu	Mo	Sy	D	Mu	Mo	I	I
	HF	11	Mu	Lo	D	D	Mu	Mo	D	D	Mu	Mo	Sy	D	Mu	Lo	Sy	Sy

Habitat Types: FS = Fresh Swamp; HF = Hardwood Forest; OW = Open Water. Habitat types comprising less than 5% of unit are shown only if habitat type is particularly rare or important to wildlife.

Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo = Moderate Numbers; Hi = High Numbers.

Functions of Particular Interest: Ne = Nesting; St = Stopover Habitat; W = Wintering Area; Mu = Multiple Functions.

Trends (since 1985) / **Projections** (through 2050): Sy = Steady; D = Decrease; I = Increase; U = Unknown.

Existing Conditions
Over four-hundred species of birds are known to occur in Louisiana, most of which inhabit the coastal region. During a bird survey of Maurepas Swamp conducted from 2002 to 2005, Stouffer et al. (2005) observed 117 bird species of 14 orders and 38 families. Research indicates that the diversity of bird species in the forested wetlands of the study area is directly related to habitat condition. Zoller (2004) reported that the mean number of migrant bird species observed in less degraded sites was nearly four times higher than in degraded sites in Maurepas Swamp. Despite the high species richness of wading birds, densities are typically low, and large nesting colonies are absent or rare within the swamp suggesting that suitable habitat may be limited for these species (LDWF 2001, Stouffer et al 2005). Colonial wading bird nesting colonies have not been reported within the study area but have been recorded in Maurepas Swamp to the north and east of the study area, though the status of these colonies is unknown (LNHP 2009).

4.2.7.2 Mammals

Historic Conditions
Across the state, coastal wetlands have historically provided habitat for many of the 58 terrestrial mammal species known to occur in Louisiana (Lowery, 1974). Common game mammals have included white-tailed deer, eastern cottontail, swamp rabbit, gray squirrel, fox squirrel, and raccoon; furbearers have included muskrat, nutria, raccoon, mink, Virginia opossum, striped skunk, bobcat, beaver, and coyote. Various other non-game mammals have inhabited the state, including bats, rodents, and the nine-banded armadillo. Historically, large populations of furbearers, particularly mink and raccoon have been reported in nearby baldcypress-tupelo swamps (Tinkle, 1955). The LCWCRTF & WCRA (1999) reports that since 1985 furbearer populations have typically remained stable across the Upper Pontchartrain Basin (Table 4-10). Rabbit populations, conversely, have experienced declines in the Amite/Blind and West Manchac Land Bridge mapping units, as have squirrels in the West Manchac Land Bridge mapping unit. Squirrel populations have remained steady in the study area, while deer populations have increased (Table 4-11).

Existing Conditions
Despite changes in populations, mammal species historically present in the Upper Pontchartrain Sub-Basin remain today. The coastal wetlands in the study area provide important and essential wildlife habitats, especially transitional habitat between estuarine and marine environments used for shelter, nesting, feeding, cover, and other life requirements. However, both game animals and furbearers are typically found at low densities (Table 4-10). Although one-third of Louisiana's deer population is reported to live in the coastal marshes, very few studies have reported on their feeding and habitat requirements in this environment. According to Gosselink (1984), fresh marshes are preferred by deer almost to the exclusion of brackish and saline marshes. Mammal species likely to occur within the study area based on available habitat and species' distributions and habitat preferences are included in Table 4-10.

Table 4-10: Mammal species likely to occur within the study area based on available habitat and species' distributions and habitat preferences.

Common Name	Scientific Name
Beaver	*Castor Canadensis*
Bobcat	*Felis rufus*
Cotton Mouse	*Peromyscus gossypinus*
Cotton Rat	*Sigmodon nispidus*
Coyote	*Canis latrans*
Eastern Cottontail	*Sylvilagus floridanus*
Eastern Harvest Mouse	*Reithrodontomys humulis*
Eastern Spotted Skunk	*Spilogale putorius*
Feral Hog	*Sus scrofa*
Fox Squirrel	*Sciurus niger*
Golden Mouse	*Ochrotomys nuttalli*
Gray Fox	*Urocyon cinereoargenteus*
Gray Squirrel	*Sciurus carolinensis*
House Mouse	*Mus musculus*
Least Shrew	*Cryptotis parva*
Long-tailed Weasel	*Mustela frenata*
Marsh Rice Rat	*Oryzomys palustris*
Mink	*Mustela vison*
Muskrat	*Ondatra zibethicus*
Nine-banded Armadillo	*Dasypus novemcinctus*
Nutria	*Myocastor coypus*
Old World Rats	*Rattus* spp.
Raccoon	*Procyon lotor*
Red Fox	*Vulpes vulpes*
River Otter	*Lutra canadensis*
Southern Flying Squirrel	*Glaucomys volans*
Southern Short-tailed Shrew	*Blarina carolinensis*
Striped Skunk	*Mephitis mephitis*
Swamp Rabbit	*Sylvilagus aquaticus*
Virginia Opossum	*Didelphis virginiana*
West Indian Manatee	*Trichechus manatus*

4.2.7.3 Reptiles

Historic Conditions

Deepwater baldcypress-tupelo swamps historically provided habitat for only a few locally abundant reptile species (Wharton et al. 1982). The most common reptiles have included snakes, turtles, skinks, and the American alligator (*Alligator mississippiensis*). Due to the ecological and economic importance of the American alligator, historical and current figures on population numbers are available. In contrast, data on other reptile species in the area is unavailable.

The American alligator has been historically exploited in Louisiana since the 1880s. The species was considered endangered throughout its range by the 1960s due to habitat destruction and overharvest. Harvests were driven by the high economic value of their skin and meat, and in the taking of nuisance individuals. In 1962, the state of Louisiana outlawed the slaughter of alligators, but illegal harvests continued. Due to population declines, the species was listed under the federal Endangered Species Preservation Act of 1967.

During the 1960s, the LDWF developed a scientifically-based management program for the species that allowed incremental harvest of alligators after the species' delisting in 1967 and has resulted in the proliferation of alligator populations. Legal hunting was reinstituted in 1972, and since then, alligator numbers have increased ten-fold. Over $500 million in revenue has been generated through the program. Based on the program's effectiveness, numerous states across the Southeast have used it as a model of wildlife management in designing similar programs.

Existing Conditions

Based on LDWF survey data from 1996-2000, alligator nest densities within the study area are medium (approximately 1 nest per 250 acres). In June-August 2006, alligator spotlight surveys were conducted in the Maurepas Swamp. Alligators in size classes less than four feet long were most frequently detected (Stouffer et al. 2005). Few alligators under one foot long or over seven feet long were detected. Although the trend was not documented, alligator density, and the density of large alligators, appeared to increase with proximity to Lake Maurepas (Stouffer et al. 2005).

There are at least four lizard species, 16 snake species, and 9 turtle species documented in baldcypress-tupelo swamps of southern Louisiana (Dundee and Rossman, 1989). The lack of recorded evidence obscures accurate historic and existing conditions for other reptile species that are known or are likely to have inhabited the Maurepas Swamp.

Amphibians

The baldcypress-tupelo swamp ecosystem in southern Louisiana supports a wide array of amphibians. Many species of amphibians are known or likely to occur in the study area. Amphibians are often exceptional indicators of wetland ecosystem health. Limited information exists regarding historic population trends of amphibians in the study area and baldcypress-tupelo forests in general.

Historic Conditions

Historic information on amphibians in the study area is limited. Data obtained through literature accounts and museum specimens suggest the presence of pig frogs (*Rana grylio*) (Dundee and Rossman 1989) in Ascension and St. James Parishes. This species, along with the bullfrog, are important to the Louisiana frog-leg industry. In a study on similar habitat close in proximity to the study area, Tinkle (1954) observed numerous amphibian species over the course of a year.

Existing Conditions

Many studies have documented the continued decline of amphibian populations worldwide. The situation is no different in Louisiana. The LDWF established the Louisiana Amphibian Monitoring Program (LAMP) in 1996 to gain detailed information on the possible causes of amphibian decline. The LAMP is a primarily volunteer-driven effort to accumulate data on Louisiana's amphibians. To date, the majority of the organization's efforts have been towards establishing calling frog surveys. Several of the monitoring sites established for such surveys are near the study area.

The baldcypress-tupelo ecosystem in southern Louisiana supports a wide variety of frogs, toads, and salamanders. The abundant water, shelter, and food sources enable several species to thrive. At least 13 species of frogs and toads and six species of salamanders are known to inhabit this community type in southern Louisiana.

4.2.7.4 Invasive Wildlife Species

Historic Conditions

Invasive wildlife species are institutionally significant because of Executive Order 13112. They are technically significant because of the damage they can cause to coastal wetlands that provide important and essential fish and wildlife habitats, used for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements. Prior to the reported introduction of nutria (*Myocastor coypus*) to Louisiana in 1937 (USGS, 2000), no invasive wildlife species were present in the study area. The species likely appeared in the study area shortly after its introduction based on its rapid dispersal throughout coastal Louisiana. A substantial population increase was attributed to a decline in the price of nutria pelts in 1989 (USGS, 2000).

Existing Conditions

Although population estimates are uncertain, nutria is currently present within the study area according to field observations and reports. The species is a voracious herbivore that consumes the roots of wetland plants, including the seedlings of woody species and herbaceous and aquatic plants at all life stages (USGS, 2000;

APHIS, 2005). Areas of extensive nutria damage, or "eat outs," alter the composition and habitat type of wetland communities (USGS 2000, APHIS 2005). Research suggests that nutria damage may substantially reduce herbaceous productivity in Maurepas Swamp (Shaffer et al. 2006). Further, nutria damage may limit the regeneration of baldcypress and other wetland tree species (Blair and Langlinais, 1960; Conner et al. 1986; Conner, 1988; Brantley and Platt, 1992; Myers et al. 1995; Chambers et al., 2005).

Currently, a 2002 Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Coast-wide Nutria Control Program is in place to reduce nutria populations and reduce negative impacts on wetland communities. The program offers incentives for nutria harvesting and monitors vegetation damage and habitat changes due to nutria herbivory. As of the 2009 report, over two million nutria have been harvested from the program area since its inception, averaging over three hundred thousand nutria per year (Wiebe and Mouton, 2009). In St. James Parish, 34,040 nutria have been harvested. Annual vegetation surveys of the program area have shown a decrease in the estimated acres of herbivory damage from 97,271 acres in 2000 to 20,333 acres in 2009 for coastal Louisiana. Data specific to St. James and Ascension Parishes are not available.

4.2.8 Aquatic Resources

4.2.8.1 Plankton

This resource is institutionally significant because of the National Environmental Policy Act of 1969, the Coastal Zone Management Act, and the Estuary Protection Act. This resource is technically significant because plankton provide a major, direct food source for animals in the water column and in the sediments; plankton are responsible for at least 40 percent of the photosynthesis occurring on the earth; plankton are important for their role in nutrient cycling; plankton productivity is a major source of primary food-energy for most estuarine systems throughout the world; and phytoplankton production is the major source of autochthonous organic matter in most estuarine ecosystems (Day et al. 1989). This resource is publicly significant because plankton constitute the lowest trophic food level for many larger organisms important to commercial and recreational fishing. In addition, there is a public health concern with noxious plankton blooms (red and brown tides) that produce toxins, and large-scale blooms can lead to hypoxic conditions, which can result in fish kills. Consistent with 40 CFR Parts §§1500.4 (j) and 1502.21 description of plankton resources provided in the LCA PEIS (2004) is hereby incorporated by reference.

Lower Mississippi River

Historic Conditions

Limited information is available regarding historic plankton resources in the Lower Mississippi River. Zooplankton in the Lower Mississippi River have served as an important food source for many fish species. Despite their importance in the trophic web, little is known about zooplankton populations in this waterbody (USGS 1998).

Sabol et al. (1984) noted that the main channel of the Mississippi River was characterized by low concentrations of chlorophyll and zooplankton.

The Louisiana Wildlife and Fisheries Commission (1971) prepared "The Cooperative Gulf of Mexico Estuarine Inventory and Study, Louisiana" in 1971, in which they summarize the status of plankton resources across the coastal estuaries of Louisiana during the late 1960s. The dominant member of the zooplankton community throughout that study was the copepod *Acartia tonsa*. The Mississippi River exhibited high species diversity in relation to other locations sampled.

Existing Conditions

Limited information is available regarding existing plankton resources within the Lower Mississippi River. Pinkney et al. (2009) observed that both high turbidity and total suspended sediment concentrations limit light penetration in the river's water column. When turbidity exceeds 50 mg/L, light is attenuated rapidly restricting phytoplankton photosynthesis to a shallow zone (Pinckney et al. 2009).

Blind River and Maurepas Swamp

Historic Conditions

Plankton communities serve an important role in the coastal waters of Louisiana. Phytoplanktons are the primary producers of the water column, and forms the base of the estuarine food web. Zooplankton provide the trophic link between the phytoplankton and intermediate level consumers such as aquatic invertebrates, larval fish, and smaller forage fish species (Day et al. 1989). Coastal swamps characterized by historic ditching, brown water, and low nutrient concentrations have been found to have numerous species of zooplankton present (Anderson et al. 1977). Zooplankton populations present in swamp ditches were similar to those found in the adjacent lake in a study by Anderson et al. (1977).

Historically, salinity appears to be the chief controlling factor of species richness (the number of species) in a community, while temperature, competition, and predation regulate population densities (Day et al. 1989). The abundance of certain zooplankton species may be indicative of fishing conditions. While some zooplankton are euryhaline, others have distinct salinity preferences (Day et al. 1989).

Existing Conditions

There is little information available on plankton communities in Lake Maurepas and the upstream waterbodies in Maurepas Swamp. Data available for Lake Maurepas supports the dominance of Anabena, dinoflagellates, diatoms, and cyanobacteria with occasional strong presence of chlorophytes (Atilla et al. 2007).

Phytoplankton

Phytoplankton are tiny, single-cell algae that drift with the motion of water. The dominant groups are diatoms and dinoflagellates. Other important groups include cryptophytes, chlorophytes (green algae), and chrysophytes (blue-green algae). In

Louisiana, eutrophic conditions can induce noxious blooms of blue-green algae. These algal blooms are often, but not always, dominated by a single species of the genus Anabaena or Microcystis. Large-scale blooms result in hypoxic conditions that can cause fish kills, and some species even produce toxins. Occurrence of algal blooms tends to occur in freshwater and oligohaline waters with a maximum salinity of approximately 7 ppt.

Large-scale blooms of blue-green algae occurred in Lake Pontchartrain in 1993 and 1997, with smaller blooms observed in other years. The 1997 bloom occurred after a month-long opening of the Bonnet Carre Spillway, which introduced up to 240,000 cfs of Mississippi River water into Lake Pontchartrain. Blooms in the lake are not unusual in July and August when light winds allow for low turbidity. This in turn allows for light penetration into the water column, and in combination with high nutrient concentrations and high temperatures, conditions are optimal for phytoplankton growth. Lake Pontchartrain, Lac Des Allemands, and various other coastal lakes that receive runoff high in nutrients experience algal blooms under these conditions. Runoff from fertilized areas, including lawns, golf courses, agricultural fields and both treated and untreated sewerage contribute nutrients that promote eutrophication.

Increased primary productivity often results from high nutrient loading in waterbodies; however, in and of itself, this is not necessarily detrimental. Phytoplankton production is the major source of autochthonous (produced within the system) organic matter in most estuarine systems (Day et al. 1989), and as such, it is essential for the outwelling of organic material and the maintenance of complex estuarine trophic webs. In fact, abundant growth of green algae can be observed in healthy waterbodies. When productivity exceeds the systems threshold during blooms, particularly of blue-green algae, detrimental impacts are incurred.

Palustrine freshwater swamps such as the study area have been observed to be both sources and sinks of nutrients, particularly nitrogen. Whereas phosphorus is often the limiting nutrient responsible for inducing algal blooms in inland systems, nitrogen is more often the limiting nutrient in coastal ecosystems (Lane et al. 2003). Plant uptake of phosphorus and allocation to biomass is typically low, with phosphorus storage in the system typically occurring through adsorption to sediment. As such, sediment transport further leads to mobilization of phosphorus. Denitrification drives large reductions of nitrogen in wetland systems, but burial in subsiding sediments provides an alternate means of nutrient storage in wetland systems (Lane et al. 2003).

4.2.8.2 Benthic Resources

These resources are institutionally significant because of the NEPA of 1969; the Coastal Zone Management Act; and the Estuary Protection Act. These resources are technically significant because the bottom of an estuary regulates or modifies most physical, chemical, geological, and biological processes throughout the entire estuarine system through what is called a "benthic effect." Benthic animals are directly or indirectly involved in most physical and chemical processes that occur in estuaries (Day et al. 1989). Benthic resources are publicly significant because members of the epibenthic community (e.g., oysters, mussels, etc.) provide commercial and recreational fisheries as well as creating oyster reef habitats used by many marine and estuarine organisms.

Lower Mississippi River

Historic Conditions

Due largely to difficult sampling conditions, historic populations of benthic organisms are relatively unknown in the Lower Mississippi River. Habitat destruction has undoubtedly had an effect on benthic populations and has been documented. Most floodplain habitats have decreased dramatically due to the development of the levee system and development under the MR&T project. The loss of a substantial portion of floodplain habitats has indirectly affected invertebrates within the river ecosystem by reducing suspended and dissolved organic matter (Baker et al. 1991).

In addition, channel habitat has declined modestly due to losses from river shortening and to a general constriction of river width by dikes to produce a deeper navigation channel. The historic presence of 125 or more islands, and the sandbar habitats associated with these islands, would have provided conditions for a number of oligochaetes and chironomids that are now exceedingly rare (Baker et al. 1991). Natural steep bank habitat has declined substantially due largely to the construction of revetments and dikes, especially at the upstream entrance to secondary channels, and to the overall shortening of the river that has resulted from navigation and flood control works.

Existing Conditions

Potential macroinvertebrate habitats in the Lower Mississippi River near the Romeville and South Bridge diversion intake sites include channel, natural bank, revetment bank, and pool. Macroinvertebrates common to these habitats per Baker et al. (1991) are included in **Table 4-11**.

Table 4-11: Common macroinvertebrates by habitat type for the Lower Mississippi River (Baker et al. 1991).

Channel, lotic sandbar	Natural steep bank	Revetted bank	Lentic sandbar	Pool	Tributary, Oxbow lake, Borrow pit, slough	Seasonal floodplain	Pond
Sand-Gravel *Corbicula* Oligochaeta Chironomidae Microturbel laria Nematoda	**Sand-Gravel** Ephemeroptera *Corbicula* Trichoptera Amphipoda **Clay** Ephemeroptera Trichoptera Chironomidae Amphipoda **Snags** Trichoptera Chironomidae Oligochaeta	**ACM[1]** Trichoptera Chironomidae Ephemeroptera Oligochaeta Amphipoda **Sand** Oligochaeta Chironomidae Nematoda	**Sand-Silt** Oligochaeta Ephemeroptera Chironomidae Cladocera Copepoda	**Sand-Gravel** *Corbicula* Oligochaeta Chironomidae Trichoptera **Mud-Sand** Oligochaeta *Chaoborus* Chironomidae Ephemeroptera **Clay** Trichoptera Ephemeroptera **Dikes** Trichoptera Ephemeroptera Chironomidae	**Mud** Oligochaeta *Chaoborus* *Sphaerium* Chironomidae **Clay** Oligochaeta *Chaoborus*	**Mud, Debris** Lumbriculidae Enchytraeidae Turbellaria Nematoda Oligochaeta Copepoda Isopoda Amphipoda Chironomidae Ostracoda	**Mud, Debris** Oligochaeta Copepoda Ostracoda Nematoda Chironomidae Amphipoda Isopoda Odonata *Sphaerium* Turbellaria *Chaoborus* Plecoptera

[1]Articulated concrete mattress revetment

Macroinvertebrate communities of channel habitat were once thought to exhibit low diversity and abundance. However, recently, a unique assemblage of very small organisms (three chironomids, nematodes, aeolosomatid worms, and microturbellarians) has been found in very high densities in sand substrates (Baker et al. 1991).

Revetments in the study area are constructed of mostly articulated concrete mattress (ACM) with riprap occasionally near the top bank. Revetment habitat is colonized by a large number of macroinvertebrate species, and densities are often quite high. Caddisflies are abundant wherever unsedimented ACM is exposed to strong currents. Where sediments cover the revetment, oligochaetes, amphipods, and some chironomids are found (Baker et al. 1991).

Invasive Benthic Species

Invasive benthic species are institutionally significant because of Executive Order 13112. They are technically significant because of the damage they can cause to coastal wetlands in the study area. Damage to these systems is of public concern in that it impedes their capacity to provide services valued by society. Introduced from Eurasia to the Great Lakes in 1988, the zebra mussel (*Dreissena polymorpha*) had spread through the Mississippi River's drainage to Louisiana by 1992 (USGS, 2009). Diversion of freshwater from the Mississippi River into the study area would likely result in the introduction of zebra mussels. Research is currently underway to determine the range of zebra mussels in Louisiana and the potential impacts to the Lake Pontchartrain Basin from the potential introduction of this species through the proposed diversions (Font, 2007).

Blind River and Maurepas Swamp

Historic Conditions

Within riverine and forested wetland systems, aquatic and wetland invertebrates are critical components of the trophic web. Of these, benthic macroinvertebrates tend to dominate deepwater swamp invertebrate communities. Characteristic species include crayfish, clams, oligochaete worms, snails, freshwater shrimp, midges, amphipods, and various immature insects (Mitsch and Gosselink 1993). Primary factors regulating species distribution and abundance are the water depth, duration of flooding, current, substrate, food availability, and oxygen level (Beck 1977; Sklar 1983; Murkin et al. 1992). Pulsing and periodic flooding are important in maintaining the density and diversity of invertebrate communities (Sklar and Conner 1979, Conner and Buford 1998). Several studies have found a high diversity and density of invertebrates in both permanently flooded (Mitsch and Gosselink 1993; Sharitz and Mitsch 1993) and seasonally inundated (Sklar and Conner 1979) baldcypress-tupelo forested wetlands. Compared to other habitat types, baldcypress-tupelo wetlands may support higher invertebrate densities. In the Atchafalaya Basin of Louisiana, Beck (1977) observed greater invertebrate densities in a baldcypress-tupelo swamp (3,768 individuals/m^2) than nearby bayous (3,292/m^2), lakes (1,840/m^2), canals (1,593/m^2), and rivers (327/m^2).

Existing Conditions

Limited data exists on benthic communities in the study area. Species present are likely typical of deepwater forested wetlands and slow-flowing rivers in the region. However, the increased duration of inundation and the low flow and exchange due to impoundment have promoted a system characterized by low dissolved oxygen levels and limited drawdown of water levels to below surface elevations. These conditions likely have resulted in reduced diversity of benthic organisms. More so, species composition has likely shifted towards species more tolerant of low dissolved oxygen levels, such as oligochaetes and midges. Reduced soil bulk densities and changes in average particle size, texture, and organic content due to low sediment input may further influence habitat suitability and species presence (Day et al. 1989, Vittor and Associates 1995). Within Blind River, woody debris introduced from the adjacent swamp may provide suitable substrate for invertebrates to colonize and thus support benthic community diversity (Thorp et al. 1985).

In addition to factors previously mentioned, salinity strongly influences the species composition of invertebrate communities. Higher abundance of benthic organisms has been associated with decreasing salinity from saline to freshwater sites in coastal Louisiana (Philomena 1983). Invertebrate species vary in the range of salinities within which they can survive and their tolerance to fluxes (Day et al. 1989).

4.2.9 Fisheries

Fishery resources are institutionally significant because of the Fish and Wildlife Coordination Act of 1958, as amended; the Endangered Species Act of 1973; the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended (Magnuson-Stevens Act); the Magnuson-Stevens Act Reauthorization of 2006; the Coastal Zone Management Act; and the Estuary Protection Act. Fishery resources are technically significant because they are a critical element of many valuable freshwater and marine habitats; they are indicators of the health of various freshwater and marine habitats; and many species are commercially important. Fishery resources are publicly significant because of the high priority placed on their aesthetic, recreational, and commercial value. Consistent with 40 CFR Parts §§1500.4 (j) and 1502.21 description of the fisheries resources provided in the LCA PEIS (2004) is hereby incorporated by reference.

The NMFS in a letter dated February 20, 2009 (**Appendix C**), indicated that the water bodies and wetlands in the study area provide essential nursery and foraging habitats supportive of a variety of economically important estuarine-dependent fishery species, including blue crab, striped mullet, and Gulf menhaden.

In developing the Coast 2050 report, regional planning team members for the Upper Pontchartrain Sub-Basin assessed population trends for major fishery species within the Amite/Blind River mapping unit, which contains the study area. Over a ten- to twenty-year period, several species, including blue crab, largemouth bass, and channel catfish, exhibited stable population trends in 1999. Furthermore, populations of these species are anticipated to remain stabile through 2050. Gulf menhaden is also present in the study area, but population trends are unknown for this species (LCWCRTF & WCRA 1999).

4.2.9.1 Lower Mississippi River

Historic Conditions

The Lower Mississippi River has been sampled relatively poorly because of its great size, depth, and strong currents. Until the early 1970s, there had been almost no large-scale fish studies of the river (Baker et al. 1991). Habitats have since been studied in inverse proportion to the difficulty in sampling them. Therefore, more information is available on pools and sandbars while channels remain relatively unexplored.

Most habitats have been decreasing in abundance since river regulation activities began over 250 years ago. The single-most deleterious modification has been reduction in the amount of seasonally inundated floodplain due to levee construction (Baker et al. 1991). Channelization works that have prevented the river from meandering to form new backwater floodplain habitats have also had a negative ecological impact (Beckett and Pennington 1986).

Existing Conditions

At least 91 species of freshwater fishes have the Lower Mississippi River as their primary population center; 30 or more species may be present sporadically (Baker et al. 1991). Other studies have listed from 110 to 121 species. Fish collections from channel habitat in the Lower Mississippi River are essentially nonexistent. From what is known of its physical attributes, few species could regularly inhabit the upper and middle water column in this habitat. Some larger fishes, such as paddlefish, white bass, and striped bass, and smaller actively swimming fishes such as skipjack herring and goldeye may often occupy this area for feeding or moving among other habitats (Baker et al. 1991).

At least 63 species have been recorded from natural steep banks and 55 from revetted banks (Beckett and Pennington 1986). Centrarchids, more typical of floodplain habitats, are regularly collected along natural steep banks, but are much less common along revetments (Baker et al. 1991). A number of small species (e.g. minnows, silversides) have been documented in steep bank habitat (Beckett and Pennington 1986). Fish were primarily distributed close to the shoreline, near the bottom, or in eddies, although exceptions to this general pattern were common, and distributions can change with river stage and season.

Pools support a diverse array of species, perhaps 68 or more (Baker et al. 1991). Among mainstem habitats, the wide variety and often high densities of fishes found in these habitats may stem from the relatively benign physical conditions of pools. High biomass recordings for pools appear to be attributable to high numbers of gizzard and threadfin shad, and to a lesser extent, river carpsucker and freshwater drum (Baker et al. 1991).

4.2.9.2 Blind River, Maurepas Swamp, and Lake Maurepas

Historic Conditions

Pre-levee construction, little information exists on the condition of fisheries in the study area and throughout the state (Moore 1963). Speculatively, however, frequent inflow of Mississippi River flood water that delivered sediments, nutrients, and freshwater most likely led to a less saline, aquatic environment with physicochemical properties more conducive to fisheries.

During a survey conducted from January 1976 to August 1977, Watson et al. (1981) sampled fisheries species at six locations along Blind River from south of Highway 61 to Lake Maurepas using gill nets and rotenone. In doing so, 57 species of finfish, across 23 families and 12 orders, were collected and included 12 estuarine, 43 freshwater, one catadromous (living in freshwater but breeding in saltwater) and one anadramous (living in saltwater but breeding in freshwater) species. Freshwater species were dominant both spatially and temporally. Finfish diversity appeared to be higher at the lower stretches of Blind River, below the Amite River Diversion Canal and nearer Lake Maurepas.

Shortly preceding Watson's survey efforts, Laiche (1980) sampled fisheries at 73 locations along the Amite River to the north of the study area. Species richness was comparable to that observed by Watson, with marine species present but freshwater species predominant. The most abundant species observed included blacktail shiner (*Cyprinella venusta*), bullhead minnow (*Pimephales vigilax*), mosquitofish (*Gambusia affinis*), longear sunfish (*Lepomis megalotis*), mimic shiner (*Notropis volucellus*), blackstripe topminnow (*Fundulus notatus*), bluegill (*L. macrochirus*), and longnose shiner (*N. longirostris*).

Conversely, in earlier sampling events along the Amite River, Lantz (1970) observed only 21 species using rotenone and seine techniques. Common species collected using rotenone included blue catfish (*Ictalurus furcatus*), gizzard shad (*Dorosoma cepedianum*), spotted gar (*Lepisosteus oculatus*), freshwater drum (*Aplodinotus grunions*), channel catfish (*I. punctatus*), striped mullet (*Mugil cephalus*), and largemouth bass (*Micropterus salmoides*); young of the fish collected by seining (in order of decreasing abundance) included bluegill, black crappie (*Pomoxis nigromaculatus*), longear sunfish (*L. megalotis*), spotted bass (*M. punctulatus*), and largemouth bass.

In a later fisheries survey of Lake Maurepas, Hastings et al. (1987) used various techniques: trawls, gill nets, and rotenone. An approximately equal proportion of freshwater (55 percent) and marine (40 percent) fish species were collected in these efforts, with four-percent of individuals diadromous. A correlation was observed between the fisheries species present in the lake and mouth of Blind River and salinity levels in Lake Maurepas: marine species exhibited a higher contribution to the fisheries of Lake Maurepas and had a greater likelihood of presence in Blind River with increasing salinity levels, with the opposite trend apparent for freshwater species.

Though finfish dominate the fisheries resource of the study area, shrimp have historically constituted an important part of Louisiana's commercial fisheries by value and have been present in the vicinity of the study area (LADWF 2000). For the Lake Pontchartrain Basin, white shrimp have been typically more prevalent than brown shrimp in the inland fisheries (Schexnayder and Caffey, 2002), NMFS annual shrimp landings data from 1988-2000, however, indicate a continuing trend of brown shrimp landings exceeding those of white shrimp.

Existing Conditions

A fisheries survey of Maurepas Swamp surface waters adjacent to the study area was conducted in support of CWPPRA Project PO-29, *Mississippi River Reintroduction into Maurepas Swamp (Kelso et al. 2005).*. Based on the hydrologic connectivity of these areas, the survey should be indicative of existing fishery resources within the study area. Kelso et al. (2005) observed high spatial, variability of physical and chemical water quality parameters in southern Maurepas Swamp, with many areas characterized by hypoxic and stagnant conditions. Associated fish communities differentiated across these conditions. In total, 26 fish species were observed; however, spotted gar (*Lepisosteus oculatus*) and striped mullet (*Mugil cephalus*) composed over three-fourths of fish sampled. Community diversity was highly variable. Areas more interior to the swamp were characterized by little flow, lower pH values and lower DO levels, and exhibited lower species diversity, richness, and evenness. Similar conditions are characteristic of the study area, and as such, low fish community diversity is expected. A list of observed species is included in **Table 4-12**.

Table 4-12: Fish species sampled by Kelso et al. (2005) in southwest Maurepas Swamp.

Scientific Name	Common Name
Alosa chrysochloris	skipjack herring
Ameiurus melas	black bullhead
Amia calva	bowfin
Anguilla rostrata	American eel
Aplodinotus grunniens	freshwater drum
Brevoortia patronus	Gulf menhaden
Cyprinus carpio	common carp
Dorosoma cepedianum	American gizzard shad
Dorosoma petenense	threadfin shad
Elops saurus	ladyfish
Fundulus chrysotus	golden topminnow
Ictalurus furcatus	blue catfish
Ictalurus punctatus	channel catfish

Scientific Name	Common Name
Ictiobus cyprinellus	bigmouth buffalo
Lepisosteus oculatus	spotted gar
Lepisosteus osseus	longnose gar
Lepomis gulosus	warmouth
Lepomis humilis	orangespotted sunfish
Lepomis macrochirus	bluegill
Lepomis megalotis	longear sunfish
Lepomis microlophus	redear sunfish
Micropterus punctulatus	spotted bass
Micropterus salmoides	largemouth bass
Morone mississippiensis	yellow bass
Mugil cephalus	striped mullet
Pomoxis nigromaculatus	black crappie

The LDWF has also conducted electrofishing surveys of Blind River at five locations distributed from slightly northeast of US Highway 61 to its outflow at Lake Maurepas. Biannual, spring and fall sampling occurred from 1996-1997 and 2006-2008. Only game fish were inventoried in spring sampling events, while forage species were included in fall sampling (personal communication, Rachel Walley, LDWF, 2009). Additional species recorded in these surveys but not Kelso et al. (2005) included white crappie (*Pomoxis annularis*), black tail shiner, mosquito fish, sailfin molly (*Poecilla latipinna*), bay anchovy (*Anchoa michilli*), Atlantic croaker (*Micropogonias undulatus*), Southern flounder (*Paralichthys lethostigma*), and inland silverside (*Menidia beryllina*),

In the southwestern portion of Lake Maurepas, Peyre et al. (2007) conducted a survey of fish and decapods crustaceans during the fall of 2005 and 2006 and the spring of 2006. Ten stations stratified by salinity and representing five habitat types were sampled by electrofishing and otter trawl. Based on the number of individuals caught and catch per unit effort, low abundances of white shrimp (*Penaeus setiferus*) and blue crab (*Callinectes sapidus*) were observed. Field observations and interviews with local residents familiar with the study area confirm the occurrence of these species well into the headwaters of Blind River. These species are believed to be infrequently present in the distribution area, and when present, occur at low densities.

4.2.10 Essential Fish Habitat (EFH)

Essential fish habitat (EFH) is institutionally significant due to the 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act. This resource achieves technical significance through its critical role in sustaining various life stages of fisheries and the persistence of the species. It is publicly significant through the high priority placed on the aesthetic, recreational, and commercial value of fishery resources that are dependent on EFH.

The aforementioned 1996 amendments established a mandate that fishery management councils (FMC), with assistance from NMFS, delineate EFH in fishery management plans (FMP) or FMP amendments for all federally managed fisheries. Federal action agencies which fund, permit, or carry out activities that may adversely impact EFH are required to consult with NMFS regarding potential adverse effects of their actions on EFH, and respond in writing to NMFS and FMC recommendations. NMFS is further directed to comment on any state agency activities that may potentially impact EFH.

The study team has been coordinating with the NMFS to determine potential no action and action alternative impacts to EFH. In correspondence dated February 20, 2009, NMFS stated that no EFH exists within the study area. The study area does provide foraging and nursery habitat for economically-important, estuarine-dependent species including blue crab, striped mullet, and Gulf menhaden. Additional guidance provided April 17, 2009, indicates that Lake Maurepas is designated EFH for red drum (*Sciaenops ocellatus*) and white shrimp. If proposed alternatives will have water quality impacts on Lake Maurepas, further evaluation of potential impacts on EFH must be conducted. It is anticipated the the project will improve the water quality. During PED hydrology and water quality will be further modeled as necessary to address any remaining uncertainties regarding water quality impacts.

Historic Conditions

The study area has not historically served as EFH for any managed species.

Existing Conditions

The study area does not provide EFH for any managed species. Lake Maurepas contains designated EFH for red drum and white shrimp.

4.2.11 Threatened and Endangered Species

This resource is institutionally significant because of the Endangered Species Act of 1973, as amended, and the Marine Mammal Protection Act of 1972. Endangered (E) and threatened (T) species are technically significant because of the role these species play in maintaining ecosystems and, because of which, these species serve as indicators of overall ecosystem health. These species are publicly significant because of the public desire to protect these species and their habitat.

Historic Conditions

The study area has historically and continues presently to provide critical habitat for nesting, foraging, reproduction, and other life stage requirements for numerous threatened and endangered species. Historical records are limited for individual populations of threatened and endangered species in the study area. The distribution area likely provided suitable habitat for bald eagle and American alligator, and consequently supported the recovery of these species following their protection in 1967. As today, the Blind River and Lake Maurepas provided suitable habitat for West Indian manatee (*Trichechus manatus*) and Gulf sturgeon (*Acipenser oxyrinchus desotoi*). Pallid sturgeon (*Scaphirhynchus albus*) likely inhabited the reach of the Lower Mississippi River within the study area. Additional description of historic conditions for threatened and endangered species is provided in **Appendix A**.

Existing Conditions

Within the State of Louisiana there are 29 animal and three plant species (some with critical habitats) under the jurisdiction of the USFWS and/or the NMFS that are presently classified as endangered or threatened (13) (Table 4-13). The USFWS and the NMFS share jurisdictional responsibility for sea turtles and the Gulf sturgeon. Of the animals and plants under USFWS and/or NMFS jurisdiction, four animal species and no plant species are potentially found within the Study Area (Table 4-13).

The pallid sturgeon is an endangered fish species found in large rivers in the Mississippi River Basin (Lee et al. 1980; Killgore et al. 2007). The species is adapted to large, free-flowing turbid rivers with a diverse assemblage of physical characteristics that are in a constant state of change. Detailed habitat requirements of this fish are not known, but it is believed to spawn in Louisiana. Occurrence of pallid sturgeon in the Mississippi River near the diversion site is extremely likely according to Kilgore et al. (2007) and based on sampling efforts by Kirk et al. (2007) in August 2005 and monthly from December 2005 through June 2006. Presence of sub-adult and adult pallid sturgeon is nearly certain within this reach of the Mississippi River; however, occurrence of juvenile specimens is unconfirmed. Their presence warrants further consideration given that these individuals would be at greatest potential risk from diversion installation (Kirk et al. 2007).

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Table 4-13: Federally listed threatened and endangered plant and animal species located within Louisiana, organized by jurisdictional authority, and bolded if potentially occurring within study area.

Species Under Jurisdiction of the USFWS Status Common Name (*Scientific Name*)	Species Under Jurisdiction of NMFS Status Common Name (*Scientific Name*)
mammals E[1] -- Florida Panther (*Felis concolor coryl*) E[1] -- Red wolf (*Canis rufus*) **E -- West Indian manatee (*Trichechus manatus*)** T -- Louisiana black bear (*Ursus americanus luteolus*) Birds E[2] -- Bachmans's warbler (*Vermivora bachmanii*) E[1] -- Eskimo curlew (*Numenius borealis*) E[1] -- Ivory-billed woodpecker (*Campephilus principalis*) E -- Least tern; interior population (*Sterna antillarum*) E -- Red-cockaded woodpecker (*Picoides borealis*) T -- Piping plover (*Charadrius melodus*) Reptiles E[3] -- Hawksbill sea turtle (*Eretomchelys imbricata*) E[3]-- Kemp's (Atlantic) Ridley sea turtle (*Lepidochelys kempii*) E[3]-- Leatherback sea turtle (*Dermochelys coriacea*) **T(S/A)[4] --American alligator (*Alligator mississippiensis*)** T -- Gopher tortoise (*Gopherus polyphemus*) T[3]-- Green sea turtle (*Chelonia mydas*) T[3] -- Loggerhead sea turtle (*Caretta caretta*) T -- Ringed sawback turtle (*Graptemys oculifera*) Fish **E -- Pallid sturgeon (*Scaphirhynchus albus*)** **T[3] -- Gulf sturgeon (*Acipenser oxyrinchus desotoi*)** Invertebrates E -- Mussel, Fat pocketbook (*Potamilus capax*) E -- Pink pearlymussel Mucket (*Lampsilis abrupta*) T -- Inflated (Alabama) heelsplitter (*Potamilus inflatus*) T -- Louisiana pearlshell (*Margaritifera hembeli*) Plants E -- American chaffseed (*Schwalbea americana)* E -- Louisiana quillwort (*Isoetes louisianensis*) T -- Earth fruit (*Geocarpon minimum*) Candidate Species[5] C -- Snake, Louisiana pine (*Pituophis ruthveni*)	Marine Mammals E -- Sperm whale (*Physeter macrocephalus*) E -- Sei whale (*Balaenoptera borealis*) E -- Humpback whale (*Megaptera novaeangliae*) E -- Finback whale (*Balaenoptera physalus*) E -- Blue Whale (*Balaenoptera musculus*) Sea Turtles[3] E -- Hawksbill sea turtle (*Eretomchelys imbricata*) E -- Kemp's (Atlantic) Ridley sea turtle (*Lepidochelys kempii*) E -- Leatherback sea turtle (*Dermochelyscoriacea*) T -- Green sea turtle (*Chelonia mydas*) T -- Loggerhead sea Turtle (*Caretta caretta*) Fish **T -- Gulf sturgeon (*Acipenser oxyrinchus desotoi*)** Candidate Species[5] C -- Dusky shark (*Carcharhinus obscurus*) C -- Sand tiger shark (*Odontaspis taurus*) C -- Night shark (*Carcharinus signatus*) C -- Speckled hind (*Epinephelus drummondhayi*) C -- Saltmarsh topminnow (*Fundulus jenkensi*) C -- Jewfish (*Epinephelus itajara*) C -- Warsaw grouper (*Epinephelus striatus*) _____ [1] Florida panther, red wolf, Eskimo curlew, and ivory-billed woodpecker presumed extirpated in the state. [2] No confirmed sightings of Bachman's warbler on U.S. nesting grounds since mid-1960s. Species may be extirpated in Louisiana. [3] USFWS and NMFS share jurisdictional responsibility for sea turtles and the Gulf sturgeon. [4] Alligator in Louisiana is classified for law enforcement purposes as "Threatened due to Similarity of Appearance." They are biologically neither endangered nor threatened. Regulated harvest is permitted under state law. [5] Candidate species are not protected under the ESA, but concerns regarding their status indicate they may warrant listing in the future. Federal agencies and the public are encouraged to consider these species during project planning so that future listings may be avoided.

Formal consultation was conducted on the pallid sturgeon in compliance with ESA of 1973. A Biological Opinion (**Appendix A**) was received on September 23, 2010 from the USFWS outlining the following *Reasonable and Prudent Measures* and *Terms and Conditions* for the pallid sturgeon:

REASONABLE AND PRUDENT MEASURES

*The Service believes the following reasonable and prudent measures (RPMs) are necessary and **appropriate** to minimize the incidental take of pallid sturgeon by entrainment through the small diversion at Convent/Blind River.*

1. Gate operations should minimize velocity through the structure by maximizing the open cross-section, especially at Mississippi River stages of 6 feet Mean Sea level or less (equates to velocities at the culvert face of 7.2 fps or less).
2. Any gate operation that would significantly increase or decrease the velocity (change greater than 500 cfs) should be implemented over several hours to allow fish sufficient time to migrate back to the river or swim away from the structure.
3. Once the end of the annual discharge period is reached minimal gate openings should be maintained for several days to allow passage of any sturgeon that may have emigrated downstream.
4. The downstream edge of the culverts should have a slope to act as a ramp and/or sufficient erosion protection that would prevent scour from forming a vertical ledge greater than 6 inches at the downstream end of the culvert.
5. In channel refuge consisting of several submerged wing dikes (or similar structures) on both banks should be constructed no further downstream than 75 feet from the structure. Minimal spacing between the structures should be 10 feet but can be moved to account for scour. The maximum suggested height is 24 inches, but the length extending into the channel is not yet determined.
6. The downstream side walls should be angled towards the culverts so they will guide fish back into the culverts at lower velocities.
7. The two outer most culverts should have fish passage baffles constructed on the floor of the culverts.
8. Monitoring to determine take and to reduce potential take by returning pallid sturgeon to the river should be undertaken

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Corps shall execute the following terms and conditions, which implement the RPMs described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. Manuals (or other similar documents) written to guide the daily operations and maintenance activities of the diversion should be written in cooperation with the Service. Any proposed changes to such document would require re-initiation of consultation under Section 7 of the ESA.
2. Detailed design of wing dikes and the scour protection to prevent development of a vertical ledge should be coordinated with the Service. After construction annual

inspection (i.e., measurements) should be taken at the downstream edge of the culvert to determine need to for maintenance. If maintenance is required funding should be immediately requested.
3. Design of downstream side walls and detailed design of the fish passage baffles should be coordinated with the Service.
4. Three days of sampling effort will be made each quarter. Sampling will consist of at minimum utilizing otter trawls, gillnets (i.e., 27.4 meter by 1.8 meter, six mesh panel ranging from 23 to 76 centimeters), and trotlines (61 meters long with 60 dropper lines at 0.9 meter intervals using 2/0 hooks baited with worms). Up to eight trotlines will be fished on the bottom overnight and two gillnets will also be fish overnight. All procedures and protocols for handling sturgeon should be followed and are available at: www.fws.gov/mountain-praire/endspp/protocols/PallidSturgeonHandlingProtocol2008B.pdf

All pallid sturgeon captures should be measured and tagged according to the protocol; if permitted and when feasible, ageing and endoscopy to determine sex and reproductive stage should also be conducted. All pallid sturgeon captured should be returned to the Mississippi River as soon as practicable. The number and size of each pallid sturgeon caught by date and gear type should be provided to the Service. Unsuccessful sampling efforts should also be reported by date and gear type.

Upon locating a dead or injured pallid sturgeon that may have been harmed or destroyed as a direct or indirect result of the proposed project, the Corps and/or contractor shall be responsible for notifying the Service's Lafayette, Louisiana, Field Office (337/291-3100) and the LDWF's Natural Heritage Program (225/765-2821). Care shall be taken in handling an injured sturgeon to ensure effective treatment or disposition and in handling dead specimens to preserve biological materials in the best possible state for later analysis. Disposition of dead sturgeon is also addressed in the protocols.

Gulf sturgeon have been reported in rivers and lakes of the Lake Pontchartrain Basin and adjacent estuarine areas (personal communication, USFWS, 2009). Within Louisiana, areas including Lake Pontchartrain east of the Causeway Bridge have been designated as critical habitat for the Gulf sturgeon. The Study Area is not designated critical habitat for this species (personal communication, James F. Boggs, USFWS, 2009). Based on habitat preferences and past studies, the presence of Gulf sturgeon is unlikely along the reach of the Mississippi River where proposed diversion uptake locations are proposed (Douglas 1974, Ross 2001). The species may however seasonally inhabit Lake Maurepas during migratory periods—most likely during October or November and again from February through April (Kirk et al. 2007). Kirk et al. (2007) conducted an inventory for Gulf sturgeon in Lake Maurepas from November 2005 through June 2006. No Gulf sturgeon were detected or captured in Lake Maurepas in this investigation.

Based on habitat preferences and past studies, the presence of Gulf sturgeon is unlikely along the reach of the Mississippi River where proposed diversion uptake locations are proposed (Douglas 1974, Ross 2001). The species may however seasonally inhabit Lake Maurepas during migratory periods—most likely during October or November and again from February through April (Kirk et al. 2007). Kirk et al. (2007) conducted an inventory for Gulf sturgeon in Lake Maurepas from November 2005 through June 2006. Gill nets and mobile sonic telemetry were used in an attempt to locate 40 individuals tagged from 2001 through 2006 by LDWF in the Pearl River system and other Gulf sturgeon. No Gulf sturgeon were detected or captured in Lake Maurepas in this investigation.

The West Indian manatee may occasionally enter Lake Pontchartrain, Lake Maurepas, and the associated coastal waters and marshes of Louisiana (personal communication, James F. Boggs, USFWS, 2009). On April 29, 1985, a manatee was sighted in the Blind River approximately 200 yards south of the I-10 bridge (USFWS, 1997). Additional sightings have occurred in the vicinity of the Study Area (USFWS, 1997). Manatees are found within local waterways only during months with warm enough conditions. While rare, the potential exists for the manatee to be within the Study Area.

While the bald eagle was officially removed from the Endangered Species Act list of threatened and endangered species it has continued protection under the Migratory Bird Treaty Act (16 U.S.C. 703-712) and the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c). The LDWF has identified three recorded nesting sites within the Study Area. Field investigations to determine the exact locations and potential statuses of these bald eagle nests were performed and resulted in the location of one potentially active nest. The existence of other bald eagle nests is possible, and several adult and juvenile birds were observed during field studies in 2009.

The American alligator, a recently recovered species, is still listed as threatened due to similarity of appearance with other protected species and provided protection under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). At present, Louisiana's wild alligator population is estimated by LDWF to be approximately 1.5 million animals, with over 500,000 additional specimens on alligator farms in the state. Nest densities within the Study Area are medium (approximately 1 nest per 250 acres) based on survey data from 1996-2000 (LDWF 2001).

State Listed Threatened and Endangered Species

The LNHP is maintained by the LDWF. The organization was founded in 1984 through a partnership between the State of Louisiana and The Nature Conservancy with their purpose to develop and maintain a database of rare, threatened and endangered species of plants and animals, and natural communities for Louisiana. Currently, the LDWF maintains the LNHP Biological Conservation Database, which includes over 6,000 occurrences of rare, threatened, and endangered species, unique natural communities and other distinctive elements of natural diversity, and some 380 ecologically significant sites statewide. Within Ascension and St. James Parishes, LNHP tracks the occurrence of the species and habitats listed in Table 4-14.

Table 4-14: LNHP Rare, Threatened and Endangered Species and Natural Communities in Ascension and St. James Parishes (April 2008)

Common Name	Scientific Name	State Rank[1]
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	S1S2
swamp milkweed	*Asclepias incarnate*	S2
bottomland hardwood forest	-	S4
cypress swamp	-	S4
cypress-tupelo swamp	-	S4
bald eagle	*Haliaeetus leucocephalus*	S2N, S3B
four-toed salamander	*Hemidactylium scutatum*	S1
long-tailed weasel	*Mustela frenata*	S2S4
Correll's false dragon-head	*Physostegia correllii*	S1
inflated heelsplitter	*Potamilus inflatus*	S1
eastern spotted skunk	*Spilogale putorius*	S1
West Indian manatee	*Trichechus manatus*	SZN
waterbird nesting colony	-	SNR

[1]State Element Ranks: S1 = critically imperiled in Louisiana because of extreme rarity; S2 = imperiled in Louisiana because of rarity; SZ = transient species in which no specific consistent area of occurrence is identifiable; B = breeding occurrence; N = nonbreeding occurrence; SR = reported from Louisiana but without conclusive evidence to reject or accept the report; S? = rank uncertain.

4.2.12 Cultural and Historic Resources

Historic Conditions

Eight cultural units are used to characterize the prehistoric cultural sequence in southeast Louisiana: Paleo-Indian (10,000 – 8,000 B.C.), Archaic (8,000 – 1,000 B.C.), Poverty Point (1,700 – 500 B.C.), Tchefuncte (500 B.C. – A.D. 100), Marksville (100 A.D. – A.D. 500), Baytown (A.D. 400 – 700), Coles Creek (A.D. 700 – 1,200) and Mississippian/Plaquemine (A.D. 1,200 – 1,700). In addition to prehistoric cultural sequences, historical overviews of Ascension and St. James Parishes were completed to provide a context in which to assess land use data for the project study area. Historical perspectives of these two parishes were researched beginning with the period of French exploration to present, and include development and economic growth in the area. Historic perspectives generally cover the colonial period to 1764, Acadian migration to the area (1764 to 1790), end of the Colonial period (1790 to 1803), the Antebellum period (1803 to 1861), the Civil War (1861 to 1865), reconstruction in the late nineteenth century (1880s), and the early twentieth century. Both prehistoric and historic research results are summarized and historic conditions characterized in detail in the "Background Research and Cultural Resources Inventory for the Convent/Blind Freshwater Diversion Project" (Earth Search, December 2009). Background research of the cultural resources within the study area found that there were 39 previously recorded prehistoric and/or historic archaeological sites located within one mile of the study area **(Figure 4-17)**. Eighteen (18) sites are located within the perimeter of the Area of Potential Effect (APE) and are shown in **Figure 4-18**, of which four sites (16SJ20, 16SJ21, 16SJ30 and 16SJ64) are eligible to the National Register of Historic Places (NRHP). Seven sites (16SJ7, 16SJ9, 16SJ15, 16SJ16, 16SJ18, 16SJ54 and 16SJ57) have been determined ineligible for the NRHP. Five sites (16SJ34, 16SJ49, 16AN30 and 16AN32) are listed as potentially eligible, while the NRHP status of two previously recorded sites (16SJ5 and 16AN50) has not been determined and cannot be ascertained for certain until further investigations can be conducted at these sites. Archaeological investigations within one mile of the study area have identified four prehistoric sites (16SJ1, 16SJ50, 16SJ51 and 16AN50). These sites represent occupations ranging in age from the Archaic-Indian to Mississippian Period.

Existing Conditions

Recorded archival and historical research was conducted to develop a baseline level of knowledge for prehistoric and historic period cultural developments and to identify archaeological and historical sites previously recorded in the Small Diversion at Convent/Blind River Study Area. Information maintained by the Louisiana Division of Archaeology was consulted to identify previous cultural resources surveys in the area as well as to obtain site forms for previously recorded sites. Detailed results for the background research and cultural resources inventory conducted for the study area are presented in "Background Research and Cultural Resources Inventory for the Convent/Blind Freshwater Diversion Project" (Earth Search, December 2009). Additional cultural resource surveys will be conducted in the study area to verify existing resources, and determine whether previously unknown resources exist, based on geomorphology and historical sequence of growth and development in the area.

Coordination with the State Historic Preservation Office and Native American Tribes was initiated during the study, and will continue throughout the completion of the study. Initiation letters to SHPO and various native American tribes are included in **Appendix F**.

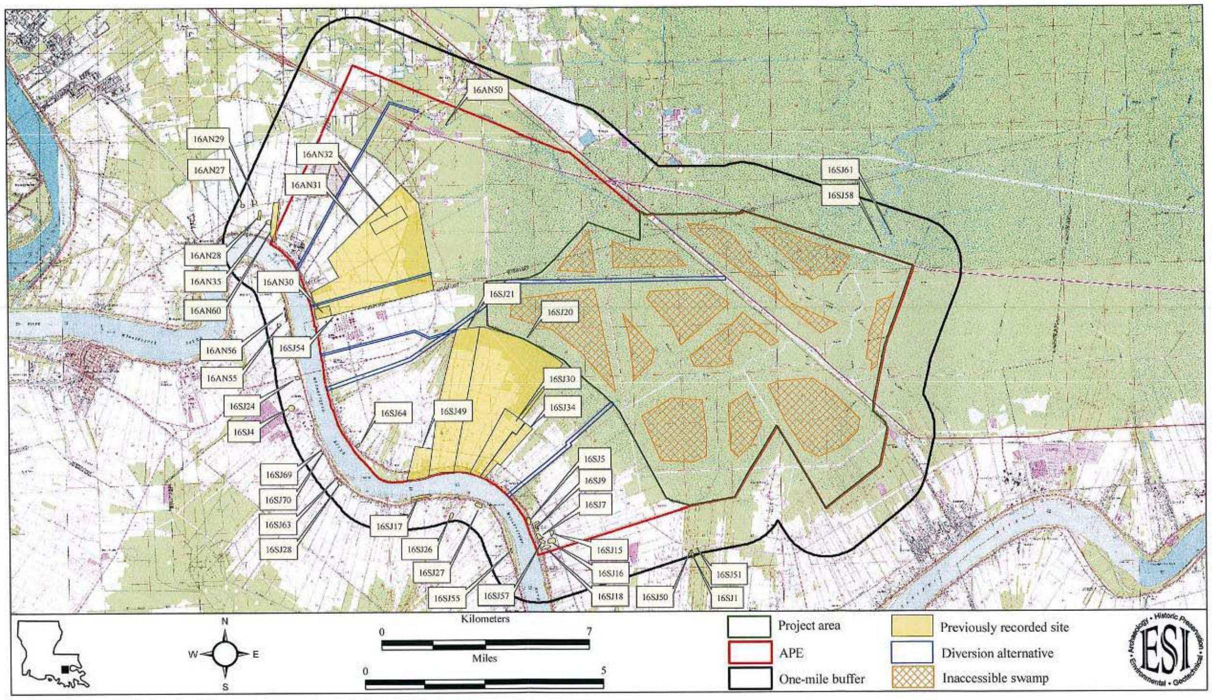

Figure 9. Excerpts from the USGS *Convent, Donaldsonville, Gonzales, Lutcher, Mount Airy NW,* and *Sorrento, LA* 1:24,000 topographic quadrangles showing the locations of previously recorded archaeological sites within one mile of the CBRFD APE.

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Figure 4-17--- Area of Potential Effect (APE) for Study Area

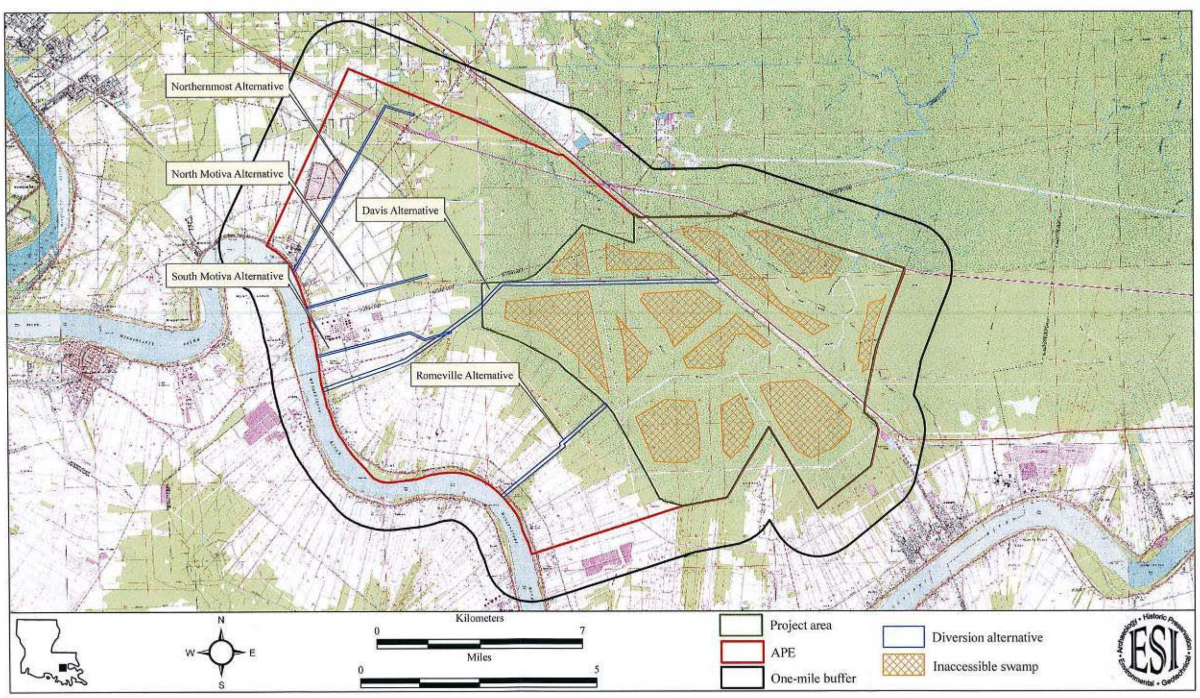

Figure 1. Excerpts from the USGS *Belle Rose, Carville, Convent, Donaldsonville, Gonzales, Lutcher, Mount Airy NE, Mount Airy NW, Reserve* and *Sorrento, LA* 1:24,000 topographic quadrangles showing the location of the CBRFD project area, APE, one-mile buffer, diversion alternatives, and inaccessible swamps.

Figure 4-18 Cultural Resource Sites Located within the Study Area

In accordance with ER 1105-2-100, Appendix C, paragraph C-4(d)(5)(d)(2), the U.S. Army Corps of Engineers (USACE) elected to fulfill its obligations under Section 106 of the National Historic Preservation Act of 1966, as amended, through the execution and implementation of a Programmatic Agreement. In consultation with the Advisory Council on Historic Preservation (ACHP), Louisiana State Historic Preservation Officer (SHPO), Indian tribes, representatives of local governments, and other consulting parties, the USACE developed a Programmatic Agreement among the USACE, Coastal Protection and Restoration Authority of Louisiana, SHPO, and ACHP, pursuant to 36 CFR § 800.14(b)(1), executed July 29, 2010 (**Appendix F**). The Programmatic Agreement establishes the procedures for consultation, identification of historic properties, assessment and resolution of adverse effects.

4.2.12.1 Previous Investigations

The present chapter provides background contextual information regarding previous archeological and architectural investigations completed within the general vicinity of the study area in St. James and Ascension Parishes, Louisiana. This background information was compiled to ensure that any previously recorded cultural resources situated within the current study area were relocated accurately during fieldwork, as well as to provide data on the nature and distribution of previously recorded cultural resources in the immediate project vicinity. A records review was undertaken of all previously completed archeological investigations conducted within 1.0 mile (1.6 km) of the study area, as well as for archeological sites, historic standing structures, and National Register properties situated within this area. The review involved the following activities: a search of relevant archeological site forms, surveys, and historic map data on file with the Louisiana Division of Archaeology and the State Library; a review of the historic standing structures files housed at the Louisiana Division of Historic Preservation; and a search of the online National Register of Historic Places (NRHP) database for St. James Parish, Louisiana. The results of this background investigation are summarized in the "Background Research and Cultural Resources Inventory for the Convent/Blind Freshwater Diversion Project" (Earth Search, December 2009).

4.2.12.2 Previously Conducted Cultural Resources Surveys

A total of 37 (32 archaeological and 5 architectural) previously completed cultural resources surveys and archeological inventories were identified within 1.0 mi (1.6 km) of the study area. These investigations resulted in the identification of 39 archeological sites and 115 structures that were greater than 50 years old. Of these studies, six of the archaeological studies were conducted from 2002 to the present; 11 were conducted during the 1990's; and the remaining 20 were conducted previous to 1990.

Background research discovered that there are 115 previously recorded standing structures greater than 50 years old within the APE. One structure lies within Ascension Parish and 114 within St. James Parish. In addition, there are two structures listed on the National Register of Historic Places under Criterion C (buildings of fine architectural standard) within the APE: the Chauvin House and the Colomb House.

4.2.13 Aesthetics

This resource's institutional significance is derived from laws and policies that affect visual resources, most notably the National Environmental Policy Act of 1969, the National Scenic Byway program, the Louisiana Scenic Rivers Act (1988). This resource is technically significant because of the visual accessibility to unique geological and botanical features that are an asset to the study area. Public significance is based on expressed public perceptions and professional evaluation. Consistent with 40 CFR Parts §§1500.4 (j) and 1502.21 description of the aesthetics resources provided in the LCA PEIS (2004) is hereby incorporated by reference.

Historic Conditions

The study area is located in the Lower Mississippi Riverine Forest Provence in the Subtropical Division as described in "Ecological Subregions of the United States" (1994). This province is generally flat and very gently sloping. Historically, the aesthetic resources of the study area were shaped by land use changes and depended, to a large part, on the viewer and their relationship with their surroundings. Pivotal transformations of the viewscapes occurred with early settlement and colonization, the clearing of old growth forests, the construction of levees along the Mississippi River, and the industrialization of St. James and Ascension Parishes. These events and their chronology are discussed further in their pertinent sections of this document.

Existing Conditions

As part of the LCA Small Diversion at Convent/Blind River, the Visual Resource Assessment Procedure is being used to evaluate aesthetic resources in the study area. While the Maurepas Swamp can be viewed from U.S. Highway 61 and I-10, the characteristics of the study area are most often viewed by boaters on the river itself and recreationists and hunters within the WMA.

The Blind River is a winding and complex waterway. The river is lined with mature baldcypress and tupelo trees with Spanish moss. Old baldcypress trees lean into the channel, and oftentimes the trunks are broken and hollowed. Based on canopy closure, the visible portions of the interior swamp either have sparse or dense herbaceous vegetation. Very little mid-story is present in either open- or closed-canopy environments.

The parish canals through the study area are generally straight. A dense mat of common salvinia often covers these areas in summer months. Elevated berms of side castings are covered with a tangle of upland shrubs, trees, weeds, and vines, and on either one or both bank of parish canals. These features block the view of the adjacent swamp floor and understory. Where not obstructed by berms, a view of the interior swamp is presented. Pipelines and utility lines in the swamp are maintained as linear right of ways devoid of trees but thickly vegetated with emergent plants. At the intersection of pipelines and canals, long views down the pipeline are possible.

The rapid deterioration of the swamp has affected its aesthetic qualities. Subsidence of the forest floor results in flooding for greater periods of time which changes the visual composition of the understory. The lack of baldcypress regeneration has led to an open midstory. As canopy trees die, the forest is becoming more open and in places is trending towards fresh marsh with few trees. Consequently, much of the visual complexity within the swamp is lost in these areas.

The surrounding areas near the transmission canals and diversion uptake locations are a mix of residential, commercial, agricultural, and industrial uses. Sugar cane fields are prevalent and are separated by drainage ditches that vary widely in size. Views of surrounding areas are limited when the sugar cane is mature. Industrial plants are the most prominent structure in the landscape, as they are expansive, several stories tall, and dominate their surroundings. Numerous conveyors and pipes move materials over State Route 44 and the eastbank levee to and from river barges. Views of the Mississippi River are obstructed by the levee.

4.2.13.1 Scenic Rivers and Streams

The Louisiana Natural and Scenic River System is one of the Nation's largest, oldest, most diverse and unique state river protection initiatives. The LDWF administers the Louisiana Natural and Scenic Rivers system, which was established in 1970 for the purpose of preserving, developing, reclaiming and enhancing the wilderness qualities, scenic beauties, and ecological regime of designated free-flowing water bodies. There is one designated scenic stream, the Blind River, within the study area. Louisiana Natural and Scenic River designation is applied to its expanse from the river's origin in St. James Parish to its outlet at Lake Maurepas. The Blind River and its tributaries are used for recreational activities such as boating, fishing, and canoeing.

4.2.14 Recreation

This resource is institutionally significant because of the Federal Water Project Recreation Act of 1965, as amended, and the Land and Water Conservation Fund Act of 1965, as amended. Recreational resources are technically significant because of the high economic value of recreational activities and their contribution to local, state, and national economies. Recreational resources are publicly significant because of the 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.

Historic Conditions

The study area includes 17,079 acres (6,912 ha), approximately half of the 37,163-acre (15,039 ha) Maurepas Swamp Wildlife Management Area (WMA) Western Tract. The tract was established in August 2001 and is managed by the LDWF. According to the LDWF, the site has supported a wide-range of recreational activities: fishing, hunting, camping, boating, sightseeing, hiking, bird watching, and trapping have all been common. Sporting game hunted in the project have historically included deer, raccoon, squirrel, rabbit, and waterfowl. Common sport fisheries pursued have included largemouth bass, bream, perch, catfish, sac-a-lait (crappie), garfish, and choupique (bowfin). Additional recreational activities allowed annually in the WMA and the study areas are contract trapping for alligators and permit trapping for nutria.

The St. James Boat Club, established off of US 61 in 1966, has since served as the starting point for the majority of boating activities in the area. From here, unobstructed access is provided to the lower reaches of Blind River and navigation into Lake Maurepas. Boat access to the headwaters of Blind River and the southwestern portion of the study area from the north was impeded by construction of the Kansas City Southern Railway in 1858. Grand Point Canal Public Boat Launch at the northern terminus of LA 642 provides the main entry point for recreation in this area.

Existing Conditions

The area combines natural and outdoor opportunities with those of the area's cultural heritage. Despite the presence of numerous roadways transecting and surrounding the Study Area, the majority of the area is accessible only by boat due to the nature of the swamp. The Maurepas Swamp WMA – Eastern and Western Tracts – encompasses approximately 67,712 acres (27,402 ha) that are managed by the LDWF. The WMA has provisions for camping with tent sites, trailer sites, and six boat ramps, two of which the St. James and Grand Point Boat Ramps, are in the project site area. Recreational activities in the WMA include hunting for deer, squirrels, rabbit, and raccoons; fishing for largemouth bass, bream, and crappie; and trapping alligators and nutria. Some waterfowl hunting occurs in the vicinity of the Study Area; however, impairment of waterfowl habitat by invasive plant species has reduced waterfowl harvests with respect to past conditions. According to the LDWF, in the 2007-2008 season, there were an estimated 9,442 users of the WMA. Two permitting stations, located at the boat ramps within the Study Area, are maintained by LDWF; the stations allow the public to self-obtain required permits to enter the WMA.

Recreational activities and uses currently permitted in the area year-round include boating, fishing, hunting, sightseeing, and birding. Other recreational activities permitted seasonally include deer hunting during winter months with restricted access to the hunting sites. Consideration has been given to developing walking trails and for reviving the swamp to make it more accessible to the public for walking and sightseeing. The LDWF is currently involved in the initial phase of developing WMA-specific management directives to maintain and enhance the WMA in such a way that will continue to be compatible with its current uses. The LDWF is in the midst of erecting and monitoring wood duck nesting boxes, and has future plans to build a public swamp walk.

The 2009-2013 Louisiana Statewide Comprehensive Outdoor Recreation Plan (SCORP) provides a statewide inventory of recreation resources and identifies recreational needs. The majority of the Small Diversion at Convent/Blind River Study Area fits within the larger SCORP Region 3. The portions of the Study Area within Ascension Parish fall within SCORP Region 2. As part of the SCORP-development process, a residential household survey was completed in order to determine recreation participation throughout the state. The activities rated as most important to the residents of Regions 2 and 3 are: fishing, visiting natural places, walking/hiking, and public access to state waters. In addition, within the two regions, the recreational activities enjoying the highest participation rates include driving for pleasure, fishing, camping and swimming. Recreation needs were then prioritized with regards to the survey results. Priorities in these regions are determined to include providing and improving public access to the area's natural resources for recreational purposes, developing support amenities for existing recreation facilities, coordinating recreation opportunities across multiple jurisdictions, and implementing a statewide and parish-wide trail system.

Figure 4-19 depicts the general location of the Study Area in relation to wildlife management areas, boat launches that provide primary access to these areas, and self-clearing permitting stations.

4.2.15 Socioeconomics and Human Resources

This resource is institutionally significant because of the National Environmental Policy Act of 1969; the Estuary Protection Act; the Clean Water Act; the River and Harbors Acts; the Watershed Protection and Flood Protection Act; and the Water Resources Development Acts. Of particular relevance is the degree to which the proposed action affects public health, safety, and economic well-being; and the quality of the human environment. This resource is technically significant because the social and economic welfare of the nation may be positively or adversely impacted by the proposed action. This resource is publicly significant because of the public's concern for health, welfare, and economic and social well-being from water resources projects.

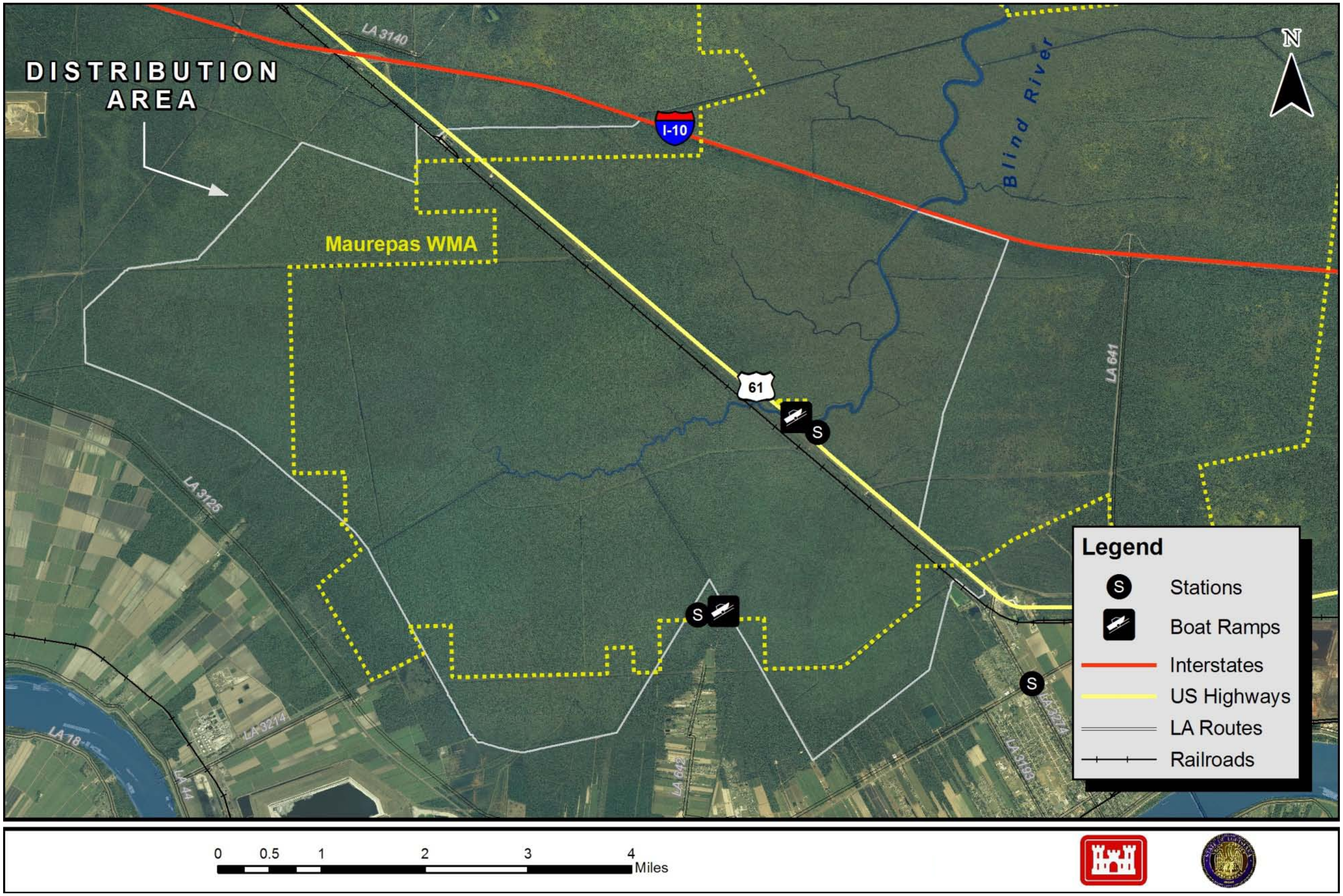

Figure 4-19: Study Area location relative to LDWF Wildlife Management Areas, boat launches, and self-clearing permitting stations.

4.2.15.1 Displacement of Population and Housing

Historic Conditions

The distribution area is located in remote and uninhabited coastal wetlands within Ascension and St. James parishes. Historic population trends from 1900 to 2008 are presented in **Figure 4-20** for the parishes of Ascension and St. James. Ascension Parish lost population from 1900 to 1930 and then slowly increased in population until the parish surpassed 1900 population levels in 1960. The parish's population continued to increase, more than doubling from 1980 to 2008. St. James Parish's population reached its peak population in 1910 before declining sharply until 1930. Although the parish's population has increased in recent decades, it has yet to reach 1910 levels.

Historic housing trends from 1900 to 2008 are presented in **Figure 4-21** for Ascension and St. James parishes. The number of housing units within Ascension Parish and St. James Parish has kept pace with the population within the parishes. In Ascension Parish, the housing units decreased from 1900 to 1930 before increasing sharply. In St. James Parish, the number of housing units reached its nadir in 1930 and then began to increase steadily.

Existing Conditions

McElroy, an incorporated community within St. James Parish is located within the study area. In St. James Parish, the closest towns to the study area include Lutcher and Gramercy, located to the southeast of the project site; Paulina, Belmont and Vacherie located to the south; and Convent located to the southwest. The closest communities to the study area in Ascension Parish are Burnside to the west and Sorrento to the northwest. **Table 4-15** provides recent population trends recorded within these parishes between 2000 and 2008.

St. James and Ascension Parish both experienced an increase in housing from 2000 to 2008, yet St. James Parish remains considerably less dense than Ascension Parish. The housing density within St. James and Ascension Parishes are presented below in **Table 4-16**.

According to the U.S. Census Bureau, Ascension Parish had a population of 101,789 in 2008, an increase of more than 25,000 people since 2000. St. James Parish's growth has been much more modest during that timeframe, increasing by just 15 individuals to 21,231 in 2008. The Louisiana Parish Population Projections Series, 2010-2030, published by the State of Louisiana Office of Electronic Services, predicts that Ascension Parish will continue to grow at a rapid rate, whereas St. James will begin to lose population by 2015. Within the distribution area, there are no permanent residents and no new residences are permitted within the WMA, which comprises much of the study area. Therefore, no growth within the study area is anticipated.

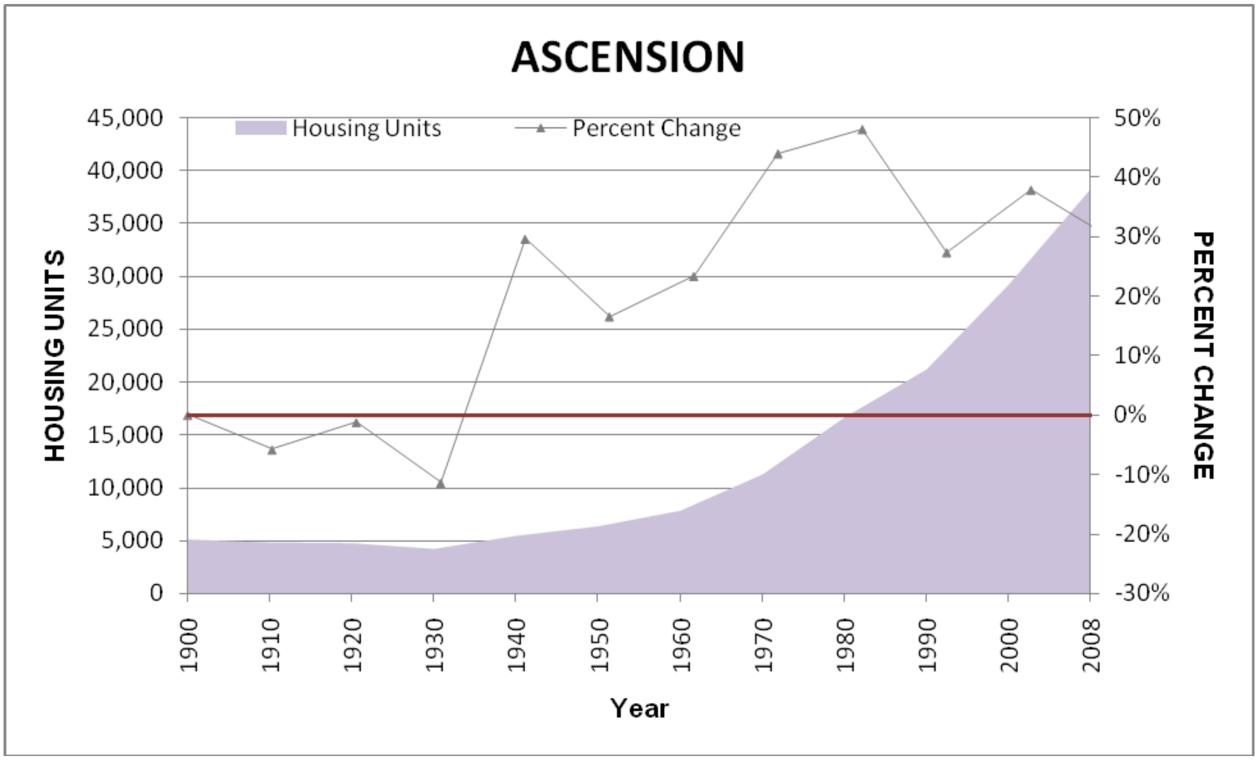

Figure 4-20: Population trends for Ascension and St. James parishes from 1900 to 2008.

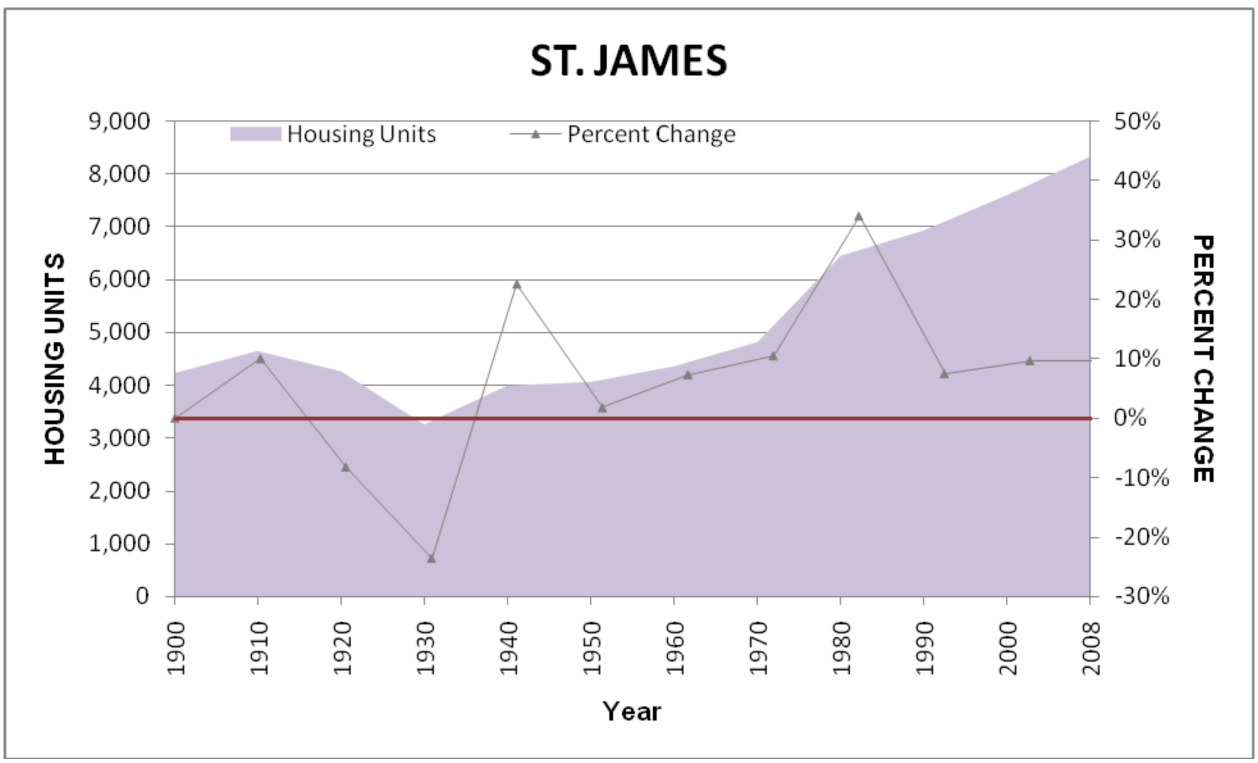

Figure 4-21: Housing trends for Ascension and St. James parishes from 1900 to 2008.

Table 4-15: Population trends from 2000 to 2008 for St. James and Ascension Parishes, Louisiana.

Parish	Population in 2000	Population in 2008	Population Change (%)	Land Area (sq. mi.)	Population Density 2008 (persons/sq. mi.)
St. James	21,216	21,231	0.58	246.13	86.3
Ascension	76,627	101,789	23.35	291.53	349.2
Source: U.S. Census Bureau, Census 2000; U.S. Census Bureau 2006-2008 American Community Survey, 3-Year Estimates.					

Table 4-16: Housing trends from 2000 to 2008 for St. James and Ascension Parishes, Louisiana.

Parish	Total Housing Units 2000	Total Housing Units in 2008	Housing Unit Change (%)	Land Area (sq. mi.)	Housing Density 2008 (persons/sq. mi.)
St. James	7,605	8,333	8.7%	246.13	33.86
Ascension	29,172	38,228	23.7%	291.53	131.13
Source: U.S. Census Bureau, Census 2000; U.S. Census Bureau 2006-2008 American Community Survey, 3-Year Estimates.					

4.2.15.2 Employment, Business, and Industrial Activity

Historic Conditions

St. James Parish and Ascension Parish are strategically positioned between New Orleans and Baton Rouge, encompassing an area that includes a 15-mile expanse along both sides of the Mississippi River in St. James Parish and a 19-mile expanse in Ascension Parish. Historically, agriculture has been a major industry within both parishes. For instance, in the 1940 census agriculture employed nearly 54 percent and 52 percent of all workers in Ascension Parish and St. James Parish, respectively. Manufacturing, food and dairy products, and among women domestic service, were all major industries and occupations within the parishes.

Existing Conditions

Due to St. James Parish's location and diversified transportation access, which includes the Port of South Louisiana along the Mississippi River, various industries are present and business and industrial activity continues to grow. Dominant sectors include manufacturing; retail; educational services; and healthcare and social assistance. Sharp declines have been experienced since 2000 in finance, insurance, real estate, rental and leasing, and wholesale trade. Conversely, retail trade, construction, manufacturing, and most other industries have been growth sectors for the parish. Major area business and industrial activities are associated with the entities listed in **Table 4-17**. Nucor Steel also is currently evaluating a site within the parish, adjacent to the study area. Employment characteristics for St. James Parish in 2000 and 2008 are presented in

Table 4-17: Major businesses in St. James Parish, Louisiana.

ST. JAMES PARISH BUSINESSES AND INDUSTRIES	
ADM Grain Company	Motiva Enterprises
AEP Elmwood Marine	Noranda Alumina
Air Products	Nustar Logistics
America Styrenics	Occidental Chemicals
El Dupont	Plain's Marketing
Ergon-St. James	RAIN CII Carbon
IC Rail Marine Terminal	St. James Stevedoring
Imperial Sugar	Shell Pipeline/Sugarland
Lafarge North America	Valero Marketing
LOCAP Pipeline	William's Field Services
Louisiana Pipe and Steel	YARA North America
Mosaic (Faustina)	Zapp's
Mosaic (Uncle Sam)	Zen-Noh Grain Company
Source: St James, LA "Economic Development: Business Statistics." Accessed: 10/23/2009, http://www.stjamesla.com/PageDisplay.asp?p1=2799	

Table 4-18: Employment characteristics and change from 2000 to 2008 for St. James Parish.

ECONOMIC CHARACTERISTIC	2000	2008	CHANGE (%)
Population 16 years and over	**15,660**	**16,378**	**4.58%**
In labor force	8,556	10,063	17.61%
Civilian labor force	8,548	10,063	17.72%
Employed	7,679	9,573	24.66%
Unemployed	869	490	*-43.61%*
Percent Unemployed	10.2	3.0	*-70.59%*
Armed Forces	8	0	*-100%*
Not in labor force	7,104	6,315	*-11.11%*
Females 16 years and over	**8,205**	**8,607**	**4.90%**
In labor force	4,103	5,050	23.08%
Civilian labor force	4,103	5,050	23.08%
Employed	3,589	4,807	33.94%
Own children under 6 years	**1,657**	**1,640**	***-1.03%***
All parents in family in labor force	1,112	1,338	20.32%
Own children 6 to 17 years	**NA**	**3,536**	**NA**
All parents in family in labor force	NA	2,597	NA
OCCUPATION			
Civilian employed population 16 years	**7,679**	**9,573**	**24.66%**
Management, professional, and related occupations	1,821	2,233	22.62%
Service occupations	1,234	2,171	75.93%
Sales and office occupations	1,695	1,731	2.12%
Farming, fishing, and forestry occupations	113	12	*-89.38%*
Construction, extraction, maintenance and repair	928	1,209	30.28%

ECONOMIC CHARACTERISTIC	2000	2008	CHANGE (%)
Production, transportation, and material moving	1,888	2,217	17.43%
INDUSTRY			
Agriculture, forestry, fishing and hunting, and mining	201	184	*-8.46%*
Construction	611	721	18.00%
Manufacturing	2,012	2,780	38.17%
Wholesale trade	197	96	*-51.27%*
Retail trade	708	1,047	47.88%
Transportation and warehousing, and utilities	581	772	32.87%
Information	46	74	60.87%
Finance and insurance, and real estate and rental	308	135	*-56.17%*
Professional, scientific, and management, and	405	402	*-0.74%*
Educational services, and health care and social	1,527	1,857	21.61%
Arts, entertainment, and recreation, and	409	607	48.41%
Other services, except public administration	276	460	66.67%
Public administration	398	438	10.05%
CLASS OF WORKER			
Private wage and salary workers	6,168	7,709	24.98%
Government workers	1,311	1,561	19.07%
Self-employed workers in own not incorporated	183	303	65.57%
Unpaid family workers	17	0	*-100%*

Source: U.S. Census Bureau, Census 2000; U.S. Census Bureau 2006-2008 American Community Survey, 3-Year Estimates; *Italics* indicate observed decrease between 2000 and 2008; NA stands for not available.

The distribution area to the northeast of St. James proper in Ascension Parish is primarily associated with oil and gas pipelines. Oil and gas infrastructure include wells, rig platforms, refineries, gas plants, and pipelines located within or near the study area. Notably, the Sorrento Gas and Oil Field is located to the north of the study area in Ascension Parish.

Dominant industry sectors in Ascension Parish include manufacturing, construction, retail trade, educational services, and healthcare and social assistance. Since 2000, only the information industry has experienced decline. In particular, the chemical industry is a significant growth industry for the Parish, with more than 20 chemical manufacturing facilities currently operating. Major area business and industrial activities are associated with the entities listed in **Table 4-19**. Employment characteristics for Ascension Parish in 2000 and 2008 are presented in **Table 4-20**.

Table 4-19: Major businesses in Ascension Parish, Louisiana.

ASCENSION PARISH BUSINESSES AND INDUSTRIES	
Westlake Chemical	Cabela's
St. Elizabeth Hospital	International Marine Tank Liquid Terminal
Turner Industries	BASF
Rubicon	Motiva Enterprises
Oxychem	Shell Chemical
Honeywell	EATEL
Chemtura	
Source: Ascension Chamber of Commerce. "2009 Membership Directory and Community Profile." Accessed: http://www.ascensionchamber.com/	

From 2000 to 2008, the economic growth of St. James Parish and Ascension Parish are reflected in the income of residents. Fewer households, families, and individuals were within lower income brackets in 2008 than in 2000, and substantial growth occurred at higher income levels. More so, the percentage of individuals living below the poverty level generally declined during this period. Income statistics for St. James Parish and Ascension Parish are presented in Table 4-**21** and **Table 4-22** respectively.

Table 4-20: Employment characteristics and change from 2000 to 2008 for Ascension Parish.

ECONOMIC CHARACTERISTIC	2000	2008	CHANGE (%)
Population 16 years and over	**56,116**	**73,893**	**31.68%**
In labor force	37,203	50,825	36.62%
Civilian labor force	37,148	50,646	36.34%
Employed	35,151	48,093	36.82%
Unemployed	1,997	2,553	27.84%
Percent Unemployed	5.4	3.5	*-35.19%*
Armed Forces	55	179	225.45%
Not in labor force	18,913	23,068	21.97%
Females 16 years and over	**28,880**	**38,108**	**31.95%**
In labor force	16,554	22,872	38.17%
Civilian labor force	16,530	22,872	38.37%
Employed	15,544	21,192	36.34%
Own children under 6 years	**6,950**	**9,129**	**31.35%**
All parents in family in labor force	4,177	6,299	50.80%
Own children 6 to 17 years	**NA**	**17,606**	**NA**
All parents in family in labor force	NA	11,993	NA
OCCUPATION			
Civilian employed population 16 years	**35,151**	**48,697**	38.54%
Management, professional, and related occupations	9,244	15,179	64.20%
Service occupations	4,392	6,469	47.29%
Sales and office occupations	9,805	13,345	36.10%
Farming, fishing, and forestry occupations	108	90	*-16.67%*
Construction, extraction, maintenance and repair	5,702	6,645	16.54%
Production, transportation, and material moving	5,900	6,365	7.88%
INDUSTRY			
Agriculture, forestry, fishing and hunting, and mining	367	483	31.61%
Construction	4,656	6,140	31.87%
Manufacturing	6,409	7,046	9.94%
Wholesale trade	1,413	2,120	50.04%
Retail trade	4,176	5,255	25.84%
Transportation and warehousing, and utilities	1,851	2,356	27.28%
Information	657	539	*-17.96%*
Finance and insurance, and real estate and rental	2,114	3,598	70.20%
Professional, scientific, and management,	2,342	4,631	97.74%
Educational services, and health care and social	5,881	8,416	43.10%
Arts, entertainment, and recreation, accommodation,	2,061	3,611	75.21%
Other services, except public administration	1,694	1,740	2.72%
Public administration	1,530	2,158	41.05%
CLASS OF WORKER			
Private wage and salary workers	29,050	40,152	38.22%
Government workers	4,466	5,588	25.12%
Self-employed workers in own not incorporated	1,572	2,319	47.52%
Unpaid family workers	63	34	*-46.03%*

Source: See Table 4-20.

Table 4-21: Income statistics and change from 2000 to 2008 for residents of St. James Parish.

SELECTED ECONOMIC CHARACTERISTIC	2000	2008	% CHANGE	SELECTED ECONOMIC CHARACTERISTIC	2000	2008	% CHANGE
INCOME AND BENEFITS				**Families (continued)**			
Total households	**6,999**	**7,462**	**6.62%**	Median family income (dollars)	$41,751	$58,246	39.51%
Less than $10,000	1,149	653	*-43.17%*	Mean family income (dollars)	NA	$69,812	NA
$10,000 to $14,999	570	443	*-22.28%*	Per capita income (dollars)	$14,381	$21,229	47.62%
$15,000 to $24,999	902	805	*-10.75%*	**Nonfamily households**	**NA**	**1,744**	**NA**
$25,000 to $34,999	860	754	*-12.33%*	Median nonfamily income (dollars)	NA	$25,775	NA
$35,000 to $49,999	980	1,218	24.29%	Mean nonfamily income (dollars)	NA	$28,803	NA
$50,000 to $74,999	1,382	1,472	6.51%	Median earnings for workers (dollars)	NA	$26,878	NA
$75,000 to $99,999	700	837	19.57%	Median earnings for male full-time, year-round workers (dollars)	$37,487	$41,352	10.31%
$100,000 to $149,999	377	938	148.81%	Median earnings for female full-time, year-round workers (dollars)	$21,712	$25,644	18.11%
$150,000 to $199,999	35	240	585.71%	**POVERTY STATUS (% Below Poverty Level)**			
$200,000 or more	44	102	131.82%	**All families**	**18.00%**	**13.10%**	***-27.22%***
Median household income (dollars)	$35,277	$47,102	33.52%	With related children <18 years	25.00%	18.30%	*-26.80%*
Mean household income (dollars)	NA	$60,468	NA	With related children <5 years only	22.80%	4.30%	*-81.14%*
With earnings	5,296	5,727	8.14%	**Married couple families**	NA	3.60%	NA
Mean earnings (dollars)	$46,242	$64,482	39.44%	With related children <18 years	NA	2.60%	NA
With Social Security	1,878	2,469	31.47%	With related children <5 years only	NA	0.00%	NA
Mean Social Security income (dollars)	$10,787	$13,424	24.45%	**Families with female householder, no husband present**	**48.70%**	**38.20%**	***-21.56%***
With retirement income	1,188	1,644	38.38%	With related children <18 years	58.40%	47.40%	*-18.84%*
Mean retirement income (dollars)	$11,878	$15,938	34.18%	With related children <5 years only	64.70%	10.80%	*-83.31%*
With Supplemental Security Income	446	318	*-28.70%*	All people	20.70%	16.00%	*-22.71%*
Mean Supplemental Security Income (dollars)	$6,372	$7,526	18.11%	Under 18 years	NA	25.70%	NA
With cash public assistance	176	81	*-53.98%*	Related children <18 years	27.70%	25.70%	*-7.22%*

SELECTED ECONOMIC CHARACTERISTIC	2000	2008	% CHANGE
income			
Mean cash public assistance income (dollars)	$1,836	$741	*-59.64%*
With Food Stamp benefits in the past 12 months	NA	1,312	
Families	**5,564**	**5,718**	**2.77%**
Less than $10,000	683	314	*-54.03%*
$10,000 to $14,999	409	277	*-32.27%*
$15,000 to $24,999	642	494	*-23.05%*
$25,000 to $34,999	675	345	*-48.89%*
$35,000 to $49,999	804	920	14.43%
$50,000 to $74,999	1,221	1,303	6.72%
$75,000 to $99,999	677	822	21.42%
$100,000 to $149,999	382	901	135.86%
$150,000 to $199,999	30	240	700.00%
$200,000 or more	41	102	148.78%

SELECTED ECONOMIC CHARACTERISTIC	2000	2008	% CHANGE
Related children <5 years	NA	23.80%	NA
Related children 5 to 17 years	28.10%	26.40%	*-6.05%*
18 years and over	17.80%	12.60%	*-29.21%*
18 to 64 years	NA	11.50%	NA
65 years and over	15.10%	18.00%	19.21%
People in families	NA	14.80%	NA
Unrelated individuals 15 years and over	34.10%	27.10%	*-20.53%*

Source: U.S. Census Bureau, Census 2000; and U.S. Census Bureau 2006-2008 American Community Service, 3-Year Estimates

Italics indicate observed decrease between 2000 and 2008.

NA stands for not available.

Table 4-22: Income statistics and change from 2000 to 2008 for residents of Ascension Parish.

SELECTED ECONOMIC CHARACTERISTIC	2000	2008	% CHANGE	SELECTED ECONOMIC CHARACTERISTIC	2000	2008	% CHANGE
INCOME AND BENEFITS				**Families (continued)**			
Total households	**26,773**	**34,478**	**28.78%**	Median family income (dollars)	$50,626	$68,482	35.27%
Less than $10,000	2,627	1,751	*-33.35%*	Mean family income (dollars)	NA	$80,374	NA
$10,000 to $14,999	1,689	1,945	*15.16%*	Per capita income (dollars)	$17,858	$25,997	45.58%
$15,000 to $24,999	2,809	3,218	*14.56%*	**Nonfamily households**	**NA**	**8,676**	**NA**
$25,000 to $34,999	3,236	3,637	*12.39%*	Median nonfamily income (dollars)	NA	$30,694	NA
$35,000 to $49,999	4,357	3,953	-9.27%	Mean nonfamily income (dollars)	NA	$44,246	NA
$50,000 to $74,999	6,446	6,399	-0.73%	Median earnings for workers (dollars)	NA	$31,858	NA
$75,000 to $99,999	3,397	5,465	60.88%	Median earnings for male full-time, year-round workers (dollars)	$41,109	$52,282	27.18%
$100,000 to $149,999	1,809	5,510	204.59%	Median earnings for female full-time, year-round workers (dollars)	$23,054	$32,305	40.13%
$150,000 to $199,999	197	1,713	769.54%	**POVERTY STATUS (% Below Poverty Level)**			
$200,000 or more	206	887	330.58%	**All families**	**10.70%**	**9.00%**	***-15.89%***
Median household income (dollars)	$44,288	$60,293	36.14%	With related children <18 years	13.70%	12.00%	*-12.41%*
Mean household income (dollars)	NA	$72,094	NA	With related children <5 years only	15.50%	10.80%	*NA*
With earnings	22,648	29,442	30.00%	**Married couple families**	**NA**	**2.90%**	**NA**
Mean earnings (dollars)	$52,843	$74,300	40.61%	With related children <18 years	NA	3.80%	NA
With Social Security	4,590	7,216	57.21%	With related children <5 years only	NA	0.70%	NA
Mean Social Security income (dollars)	$10,395	$13,949	34.19%	**Families with female householder, no husband present**	**36.50%**	**31.90%**	***-12.60%***
With retirement income	3,372	5,309	57.44%	With related children <18 years	43.00%	40.80%	*-5.12%*
Mean retirement income (dollars)	$12,772	$16,090	25.98%	With related children <5 years only	54.60%	53.40%	*-2.20%*
With Supplemental Security Income	1088	1,451	*33.36%*	All people	12.90%	10.90%	*-15.50%*
Mean Supplemental Security Income (dollars)	$6,230	$6,521	4.67%	Under 18 years	NA	15.10%	NA

SELECTED ECONOMIC CHARACTERISTIC	2000	2008	% CHANGE
With cash public assistance income	590	365	*-38.14%*
Mean cash public assistance income (dollars)	$1,826	$2,953	*61.72%*
With Food Stamp benefits in the past 12 months	NA	4,235	NA
Families	**21,002**	**25,802**	**22.85%**
Less than $10,000	1,471	992	*-32.56%*
$10,000 to $14,999	933	904	*-3.11%*
$15,000 to $24,999	1,970	1,781	*-9.59%*
$25,000 to $34,999	2,425	2,462	*1.53%*
$35,000 to $49,999	3,486	2,974	-14.69%
$50,000 to $74,999	5,689	4,867	-14.45%
$75,000 to $99,999	3,033	4,524	49.16%
$100,000 to $149,999	1,602	5,062	215.98%
$150,000 to $199,999	197	1,407	614.21%
$200,000 or more	196	829	322.96%

SELECTED ECONOMIC CHARACTERISTIC	2000	2008	% CHANGE
Related children <18 years	16.30%	14.90%	*-8.59%*
Related children <5 years	NA	17.10%	NA
Related children 5 to 17 years	16.30%	14.00%	*-14.11%*
18 years and over	11.40%	9.20%	*-19.30%*
18 to 64 years	NA	9.30%	NA
65 years and over	15.40%	8.70%	-43.51%
People in families	NA	9.30%	NA
Unrelated individuals 15 years and over	24.20%	21.70%	*-10.33%*

Source: U.S. Census Bureau, Census 2000; and U.S. Census Bureau 2006-2008
American Community Survey, 3-Year Estimates
Italics indicate observed decrease between 2000 and 2008.
NA stands for not available

4.2.15.3 Availability of Public Facilities and Services

Historic Conditions

The public facilities and services within St. James and Ascension Parishes are designed to support and serve their constituents. Public service infrastructure includes utilities, emergency services, and education. Both Ascension and St. James Parish were established in 1807. Public facilities and services became established and expanded upon throughout the 19th century, particularly during Reconstruction following the Civil War. As technology advanced throughout the 20th century, the public services in the parishes advanced as well.

Existing Conditions

The existing public service infrastructure within St. James and Ascension Parishes are presented in **Table 4-23**.

Table 4-23: Public Service Infrastructure present in St. James Parish and Ascension Parish, Louisiana.

Infrastructure	St James Parish	Ascension Parish
Utilities		
Electricity	Entergy	Entergy; Demco
Gas	St. James Parish Utilities; Atmos Energy of LA	City of Gonzales; Atmos Energy of LA
Water	Town of Lutcher; Town of Gramercy; St. James Parish Utilities	Ascension Water Co.
Sewage Treatment	Town of Lutcher; Town of Gramercy*	City of Donaldsonville; City of Gonzales*
Emergency Services		
Medical Services	St. James Parish Hospital; Riverlands Healthcare Center	Promise Hospital of Gonzales; Prevost Hospital; St. Elizabeth Hospital; St. James Behavioral Health Hospital
EMS	Acadian Ambulance Service	Acadian Ambulance Service
Fire	Served by 6 Volunteer Fire Depts.	Served by 11 Fire Departments
Police	St. James Parish Sheriff's Parish Office; Gramercy Police Dept.; Lutcher Police Dept.	Ascension Parish Sheriff's Dept.; Sorrento Police Dept.; Gonzales Police Dept.
Education		
School	11 public schools; 1 Catholic school	28 public schools**; 5 private schools
Library	2 branches	3 branches

* Unincorporated areas are not treated.

** An additional elementary school is set to open in 2010.

4.2.15.4 Transportation

Historic Conditions

Historically, the transportation within St. James and Ascension Parishes has been tied to the water and to rail. Steam ferries traveled along the Mississippi River, transporting goods and services, and individuals up and downstream. Daily train service served the area following the Civil War. Intermodal transportation, including water-based and rail travel, continued to expand throughout the 19th and 20th centuries. The Sunshine Bridge, connecting St. James Parish and Ascension Parish opened in 1964. The Louisiana Regional Airport, a general aviation airport located in Gonzales, opened in 1992.

Existing Conditions

Transportation modes within St. James and Ascension Parishes include air, road, rail, and waterways. The parishes are served by the Louisiana Regional Airport, managed by the Ascension-St. James Airport and Transportation Authority. The major roadways within the parishes are I-10, U.S. Highway 61 (Airline Highway), and a number of state highways including LA 30, LA 44, LA 70, LA 73, LA 405, LA 3127 and LA 3125. Rail includes the Kansas City Southern Railway (formerly the Louisiana Railway & Navigation Railroad and later the Louisiana and Arkansas Railway), the Canadian National Railway (formerly the Yazoo & Mississippi Valley Railroad and later the Illinois Central Railway), and the Union Pacific Railway (formerly the Missouri Pacific Railroad). The Mississippi River runs through both parishes. In addition, the Port of South Louisiana is partly located in St. James Parish.

According to the Louisiana Department of Transportation and Development (LA DOTD), I-10, US 61, LA 30, LA 73 and LA 44 were the most traveled roadways within Ascension Parish and I-10, US 61, LA 70, LA 3125 and LA 3274 are the most traveled roadways within St. James Parish. Although US 61 runs through the study area, the most traveled segments of the roadway do not.

Two railways run through the study area. The Kansas City Southern Railway transects the distribution area and parallels U.S. HWY 61 to the south. The Canadian National Railway extends to the south of the distribution area and would be transected by the Romeville and South Bridge transmission canals.

St. James Parish manages a transit service, which operates Monday through Friday, along LA 44 and LA 18. Ascension Parish operates a paratransit service (or demand response service) for its residents. Unless specifically requested by a rider, neither service runs through the study area.

Visitors within the distribution area travel either by foot or by boat.

4.2.15.5 Disruption of Desirable Community and Regional Growth (including Community Cohesion)

Historic Conditions

Desirable community and regional growth means acting at the community level and fostering economic, social, and cultural growth. Community Cohesion is defined as "[w]working towards a society in which there is a common vision and sense of belonging by all communities; the diversity of people's backgrounds and circumstances is appreciated and valued; similar life opportunities are available to all; and strong and positive relationships exist and continue to be developed in the workplace, in schools and the wider community" (UK Department for Children, Schools and Families, 2007).

Historically, the areas surrounding the study area included well established plantation-run agricultural areas dating back to the 1700s. Culturally the region is known as Plantation Country. Community cohesion was driven by agriculturally based lifestyles. The advancement of pull-boat logging allowed extensive harvest of baldcypress. Railways, roads, and other infrastructure were constructed within and surrounding the study area as the population grew. Community and regional growth gradually developed in the area with influence from the oil and gas industry as well as increased trade along the Mississippi River. In spite of industrial growth and infrastructure development, the surrounding swamp areas continued to be used extensively for fishing and hunting.

Existing Conditions

Existing conditions today include communities in the area that rely heavily on business and industrial activity while still maintaining support to agricultural interests, particularly sugarcane farming. Waterborne commerce along the Mississippi River has spurred economic growth in the area with support to landside business and oil and gas related industries. Regional growth is projected to be two percent per year as residential development progresses from Baton Rouge to New Orleans. Land sites in the area that are available for industrial development are actively being marketed with tax incentives to foster business and community alliances that will continue to support economic development in the area. Although wetlands in the Pontchartrain Basin have degraded over time as a result of urban encroachment and human modifications, these areas still support diverse recreation activities. However, the continued degradation and loss of forested swamp threaten its integrity as a desirable area for these endeavors and the continuation of these activities that support the culture in this area.

4.2.15.6 Tax Revenues and Property Values

Historic Conditions

According to the U.S. Census Bureau, historic property values within St. James Parish have been consistently lower than in adjacent Ascension Parish, and in turn, property values in these parishes have been consistently lower than in the United States as a whole. Beginning in 1980, Ascension Parish's median home value rose above the State of Louisiana's and has since remained so. Conversely, the median home value for St. James Parish has remained lower than the state's except in 1980 when it was slightly higher. **Table 4-24** below displays median owner-occupied home values from 1930 to 2000.

Table 4-24: Median owner-occupied home values from 1930 to 2000.

Location	1930	1940	1950	1960	1970	1980	1990	2000
Ascension Parish	$783	$513	$2,355	$7,300	$12,600	$46,000	$61,000	$103,800
St. James Parish	$638	$380	$2,254	$7,200	$11,900	$43,900	$57,100	$81,500
Louisiana	$2,730	$1,414	$5,141	$10.700	$14,600	$43,000	$58,500	$85,000
United States	$4,778	$2,938	$7,354	$11,900	$17,000	$47,200	$79,100	$119,600
Source: U.S. Census Bureau, Accessed 11/14/2009.								

The study area encompasses a portion of the Maurepas Swamp WMA. The area was once owned by the Lutcher and Moore Cypress Lumber Company. The Richard King Mellon Foundation in coordination with The Conservation Fund secured the site in 2000, after which it granted the area to the LDWF. Prior to state acquisition, the distribution area was privately owned and therefore on the parish, state, and Federal tax roll.

Existing Conditions

The proposed study area includes a portion of the Maurepas Swamp WMA, a state-managed property. Thus, the majority of the study area is not subject to state and local taxation. The remaining parcels, located along the southern, western and northern edge of the project site boundary, are privately owned and subject to taxation.

The U.S. Census Bureau estimates the 2008 median house value of owner-occupied units as $158,600 within Ascension Parish and $112,500 within St. James Parish, representing a 34.6 percent and a 27.6 percent increase respectively from the median house values in 2000.

4.2.15.7 Infrastructure

Historic Conditions

Infrastructure present in the study area includes federal, state, parish, municipal, and private facilities including (but not limited to) physical structures for housing, energy (transmission lines, transformers, and substations), telecommunications, oil and gas pipelines, flood control and protection (levees, drainage, channel improvement and stabilization), and transportation (roads, railways, bridges). Information provided below supplements descriptions within respective sections for each resource.

The area was settled by French colonists in 1700s who surveyed the property lines upon which many of the roadways are based. Flood protection and utility infrastructure developed throughout the 19th and 20th centuries. Railways began operation in 1884 with the Yazoo & Mississippi Valley Railroad (later the Illinois Central, presently Canadian National) and in 1906 with the Louisiana Railway & Navigation Rail Road (later the Louisiana and Arkansas, presently Kansas City Southern) (St. James Parish Development Board, 1954). As part of the Louisiana Highway Commission's road modernization efforts, U.S. Highway 61 (Airline Highway) was constructed in the early 1930s.

Existing Conditions
Transportation infrastructure within or near the distribution area includes the Kansas City Southern Railroad, US Highway 61 and I-10, and their associated bridges and culverts (US 61: 5 bridges / no culverts; I-10: 2 bridges / 10 culverts). The Romeville and South Bridge transmission canals would cross LA 44, the Canadian National Railway, and LA 3125. Two boat landings are present in the distribution area: one is located at the north terminus of LA 642 with access to Grand Point Canal, and the other is located at the St. James Boat Club on US Hwy 61 with access to Blind River. Telecommunication and energy infrastructure within the study area are described in **Table 4-25**.

Table 4-25: Telecommunication and energy infrastructure within the study area.

Company Name	Description	Utility Size	Type
Entergy			
Convent to Frisco	Transmission	230 kV	Aerial
Convent to Romeville	Transmission	230 kV	Aerial
Lutcher to Sorrento	Transmission	230 kV	Aerial
Panama to Dutch Bayou	Transmission	230 kV	Aerial
Romeville to Panama	Transmission	230 kV	Aerial
MCI Telecommunications	Fiber Optic Backbone	24 F Count	Buried
Level 3 Communications	Primary Fiber Optic	96F Count, 170F Count	Buried
AT&T Telecommunication	Proprietary	Proprietary	Aerial & Buried

4.2.15.8 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 is $22,050.00 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 is updated annually at http://aspe.hhs.gov/poverty/09poverty.shtml. 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 (50 percent) and/or percent low-income (20 percent) population in an EJ study area are greater than those in the reference community. For purposes of this analysis, all Census Block Groups within a one mile radius of the project footprint are defined as the EJ study area. Ascension and St. James Parishes, of which the Louisiana Coastal Area (LCA) Small River Diversion at Convent/Blind River project is located, is considered the reference community of comparison, whose population is therefore considered the EJ reference population for comparison purposes. Parish figures were used for unincorporated areas located within one mile of the proposed project footprint.

The methodology, consistent with E.O. 12898, to accomplish this Environmental Justice analysis includes, identifying low-income and minority populations within the LCA Convent/Blind River project area using up-to-date economic statistics, aerial photographs, 2000 U.S. Census records, Environmental Systems Research Institute, Inc. (ESRI) estimates, as well as conducting community outreach activities such as public meetings. Despite the 2000 U.S. Census being nine years old, it serves as a logical baseline of information and is the primary deciding variable per data accuracy and reliability for the following reasons:

Census 2000 data is the most accurate source of data available due to the sample size of the Census decennial surveys. With one of every six households surveyed, the margin of error is negligible.

The Census reports data at a much smaller geographic level than other survey sources, providing a more defined and versatile option for data reporting.

Census information sheds light upon the demographic and economic framework of the area pre-Hurricane Katrina. By accounting for the absent population, the analysis does not exclude potentially low income and minority families that wish to return home.

Due to the considerable impact of Hurricane Katrina upon the New Orleans metropolitan area, and the likely shift in demographics and income, the 2000 Census data are supplemented with more current data, including 2007 and 2008 estimates provided by ESRI. The 2007 and 2008 estimates are utilized for reference purposes only to show changing trends in population since 2000.

Historic Conditions

The concept of "environmental justice" is rooted in Title VI of the Civil Rights Act of 1964, which prohibited discrimination based on race, color and national origin, and other nondiscrimination statutes as well as other statutes including the National Environmental Policy Act of 1969, the Uniform Relocations Assistance and Real Property Acquisition Policies Act of 1970, and 23 U.S.C Section 109 (h). In 1971, the Council on Environmental Quality's (CEQ) annual report acknowledged racial discrimination adversely affects the environment of the urban poor. During the next ten years, activists maintained that toxic waste sites were disproportionately located in low-income and areas populated by "people of color." By the early 1980s, the environmental justice movement had increased its visibility and broadened its support base (Commission for Environmental Equality 2009).

This led to the United Church of Christ (UCC) undertaking a nationwide study and publishing Toxic Waste and Race in the United States (UCC 1987). This eventually gained the attention of the federal government and in 1992 the U.S. Environmental Protection Agency's (EPA's) Office of Environmental Equity was established. In 1994, EJ was institutionalized within the federal government through Executive Order 12898 (EPA 1995a), which focused federal attention on human-health and environmental conditions in minority and low-income communities (EPA 1995a, 1995b, 1995c, 1995d).

Executive Order 12898 requires greater public participation and access to environmental information in affected communities. The results of early efforts and research (UCC 1987) into EJ suggested that environmental amenities and toxic waste sites were not uniformly distributed among income groups, classes, or ethnic communities. Disparities of this nature may have been and continue to be the result of historical circumstances, lack of community participation, or simply inadequate or inappropriate oversight. Consequently, dialogue with some community groups were not conducted and their concerns not considered in the decision making process on local or federal actions.

The study area is located in Ascension and St. James Parishes. The proportion of the population considered a racial minority in these parishes from 1900 to 2000 are included in **Table 4-26** below.

Table 4-26: Minority populations from 1900 to 2000.

Location	YEAR										
	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
Ascension Parish	49.9%	47.1%	42.8%	38.4%	37.5%	37.3%	31.9%	27.1%	23.0%	24.7%	23.8%
St. James Parish	43.8%	57.2%	54.7%	49.4%	49.6%	46.5%	49.3%	47.3%	47.4%	50.1%	50.3%

Source: U.S. Census Bureau, Census of Population and Housing, Decennial Censuses. Accessed: www.census.gov/prod/www/abs/decennial/index.htm

Excluding a slight increase from 1980 to 1990, the minority population within Ascension Parish has declined steadily throughout the century. A similar trend has not occurred in St. James Parish, where the minority population has remained relatively constant at approximately half of the population.

Poverty was not defined until the mid-1960s, when the Federal government established the poverty thresholds. At the parish level, Census data is provided from 1990 to the present. **Table 4-27** demonstrates the proportion of those living below the poverty level in Ascension and St. James Parish from 1990 to 2000.

Table 4-27: Proportion of the population living below the poverty line from 1990 to 2000.

Location	YEAR	
	1990	2000
Ascension Parish	17.5%	13.0%
St. James Parish	25.3%	20.7%

Source: U.S. Census Bureau, American FactFinder.

The low-income populations within both Ascension and St. James Parishes decreased proportionately from 1990 to 2000. Although Ascension Parish has historically not breached the thresholds established by federal environmental justice guidelines, St. James Parish has. Therefore, in general, all proposed activities within St. James Parish have had the potential for environmental justice concerns.

Existing Conditions

The proposed LCA Convent/Blind River project area is located in St. James and Ascension Parishes in Louisiana. The total population of these two parishes, according to the U.S. Census Bureau's 2008 estimates, is 123,020. This figure reflects a more than 25 percent increase in population since 2000, with the overwhelming majority of this projected growth concentrated in Ascension Parish.

According to the 2000 U.S. Census, the LCA Convent/Blind River project boundary in Ascension Parish is located within Census Tracts 303 and 305, Block Groups 1 and 3. In St. James Parish, the project boundary falls within Census Tracts 401, 403 and 404; Block Groups 1, 2 and 3. The 2000 Census demographic profile records indicate that the minority population in Louisiana was 38.7 percent of the total population and the low-income population was 19.6 percent of the total population. In comparison, the minority population in Ascension Parish was 25.3 percent and the low-income population was 13.0 percent. For St. James Parish, the 2000 U.S. Census demographic profile records indicate that the minority population was 50.3 percent and the low-income population was 20.7 percent (http://censtats.census.gov., accessed November 6, 2009).

Table 4-28 presents the environmental justice populations of the study area as compared to Ascension and St. James Parishes as a whole.

Table 4-28: Demographic Data for Proposed Study area from 2000 U.S. Census

Parameter	Louisiana	Ascension Parish	St. James Parish	Study Area		
				Block Group 3, Census Tract 303; Block Group 1, Census Tract 305, Ascension Parish	Block Group 3, Census Tract 401; Block Group 1, Census Tract 403; Block Group 2, Census Tract 404, St. James Parish	Total
Total population	4,468,976	76,627	21,216	3,817	3,522	7,339
Total minority population[1]	1,674,585	18,249	10,678	987	1,272	2,259
	37.5%	23.8%	50.3%	25.9%	36.1%	30.8%
Percentage of population below poverty level	19.6%	13.0%	20.7%	16.1%	15.5%	15.8%

[1]Persons not "white alone" within the "Not Hispanic or Latino" subgroup.
Source: 2000 U.S. Census, American FactFinder

Analyses of the above information show that the percentage of the population that is minority and low-income in Ascension Parish is lower than state figures. While the percentage of the population that is minority in St. James Parish is significantly higher than state figures and the low-income population is slightly lower than state figures. Based on these figures, and field visits conducted in October 2009 to the proposed project area, it has been determined that the proposed LCA Convent/Blind River project area is a minority and low income population, therefore there are potential concerns for Environmental Justice per Executive Order 12898.

4.2.15.9 Water Use and Supply

Historic Conditions

Fresh groundwater and surface water is abundant in southern Louisiana. Prior to the 1900s, water used for most purposes was from surface sources. Many households collected rainwater for domestic uses and farmers generally relied on rainfall and irrigation ditches to provide water to their crops. During the late 1800s, water wells began to come into common usage and quickly proliferated in areas where fresh groundwater was available. The use of groundwater allowed farmers to plant crops in areas where sources of fresh surface water were unreliable or unavailable. In coastal areas of southeastern Louisiana, groundwater supplies are generally limited and surface water is primarily used. Elsewhere, a large supply of fresh groundwater is generally available, and therefore, used for most purposes.

Existing Conditions

Water use within Ascension and St. James Parishes has relied heavily on surface water resources. Extraction from the Mississippi River Mainstream has provided for almost all of current water use demands.

Other water sources include the Chicot Equivalent Aquifer System, the Mississippi River Alluvial Aquifer, the Evangeline Equivalent Aquifer System, the Mississippi River Delta Surface Water Basin, and the Lake Pontchartrain-Lake Maurepas Surface Water Basin, in order of decreasing supply respectively.

No surface water uptakes are in direct proximity to the proposed diversion uptake locations.

In 2005, for example, surface water sources supplied for 92 percent of water use, while groundwater sources provided for only eight percent. Combined water use in Ascension and St. James parishes increased from 1960 to 1980; after which time, overall water use has remained relatively stable. Though, a notable increase in water use was observed in St. James Parish from 2000 to 2005 due to increased industrial demand. Within the study area, the greatest water use has occurred in St. James Parish, followed by Ascension Parish, with demand driven by industrial use and other sectors constituting minor additions

Various industry groups are present within the vicinity of the study area, including petroleum refining, primary metals, food products, lumber, and chemicals. The latter constitutes the primary industrial water use group. Additional water use sectors in the vicinity of the study area are in decreasing order (as of 2005) aquaculture, public supply, rural domestic, livestock, and general irrigation.

Table 4-29: Water use in millions of gallons per day in 2005 for surface water and groundwater resources by water source for Ascension and St. James Parishes.

Water Source	Ascension	St. James
Surface Water		
Lake Pontchartrain-Lake Maurepas Surface-Water Basin	0.03	--
Mississippi River Mainstream	188.77	365.60
Mississippi River Delta Surface-Water Basin	1.53	--
Groundwater		
Mississippi River Alluvial Aquifer	1.00	3.34
Chicot Equivalent Aquifer System	10.65	19.30
Evangeline Equivalent Aquifer System	--	--

-- Denotes no use of water source by parish;
Source: Sargent (2007).

The LA DOTD online registry of water wells ttp://www.dotd.louisiana.gov/intermodal/ wells/) was queried to identify wells within the vicinity of the study area. In the distribution area, four wells are present: two plugged test wells owned by LA DOTD Public Works and Water Resources and two commercial, public supply wells—one owned by St. James Boat Club and the other by Shell Oil. Eleven additional water wells are within a half-mile radius of the project distribution area, including active and inactive wells: four plugged, abandoned, or destroyed wells, one private domestic well, one commercial public supply well, two monitoring wells, and three classed for "other" uses. No water wells lie within the transmission channels. Four plugged or abandoned wells are registered within 1,000 feet of the Romeville transmission canal. Seven water wells are registered within 1000-feet of the South Bridge transmission canal: three owned by Ancient Domain under Entergy, Inc. (one stock irrigation well and two abandoned domestic wells) and four monitoring wells owned by Star Enterprise, Inc.

Table 4-30: Annual water withdrawals (millions of gallons per day) from 1960 through 2005 for St. James and Ascension parishes.

Water Use	Water Source	Year									
		1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aquaculture	GW	0	0	0	0	0	0	0.12	0.08	0.07	22.13
	SW	0	0	0	0	22.66	18.6	51.35	10.09	11.75	0
	Total	**0**	**0**	**0**	**0**	**22.66**	**18.6**	**51.47**	**10.17**	**11.82**	**22.13**
General Irrigation	GW	0.05	0.91	0.40	1.34	0.01	0	0	0.03	0.06	0.04
	SW	0.07	0.51	0.45	7.91	0	0	0	0	0	0.01
	Total	**0.12**	**1.42**	**0.85**	**9.25**	**0.01**	**0**	**0**	**0.03**	**0.06**	**0.05**
Industrial	GW	6.53	10.62	8.71	7.65	11.67	11.15	17.64	13.36	12.63	6.05
	SW	44.40	20.31	328.53	390	466	358	404.92	438.52	426.79	551.87
	Total	**50.93**	**30.93**	**337.24**	**397.65**	**477.67**	**369.15**	**422.56**	**451.88**	**439.42**	**557.92**
Livestock	GW	0.31	0.23	0.19	0.16	0.07	0.06	0.05	0.11	0.09	0.11
	SW	0.01	0.01	0.02	0.02	0.01	0.01	0.03	0.02	0.02	0.03
	Total	**0.32**	**0.24**	**0.21**	**0.18**	**0.08**	**0.07**	**0.08**	**0.13**	**0.11**	**0.14**
Power Generation	GW	0	0	0	0	0	0	0	0	0	0
	SW	0	0	0	0	0	0	0	0	0	0
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Public Supply	GW	0.30	0.47	0.5	0.67	0.72	1.77	1.82	2.62	2.57	2.64
	SW	1.37	3.05	1.72	2.80	3.79	4.22	4.01	4.35	5.24	4.01
	Total	**1.67**	**3.52**	**2.22**	**3.47**	**4.51**	**5.99**	**5.83**	**6.97**	**7.81**	**6.65**
Rice Irrigation	GW	0	0	0	0	0	0	0	0	0	0
	SW	0	4.62	0	0	0	0	0	0	0	0
	Total	**0**	**4.62**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Rural Domestic	GW (Total)	**0.6**	**0.83**	**0.8**	**0.7**	**2.2**	**1.97**	**2.27**	**2.42**	**2.81**	**3.3**

4.2.15.10 Navigation

Historic Conditions

The Rivers and Harbors Act of 1899 and the General Bridge Act of 1946 give the U.S. Coast Guard (USCG) the authority to protect navigable waters of the United States. Navigable waters are those waters that at some time, in the past, present, or future, are used to transport interstate or foreign commerce. Protection of navigable waters is accomplished by regulating bridge-related activities and other activities that may affect navigation or the mooring of vessels on navigable waterways. The Eighth Coast Guard District regulates activities for the study area within the State of Louisiana.

Navigable waters within the study area include the Lower Mississippi River and the Blind River and its tributaries. Historically, these waterbodies have served as important conduits for navigation and commerce. Infrastructure developed to promote commerce along the Mississippi River in proximity of the study area includes the Ports of Baton Rouge, South Louisiana, and New Orleans and their associated structures.

Existing Conditions

Annual U.S. port tonnage statistics consistently rank the Ports of South Louisiana, New Orleans, and Baton Rouge among the top fifteen in the country. For 2007, these ports along the Mississippi River were respectively ranked first, eighth, and fourteenth nationally and constituted 46.0 percent, 15.3 percent, and 11.0 percent of the annual statewide port tonnage (USACE 2009). Primary inbound cargos at the Port of South Louisiana are crude oil and petroleum products, while corn, wheat, and animal feed dominate the port's exports. Primary inbound cargos at the Port of Baton Rouge are petroleum and chemicals. Outbound cargos are grain, chemicals, and petroleum products. At the Port of New Orleans, principal inbound cargos consist of steel, crude, and refined petroleum products and outbound cargos include grain, forest products, and steel. The ports of South Louisiana, New Orleans, and Baton Rouge line 172 miles (277 km) of both banks of the Lower Mississippi River.

The USCG reviews and comments on environmental documentation for Environmental Impact Statements (EIS), Environmental Assessments (EA), and in some particular cases Categorical Exclusions (CE) where navigable waters of the U.S. may be impacted. Coordination with the USCG dated December 2, 2009, indicates that at this time their organization does not find any problems associated with the proposed diversion uptake locations along the Mississippi River (personal communication, Daphne Coffman, LTJG, 2009).

4.2.15.11 Land Use Socioeconomics

Agriculture

Historic Conditions

Agriculture has been a historically important component of coastal Louisiana's economy. The rich deltaic soil and mild climate are conducive to the production of a wide variety of crops. Early settlers were primarily subsistence farmers during the colonial period, but subsequent times brought the expansion of commercial exploits. Before its decline at the end of the eighteenth century, indigo was the primary commercial crop near the study area. Sugar cane and cotton soon took its place, the former of which attained and still maintains prevalence. Other common crops included corn, rice, squash, pumpkin, varieties of peas and beans, and tobacco, most notably perique tobacco which worldwide is only produced in St. James Parish.

In 1950, there were 124,181 farms in Louisiana totaling over 11.2 million acres of farmland (US Census, 1950). The value of crops sold in Louisiana at this time exceeded $180 million. By 1997, statewide acreage in farmland had been reduced to 8.4 million acres, but the total value of crops sold had risen to over $1.4 billion (Farmland Information Center, 2006).

Based on the USDA Census of Agriculture, Ascension and St. James Parishes had 1,455 and 406 farms, respectively, in 1950. At this time, the total acreage of farms was 112,800 acres in Ascension Parish and 69,503 acres in St. James Parish.

Existing Conditions

Agriculture is still an important component of Louisiana's economy. In 2007, the acreage of farms in Louisiana was over 8.1 million acres, from which the total value of crops sold exceeded $1.6 billion (USDA 2007). Approximately 20 percent of the Nation's rice and 37 percent of the Nation's sugar are produced in Louisiana (USDA 2007). Production is largely concentrated in coastal Louisiana, much of which is experiencing land loss from RSLR or increasing salinities of waters serving as irrigation sources.

The USDA's National Agricultural Statistics Service (NASS) conducts agricultural censuses every five years. According to the 2007 survey, sugarcane is the primary crop in both Ascension and St James Parishes and accounts for approximately 38 percent and 56 percent of total farmland acreage within the parishes, respectively. Other major agricultural industries in the parishes include forage land, cattle, hogs and pigs, and other livestock. St James Parish also has a number of vegetable farms, while Ascension Parish has a small number of soybean farms. Both parishes also have a small number of orchards.

Between 2002 and 2007, declines in the number of farms and land in farms occurred in both Ascension and St. James Parish. In 2007, there were 45,455 acres in farmland in Ascension Parish while there were 43,251 acres in farmland in St. James Parish. The total market value of crops sold in 2007 was $17.3 million for Ascension Parish, an increase from 2002. In St. James Parish, the total market value of crops sold was $22.6 million in 2007 which was a decrease from 2002.

The study area contains approximately 163 acres of agricultural lands based on USGS NCLD 2004 data. Agricultural lands appear to be limited to cultivated areas between LA 44 and just north of LA 3125 and are impacted by the transmission canal routes. Farmlands along these corridors primarily consist of sugar cane plantations.

Forestry

Historic Conditions

Early settlers viewed the swamps as inhospitable and dangerous, yet inexhaustibly abundant. An estimated 15 million board feet of baldcypress grew in the delta swamps at the time of settlement (Kerr 1981). Baldcypress timber served as the primary cash crop for French settlers across the Lower Mississippi Valley in the eighteenth century, who traded in timbers for imported goods until the advent of sugar cane's profitability in the 1790s (Moore 1967). Harvesting methods were primitive during this period, and transport of timbers was often achieved by floating logs along manmade ditches from the swamp to the Mississippi River as spring floodwaters retreated to the river where sawmills were located, which limited operations to five months at most (Moore 1967, Eisterhold 1972, Prophet 1982). Small levees were often constructed to impound wetlands and facilitate lumber transport (Conner and Toliver 1990).

Large-scale commercial deforestation of baldcypress-tupelo forests did not begin until the late 19th century. The repeal of the Homestead Act of 1866 and passage of the Timber Act of 1876 made swamplands formerly deemed unattainable available for private purchase at low prices (25-50 cents/acre or 60 cents-$1.25/ha) (Davis 1975). The introduction of pull-boat logging in the 1890s and later the overhead-cableway skidder enabled increased harvest volumes and access to areas further from the navigable waters (Conner and Bulford 1998). Commercial harvests thrived in Louisiana from 1890 to 1925, with production reaching its peak in 1913, at which time more than 700 million board feet of lumber were processed in 94 mills (Mattoon 1915; **Figure 4-22**). Overexploitation and the onset of the Great Depression brought the decline of the cypress lumber industry in Louisiana, with the last old-growth harvested in the 1920s and the closure of the last baldcypress logging operation in 1956 (Conner and Toliver 1990). A mere artifact of a past booming industry, smaller logging operations continued harvests, with Mancil (1980) observing the last pull-boat logging along the Blind River in 1961.

Though harvests of baldcypress-tupelo forests declined, commercial harvests of addition timber species provided financial benefits to Louisiana. In 1965, the total value of timber sold in the state was $27.2 million (LFC 1966). Timber sales in Ascension and St. James Parishes at this time were $46,329 and $42,839, respectively. Experiencing substantial statewide and parish-level growth, the total value of timber sold in Louisiana, Ascension Parish, and St. James Parish in 2003 was $605.3 million, $765,547, and $164,356, respectively (LADAF 2004).

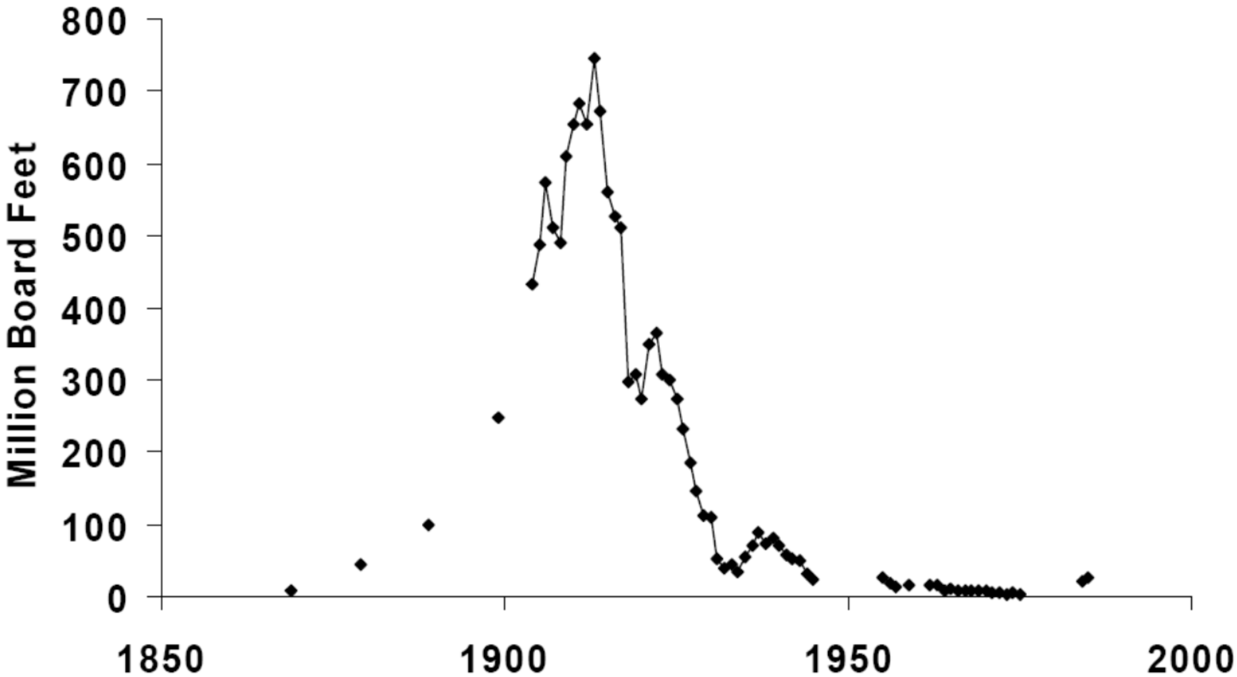

Figure 4-22: Historic volume of cypress cut in the state of Louisiana (Louisiana Department of Conservation 1943; Louisiana Forestry Commission, 1957; Louisiana Forestry Commission Progress Reports 1956-76; Mistretta and Bylin 1987 compiled in Chambers et al. 2005).

Existing Conditions

Forestry remains an important sector of Louisiana's economy with total sales of timber products in the state exceeding $471 million and providing tax revenue of $14 million (LADAF 2009). The statewide importance of the timber industry is reflected in the parishes surrounding the study area. In 2008, the total stumpage value of timber products in Ascension Parish was $344,209 and provided tax revenue of $10,142 (LADAF 2009). This included 864,022 board feet of sawtimber and 4,910 cords of pine and hardwood pulpwood. For St. James Parish in 2008, the total stumpage value of timber products was $222,657 and provided tax revenue of $6,644. This included 616,568 board feet of sawtimber and 3,497 cords pine and hardwood pulpwood.

Renewed interest has arisen for timber harvests of baldcypress-tupelo forests as second-growth forests reach economic maturity. Substantial concern exists regarding the ability of these forests to regenerate post-harvest. Therefore, the Louisiana governor has convened a Science Working Group on Coastal Wetland Forests to synthesize scientific information available on regeneration, growth, and potential harvesting effects on coastal wetland forests, and to develop science-based, interim guidelines for the conservation and utilization of coastal wetland forests (Chambers et al. 2005, Faulkner et al. 2007).

Currently, state restrictions prohibit the cutting of baldcypress trees in designated state water bottoms, as specified in Louisiana Revised Statute 41:1009 with certain exemptions for rights of way. Louisiana Revised Statute 41:1701 defines state water bottoms as "[t]he beds and bottoms of all navigable waters and the banks or shores of bays, arms of the sea, the Gulf of Mexico, and navigable lakes" and establishes the management and protection of the resources Lake Maurepas and Blind River are designated as a state water bottoms.

Public Lands

Historic Conditions

Public lands constitute all land areas managed by Federal, state and local government agencies. The U.S. Commission on Fish and Fisheries, established in 1871 to study, manage and restore fish, was the first federal conservation agency. The Bureau of Biological Survey followed in 1885, with the organizational purpose of studying birds, plants and animals. The U.S. Fish and Wildlife Service (USFWS) emerged from a merging of the Commission and Bureau in 1939. Subsequent Federal legislation led to the National Wildlife Refuge System, which strives to conserve, manage, and restore natural resources and habitats, and is managed by the USFWS.

State fish and wildlife agencies manage their state's similarly-minded WMA program. In 1909, the Louisiana Board of Commissioners for the Protection of Birds, Game and Fish was established and later evolved into the LDWF in 1975. The LDWF manages the WMA program for the State of Louisiana.

Existing Conditions

The study area includes 17,079 acres (6,912 ha), or approximately half, of the 37,163-acre (15,039 ha) Maurepas Swamp WMA Western Tract. The WMA was established in August 2001 and is managed by the LDWF. Much of the WMA was acquired through a philanthropic donation of approximately 62,518 acres (25,300 ha) by the Richard King Mellon Foundation in 2001. Historic and current activities within the WMA are detailed under **Section 4.2.14**.

Future management plans within the WMA include the erection of 200 duck boxes to enhance breeding habitat, construction of a board walk for public access and enjoyment, development of an invasive species management plan, and continued collaboration on restoration projects proposed to revive the swamp.

4.2.15.12 Man-Made Resources

Oil, Gas, Utilities

Historic Conditions

Since the discovery of oil and gas deposits in coastal Louisiana during the early 1920s, a vast network of canals, pipelines, and production facilities have been created to service the industry. Today, an estimated 9,300 miles (14,967 kilometers) of oil and gas pipelines crisscross the coastal wetlands of Louisiana. Additionally, there are approximately 50,000 oil and gas production facilities located in the Louisiana coastal area. Canals that stretch from the Gulf of Mexico inland to freshwater areas allow saltwater to penetrate much farther inland, particularly during droughts and storms, which has had severe effects on freshwater wetlands (Wang 1987 and 1988). Dredged material banks, which are much higher than the natural land surface, and the many smaller canals dredged for oil and gas exploration alter the flow of water across wetlands. Hydrologic alterations alter important hydrogeomorphic, biogeochemical, and ecological processes, including chemical transformations, sediment transport, vegetation health, and migration of organisms.

Because of the presence of dredged material banks, partially impounded areas have fewer but longer periods of flooding and reduced water exchange when compared to non-impounded marshes (Swenson and Turner 1987). This results in increased water-logging and frequently in plant death. Importantly, dredged material banks also block the movement of sediment resuspended in storms, which play a major role in sustaining land elevations (Reed et al. 1997). By altering salinity gradients and patterns of water and sediment flow through wetlands, canal dredging, which mostly occurred between 1950 and 1980, not only directly changed land to open water, but also indirectly changed the processes essential to a healthy coastal ecosystem.

Existing Conditions

Data from the LDNR Strategic Online Natural Resources Information System (SONRIS) indicate that the southeastern Maurepas Swamp has undergone extensive oil and gas exploration activities, most of which occurred in the early to mid-twentieth century. Exploration efforts have occurred primarily to the north and south of the Study Area, with the north experiencing more concentrated activities. Based on SONORIS data, 16 wells are near the Study Area: twelve are abandoned, three are active, and one has an expired permit Figure 4-25). Of these, only two wells are located within the Study Area and both are plugged and abandoned. Further description of oil and gas wells within the study area is provided in **Table 4-31**.

Additional data archived by SONRIS include directional well bottom hole point and well bore locations, depicted as straight lines extending from the top hole location to the bottom hole location. Review of this dataset does not support the presence of these features within the Study Area. Immediately outside of the Study Area, two well bores are recorded, one to the north and one to the south, with their statuses listed as dry and plugged. The exact location of these well bores is provided in **Figure 4-23**.

Table 4-31: Oil/gas wells within or adjacent to the study area.

Serial No.	Owner Name	Longitude	Latitude	Status	Status Date	Depth (ft)
158492	Texas Gulf Equipment, Inc.	-90.7403	30.0533	Producing Well	6/1/1991	11100
63286	F.A. Callery, Inc.	-90.8322	30.1261	P&A Dry Hole	12/4/1956	11802
54107	**Inactive Operator**	**-90.8192**	**30.1366**	**P&A Dry Hole**	**4/28/1955**	**15117**
98324	F.A. Callery, Inc.	-90.8322	30.1261	P&A Dry Hole	11/17/1963	11518
123319	Chevron U.S.A., Inc.	-90.8192	30.1366	Temporarily	3/5/1968	10433
138727	**Inactive Operator**	**-90.7729**	**30.0626**	**P&A Dry Hole**	**3/23/1972**	**11734**
167321	Texas Gulf Equipment, Inc.	-90.7364	30.0551	Producing Well	1/22/1995	11303
124257	P.R. Rutherford	-90.7281	30.0534	P&A Dry Hole	5/25/1968	11888
166991	Brock Exploration Corporation	-90.7259	30.0554	P&A Dry Hole	3/17/1980	12184
121176	Texaco, Inc.	-90.7986	30.1410	P&A Dry Hole	1/21/1968	11000
122145	Inactive Operator	-90.7757	30.0541	P&A Dry Hole	12/10/1967	11693
161462	Texas Gulf Equipment, Inc.	-90.7403	30.0533	WRSC	5/24/1989	11100
60013	Inactive Operator	-90.7898	30.1472	P&A Dry Hole	3/22/1956	9406
25073	Inactive Operator	-90.7792	30.1468	P&A Dry Hole	2/4/1941	9680
162124	ETC Oil Corp	-90.7312	30.0548	P&A Oil	5/9/1989	11320
154181	Brock Exploration Coporation	-90.7296	30.0511	PE	12/9/1976	NA

Notes: P&A- Plugged and Abandoned. PE- Permit expired. WRSC- Wells reverted to single completion (gas and condensate).
Wells located within the study area are denoted by **bold** font.

Table 4-32: Well bottoms and bores within or near the study area.

Serial No.	Owner Name	Product	Status	Status Date	Depth (ft)
121176	Texaco, Inc.	Unspecified	Dry & Plugged	1/21/1968	11000
166991	Brock Exploration Corporation	Unspecified	Dry & Plugged	3/17/1980	12184

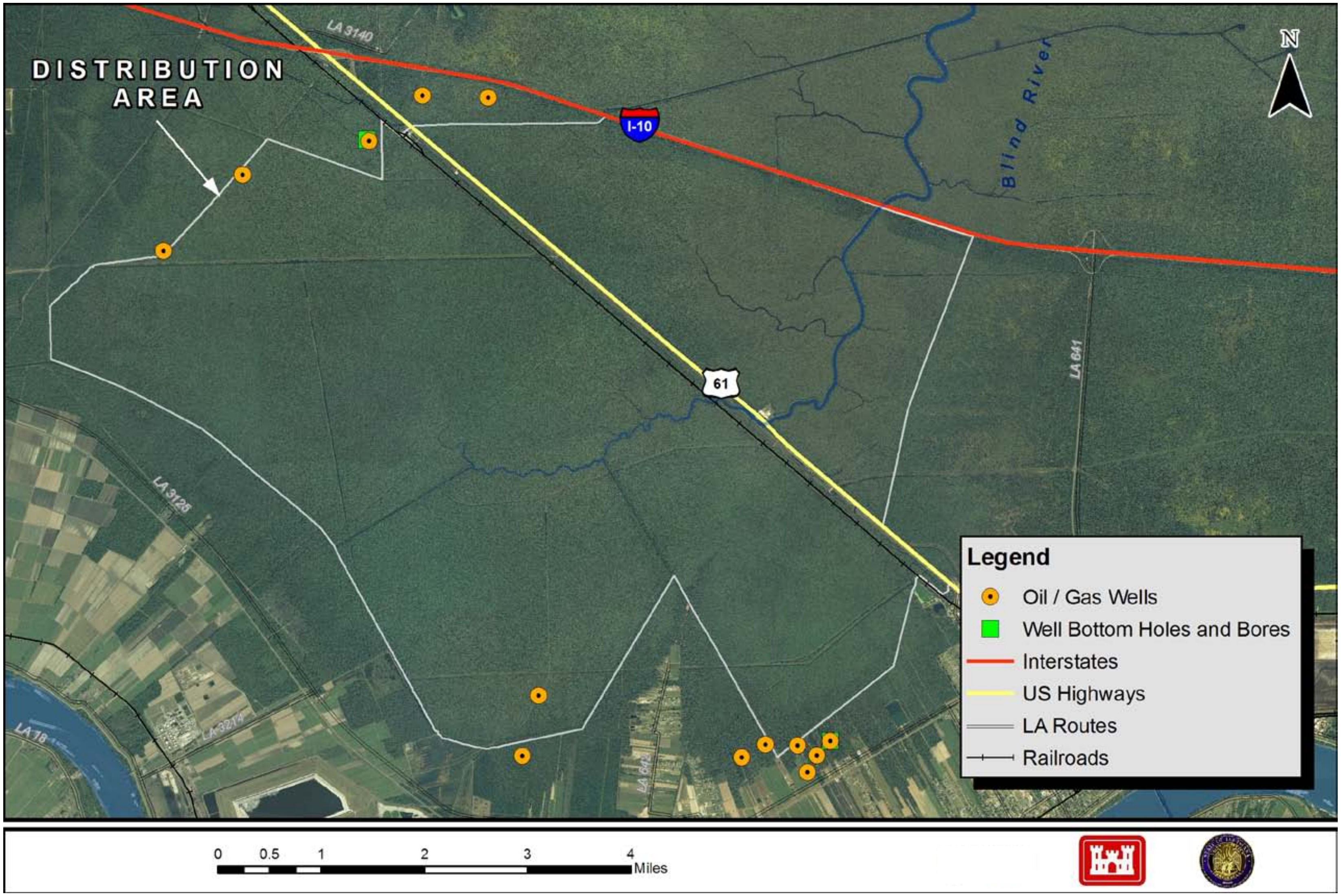

Figure 4-23: Oil and Gas well and well bottoms near Study Area.

Location data for gas transmission and hazardous liquid pipelines, liquefied natural gas (LNG) plants, and breakout tanks throughout the United States are compiled by the United States Department of Transportation (USDOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) based on contributions from pipeline operators. Geospatial data are archived in the National Pipeline Mapping System (NPMS), with the most recent iteration issued January 2004. Furthermore, in accordance with the 1988 Louisiana Damage Prevention Law, excavators and demolishers are required to contact a regional notification center—LA One Call—at least forty-eight hours before digging, and owners/operators of underground facilities are required to mark locations or provide information that will enable these entities to locate underground facilities and utilities. An initial query was performed of the NPMS which was then cross-referenced to updated records of underground structures attained through LA One Call for the Study Area. Locations of pipelines within the Study Area are provided in **Table 4-33**, and pipeline attributes are further described in **Table 4-34**.

Table 4-33: Summary of Pipeline Information in Study Area

Company	Installation Date	Product
Acadian Pipelines; Cypress Gas Pipeline	16" - 1957 4" - 1976	Natural Gas
Air Products	1992	Hydrogen Gas
Chevron Pipeline	Varies (earliest is 1965)	Natural Gas, NGL
		Propane
		Natural Gas
		Natural Gas
		Natural Gas, NGL, Propane
Gulf South Pipeline Company, LP	1990	Natural Gas
Marathon Pipeline, LLC	1978	Refined Products: Gasoline, Diesel, Jet Fuel
Petrologistics Olefins, LLC	1980	Ethylene
Williams Gas Pipeline	1971	Natural Gas
Shell Pipeline	1967	Ethylene

Table 4-34: Summary of Aboveground and Belowground Transmission Lines in Study Area

TELECOMMUNICATIONS & ELECTRICITY			
Company Name	**Description**	**Utility Size**	**Type**
Entergy			
Convent to Frisco	Transmission	230 kV	Aerial
Convent to Romeville	Transmission	230 kV	Aerial
Lutcher to Sorrento	Transmission	115 kV	Aerial
Panama to Dutch Bayou	Transmission	230 kV	Aerial
Romeville to Panama	Transmission	230 kV	Aerial
Verizon (MCI Telecommunications)	Fiber Optic Backbone	24 F Count	Buried
Level 3 Communications	Primary Fiber Optic	96F Count, 170F Count	Buried
AT&T Telecommunication	Proprietary		Aerial & Buried

Flood Control and Hurricane Protection

Historic Conditions

Efforts to control the frequent floods of the Mississippi River began shortly after French settlement. Bienville, the founder of New Orleans, initiated construction of the first manmade levee system, which began in the city in 1717 and was completed by 1727. Private landowners were responsible for extending the levee system, which by 1735 advanced along both banks of the river from approximately 30 miles (48 km) above to 12 miles (19 km) below New Orleans (USAED 1976). French colonial government decree in 1743 required private landowners along the river to complete and maintain their levees within the year or surrender their land (Gunter 1952). A period of expansive levee building followed, over which by 1844 the levee system extended along the west bank of the river from 20 miles (32 km) below New Orleans to the Arkansas River—a distance of about 600 miles—and to Baton Rouge along the east bank (Barry 1997). Levee building in the Pontchartrain Basin begin in 1812 and by 1895 had completely severed the basin from the river (Davis 2000, Lopez 2003).

Early flood protection systems were simply devised by building up the natural levee and, whether due to low structural integrity, abandonment, or neglect, were prone to breaching in flood events—an event known as crevassing (Davis 1993). More than 1,000 crevasses compromised the Lower Mississippi River's levees from 1850 to 1927 (Davis 1993). A breach of the east bank levee in the flood of 1890 allowed maximum flows of 408,520 ft^3 sec-1 (11,568 $m^3 sec^{-1}$) through the 3,104-foot (946-meter) Nita Crevasse at Romeville and into the study area for 122 days (Mills 1894). Though states became involved with flood protection through direct funding and creation of levee boards in the 1830s, Federal responsibility and directive for a coordinated levee system for the entire Lower Mississippi River did not begin until the establishment of the Mississippi River Commission (MRC) in 1897 (USACE 2009). The Flood Control Act of 1917 authorized the MRC to construct an extensive program of flood protection with cost-sharing by states and local interests. The flood of 1927—the most disastrous in the history of the Lower Mississippi Valley—led to the strengthening of this initiative through the passage of the Flood Control Act of 1928. The legislation authorized the MR&T Project, which incorporates levees, floodways, channel improvement and stabilization, and tributary basin improvements.

Inland from the levee, flood control structures included parish maintained ditches and canals. The lateral drainage system of ditches conveys flow from the adjacent uplands into canals in the distribution area. Construction of the St. James Parish canal network occurred in the 1950s and 1960s and provided direct connection with Blind River (personal communication, Jody Chenier—St. James Parish Director of Operations, 2009). Disposal of dredged material along canals created elevated spoil banks (berms) into which gaps were cut to facilitate water distribution (**Figure 4-24**). Berms vary in dimension, but their elevation typically ranges from 4 to 12 feet NAVD 88.

Existing Conditions

Existing flood control structures in the study area include the east bank levee of the Mississippi River and parish maintained ditches and canals. Built by the federal government under the MR&T Project, the east bank levee is maintained by the Pontchartrain Levee District (PLD) and contributes to the 2,203-mile (3,545-km) main stem levee system (USACE 2009). Levee elevation is approximately 38 feet NAVD 88 in the study area. The PLD St. James Hurricane Protection Levee and Study Project include potential alignments both within and near the study area. Presently in the feasibility stage, the final conceptual levee route has been chosen and will be aligned along the northeast bank of I-10.

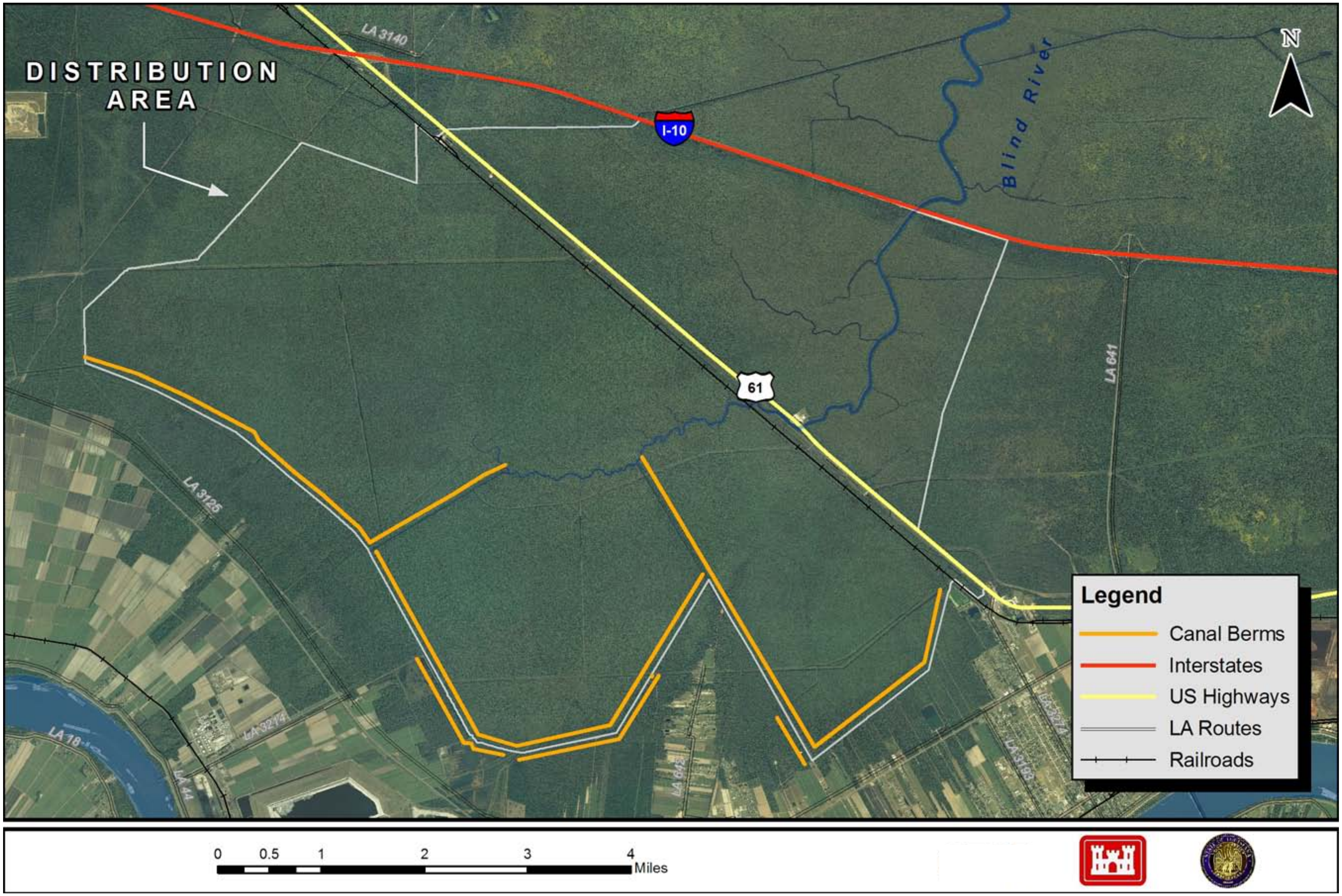

Figure 4-24 Location of berms within the distribution area.

Flood control structures in the study area include parish maintained canals within the distribution area. St. James Parish has presently completed approximately 50 percent of maintenance efforts to clear berms and re-dredge drainage canals to their original depths. Available light detection and ranging (LIDAR) imagery for the study area provides high accuracy, remotely attained elevation data acquired in 2001 (USACE, 2001). Based on preliminary analysis of this imagery, approximately 163 berm cuts exist along parish canals in the study area. Maintenance operations do not include re-dredging of berm cuts, and field observations indicate that these features have limited internal conveyance due to sediment buildup and revegetation. As present, these features restrict the distribution of water into and out of the swamp, which negatively impacts forest health and productivity.

4.2.15.13 Natural Resources

Commercial Fisheries

Historic Conditions

Commercial fisheries have been a historically important part of Louisiana's economy, supporting the livelihood of many residents. Across the state, the industry has experienced significant growth. The total value of commercial fisheries statewide was $23.6 million in 1950 compared to a near ten-fold increase ($201.7 million) in the industry by 2006 (NMFS 2007).

The LDWF's Trip Ticket Program provides a collection system for commercial landings and associated information. Individuals who purchase a wholesale/retail seafood license, fresh product license, or crab shedders license are legally required to report this information. Data have been collected since January 1, 1999. Annual total landings and their values by species were provided by LDWF (2009) for Lake Maurepas and the surrounding drainages where at least three commercial fishermen or wholesale/retail dealers provided information at the lowest level of analysis. The reported total value of commercial fisheries from 1999 to 2007 averaged $178,963 annually and included an average of 214,654 annual landings during this time (LDWF, 2009). By species, the majority of landings consisted of blue crab. Blue catfish, channel catfish, alligator gar, and brown and white shrimp also contributed to commercial landings in the area.

Among the many species commercially harvested in Louisiana, shrimp have historically constituted an important part of the state's commercial fisheries by value. Based on annual fisheries data from 1950 to 1998 for Louisiana, shrimp composed only 10 percent of average annual landings by weight but contributed to an overwhelming 56 percent of the average annual value of commercial fisheries in this period (LADWF 2000). Interestingly, the value of shrimp to Louisiana's commercial fisheries has historically increased while the number of shrimpers has declined. The total value of shrimp landings increased substantially from 1950 ($16 million) to 1998 ($156 million). Despite the high value of the fishery, the number of licensed commercial shrimpers in Louisiana declined from 16,505 to 6,694 from 1989 to 2005. This trend was also observed in Ascension and St. James parish with the number of licensed resident shrimpers declining by almost 66 percent in both parishes during this time period. In 2005, there were fifty licensed shrimpers in St. James Parish and thirty in Ascension Parish.

Existing Conditions

Louisiana's coastal wetlands are the richest estuaries in the country for fisheries production, and commercial fisheries support the livelihood of many residents. Commercially and recreationally important species, such as brown and white shrimp, blue crabs, eastern oysters, and menhaden, are abundant in the state, but these species' populations are threatened by trends of habitat degradation. Louisiana has historically been an important contributor to the Nation's domestic fish and shellfish production and is one of the primary contributors to the Nation's food supply for protein. While Louisiana has long been the Nation's largest shrimp and menhaden producer, it has also recently become the leading producer of blue crabs and oysters.

Louisiana ports produce a catch comparable to that of the entire Atlantic seaboard, and more than triple that of the remaining Gulf States (NMFS, 2001). Four Louisiana ports have ranked among the top ten in value of commercial fisheries landings throughout the U.S. since 1981 (NMFS, 2003). Louisiana's commercial landings have been over one billion pounds per year (454 million kg) for over 20 years. In 2006, commercial fisheries accounted for 26,915 jobs statewide, $1.8 billion in retail sales, and $170.5 million in state and local tax revenues, with a total economic effect of $2.4 billion (Southwick 2006). White shrimp (*Litopenaeus setiferus*), brown shrimp (*Farfantepenaeus aztecus*), and Gulf menhaden (*Brevoortia patronus*) account for the majority of commercial harvest by value.

The total value of commercial fisheries for Louisiana in 2008 was $274.8 million (NMFS, 2009). In 2008, the reported total value of commercial fisheries for Lake Maurepas and the surrounding drainage was $120,680 with 126,100 landings (LDWF, 2009). Blue crab and white shrimp made up over 97 percent of these landings.

Based on correspondence with the NMFS dated February 20, 2009, foraging and nesting habitat for economically important, estuarine-dependent fishery species is present within the study area. Important species include blue crab, striped mullet, and Gulf menhaden.

Oyster Leases

Historic Conditions

No oyster leases historically occurred within the study area.

Existing Conditions

No oyster leases presently occur within the study area.

4.2.16 Hazardous, Toxic, and Radioactive Wastes

The USACE is obligated under ER 1165-2-132 to assume responsibility for the reasonable identification and evaluation of all HTRW contamination within the vicinity of the proposed action. ER 1165-2-132 identifies the USACE policy to avoid the use of project funds for HTRW removal and remediation activities. Costs for necessary special handling or remediation of wastes (e.g., those regulated by the RCRA), pollutants and other contaminants, which are not regulated under the CERCLA, will be treated as project costs if the requirement is the result of a validly promulgated Federal, state, or local regulation.

HTRW investigations facilitate early identification and consideration of HTRW problems. The Civil Works Project Plan routinely includes a phased and documented review to provide for early identification of HTRW potential at project sites. ER 1165-2-132 requires that viable options to avoid HTRW problems be determined and a procedure for resolution of HTRW concerns be established. A Phase I ESA was conducted on the study area in accordance with ER 1165-2-132.

This Phase I ESA was conducted in a manner consistent with customary practice and in general conformance with the scope and limitations of the American Society for Testing and Materials (ASTM) Designation E 1527-05, Standard Practice for Environmental Site Assessments: Phase I ESA Process (ASTM 1527); ASTM Designation E 2247-08 Standard Practice for Environmental Site Assessments: Phase I ESA Process for Forestland and Rural Property, and the U.S. Environmental Protection Agency's All Appropriate Inquiry (AAI) standards Rule, 40 CFR Part 312. The purpose of this ESA was to identify and investigate recognized environmental conditions on the subject property and surrounding properties that may constitute actual or potential sources of environmental risk or liability that may have resulted from past or present land uses, construction activities, site management or operations.

Based upon the database information reviewed, walk-through observations of property conditions, interviews with representative property owners, and review of property ownership no recognized environmental concerns were identified within the southeastern Maurepas Swamp, the Blind River, or the proposed Romeville diversion route that would be expected to impact the subject property. An underground storage tank was identified during the database search adjacent to the transmission canal location for the South Bridge diversion route.

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5.0 ENVIRONMENTAL CONSEQUENCES

This chapter describes the potential environmental consequences of implementing alternative plans considered for freshwater diversion and nutrient and sediment introduction to the Maurepas Swamp. The following analysis compares the No Action Alternative to the alternatives carried over for detailed analysis: alternative plans 2, 4, 6, and 4B. Plan 2 was the TSP which was later confirmed as the Recommended Plan. Diversion alternatives for freshwater, nutrient, and sediment introduction are described in Chapter 3.0 Alternatives.

A comparison of the direct, indirect, and cumulative impacts for freshwater diversion and nutrient and sediment introduction opportunities is presented herein. 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, increased inflow of freshwater would be a direct impact of diverting water from the Mississippi River into Maurepas Swamp.

Indirect impacts are those effects that are caused by the action and occur later in time or further removed in distance, but are still reasonably foreseeable (Section 1508.8(b) of 40 CFR Parts 1500-1508). Indirect impacts of project implementation would include an increase in hydrologic connectivity throughout the system which would increase the flow of water out of the swamp and the frequency of dry out conditions necessary for tree seedling survival. This would allow for increased recruitment of baldcypress and water tupelo. Freshwater, nutrient and sediment introduction would increase productivity and accretion (swamp building) and reduce or offset the effects of RSLR (eustatic sea level rise and subsidence). Additionally, pulsing of the system would further enhance circulation, productivity and nutrient assimilation in the swamp and thereby improve water quality and reduce salinity in the swamp and in Blind River. Increases in productivity and accretion that increase swamp building provide stability in areas that would otherwise erode. Increases in productivity in the swamp would benefit wading bird populations by restoring diminishing suitable swamp forest habitat and increasing abundance of forage fish and crayfish in the study area. Overall, birds would benefit in the longer term from the healthier swamp forest ecosystem that would provide better food sources and nesting sites than currently exist.

Cumulative impacts would be the aggregate of impacts to the environment resulting from the proposed action in combination with other ongoing actions, and actions being considered within the reasonably foreseeable future. Cumulative impacts are the effects on the environment that result from the incremental impact of the action 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, increased ecosystem health and the prevention of degradation could significantly modify an entire basin's diversity of habitats and species assemblages. The cumulative impact analysis followed the 11-step process described in the 1997 report by the Council of Environmental Quality entitled "Considering Cumulative Effect Under the National Environmental Policy Act." **Table 5-1** summarizes cumulative impacts for all important resources.

This environmental analysis evaluates and compares, from a qualitative and quantitative perspective, the alternative plans and the No Action Alternative carried over for detailed analysis. Impact analysis described in this chapter is based on a combination of scientific and engineering analyses, professional judgment, and previously compiled information.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Soils	*US:* Institutional recognition of importance of soils with formation of Soil Conservation Service. *LA:* Louisiana coastal land loss of over 1.22 million acres since 1956. *SA:* Loss of 1,600 acres in Amite/Blind River mapping unit between 1932 and 1990 (LCWCRTF and WCRA 1999). Land area in *SA* generally stable, since 1985 (USGS 2009).	*US, LA, and SA:* Continued institutional recognition; continued loss of soil resources. *US:* Natural processes of parent material, climate, organisms, relief, and time factors in soil formation. *LA:* Continued land loss of over 25 square miles per year. *SA:* Continued stability of land area.	*US & LA:* Continued institutional recognition; continued loss of soil resources. *SA:* Increased flood duration, stage, and salinity would persist throughout resulting in continued stress and reduced productivity. Over the 50-year period of analysis, there would be conversion of approximately 11,229 acres (4,544 ha) of forested swamp to fresh marsh or open water.	US & LA: Continued institutional recognition and programs for soil conservation to reduce soil losses. *ALT*2: This alternative would have positive synergistic effects on soil resources when combined with other Federal, state, local, and private restoration efforts. *ALT*4: Cumulative impacts would be similar to *ALT*2. *ALT*6: Cumulative impacts would be similar to *ALT*2. *ALT*4B: Cumulative impacts would be similar to *ALT*2.

**Includes Spatial/Geographic Extent (Continental United States [U.S.], Louisiana [LA], and Study Area [SA], and Temporal (Past, Present, and Future with the No-Action Alternative). This cumulative impact analysis follows the 11-step process described in the 1997 report by the Council of Environmental Quality entitled "Considering Cumulative Effect Under the National Environmental Policy Act".*

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Water Bottoms	*US, LA, & SA:* Water bottoms develop in response to natural and manmade conditions. *SA:* Construction of Mississippi river levees prevents exchange between the River and the swamp. Direct construction within swamp and along River impacts water bottoms.	*US & LA:* Continued land loss results in increasing acreage of shallow open water and water bottoms. *SA:* Increased flood duration and stage causes degradation of swamp habitat towards freshwater marsh and open water. Soil increases in organic matter content, is saturated for longer durations, and resembles soils of fresh marsh and shallow water bottoms.	*US & LA:* Increased acreage of shallow water bottoms in response to wetland loss. *SA:* Conversion of swamp to freshwater marsh and open water with RSLR would convert swamp soils to shallow water bottoms. The availability of nutrients and detritus from the decomposing swamp vegetation would initially increase, and then decrease.	*US & LA:* Increased acreage of shallow water bottoms in response to wetland loss. *ALT*2: This alternative would have positive synergistic effects on water bottoms when combined with other Federal, state, local, and private restoration efforts. Reestablishing hydrologic connection would aid in restoring swamp habitat and would decrease the acreage of water bottoms within the swamp. Functional existing water bottoms of Blind River and canals would increase in contribution to downstream trophic webs. *ALT*4: Cumulative impacts would be similar to *ALT*2. *ALT*6: Cumulative impacts would be similar to *ALT*2. *ALT*4B: Cumulative impacts would be similar to *ALT*2.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Hydrology Resources – ***Flow and Water Levels***	*U.S., LA*: Flows and water levels respond to natural conditions. Increased runoff due to increased urbanization. *SA:* Decreased freshwater flows into and out of swamp and increased estuarine influences due to elimination of Mississippi River flood input with construction of levees. Flow and water levels altered by canal, ditch, and spoil bank construction.	U.S. & LA: Increased flows and water levels with increased runoff due to increasing urbanization and wetland loss. Rate of RSLR increasing over historic conditions. *SA:* Increased impoundment, water levels, and estuarine influence due to RSLR and human modifications, coastal wetland loss, and increased runoff due to increased urbanization of the Pontchartrain Basin.	US & LA: Increased flows and water levels with increased urbanization and associated runoff and increased wetland loss. Rate of RSLR rise increasing over historic conditions. *SA:* Increased impoundment, water levels, and estuarine influence due to RSLR and human modifications, coastal wetland loss, and increased runoff due to increased urbanization of the Pontchartrain Basin.	US & LA: Increased flows and water levels with increased urban runoff from increasing urbanization and increased wetland loss. *ALT*2: This alternative would have positive synergistic effects on water levels and flows when combined with other Federal, state, local, and private restoration efforts. *ALT*4: Cumulative impacts would be similar to *ALT*2. *ALT*6: Cumulative impacts would be similar to *ALT*2. *ALT*4B: Cumulative impacts would be similar to *ALT*2.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Hydrology Resources – ***Sedimentation & Erosion***	*U.S.:* Decreasing sedimentation due to reduction of erosion on land, reservoirs, and bank stabilization. *LA & SA*: Flood Control Act of 1928 ended sediment delivery from Mississippi River by crevasses.	*U.S.*: Decreasing sedimentation due to reduction of erosion on land, reservoirs, and bank stabilization. *LA & SA*: Inflow of suspended sediments by Mississippi River prevented by construction of levees; sediment deficiencies limit wetland accretion and increase RSLR; coastal wetland loss. *SA*: Decreased redistribution of sediments into and out of the swamp due to channelization and spoil banks; swamp deteriorating due to insufficient sediment supply.	*US:* Continued decreasing sedimentation due to reduction of erosion on land, reservoirs, and bank stabilization efforts. *LA*: Sediment supply does not offset coastal land loss. *SA:* Some redistribution of sediments to and from the swamp during storm events. Swamp will continue to deteriorate due to insufficient sediment supply and RSLR.	US & LA: Continued decreasing sedimentation due to reduction of erosion on land, reservoirs, and bank stabilization. *ALT*2: This alternative would have positive synergistic effects on hydrology and sediment accumulation when combined with other Federal, state, local, and private restoration efforts. *ALT*4: Cumulative impacts would be similar to *ALT*2. *ALT*6: Cumulative impacts would be similar to *ALT*2. *ALT*4B: Cumulative impacts would be similar to *ALT*2.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	**Past Actions** **(Historic Conditions)**	**Present Actions** **(Existing Conditions)**	**The No-Action Alternative** (Future Without Project)	**Cumulative Impacts** **(Comparison of Future With Proposed Action Impacts)**
Hydrology Resources -- Groundwater	*US, LA & SA:* Potential net decrease in groundwater resources due to increasing demand by growing population and saltwater intrusion. *SA:* Groundwater supply is primarily from Chicot Equivalent Aquifer System.	*US, LA, & SA:* Potential net decrease in groundwater resources due to increasing demand by growing population and saltwater intrusion. *SA*: Groundwater is primarily from the Chicot Equivalent Aquifer System.	*US, LA, &SA:* Potential net decrease in groundwater resources due to increasing demand by growing population and saltwater intrusion. *SA:* Groundwater is primarily from the Chicot Equivalent Aquifer System.	US & LA: Potential net decrease in groundwater resources due to increasing demand by increasing populations. *ALT*2: This alternative would result in minor variations in groundwater seepage due to head gradients created by the diversion and improved drainage of Maurepas Swamp. *ALT*4: Cumulative impacts would be similar to *ALT*2. *ALT*6: Cumulative impacts would be similar to *ALT*2. *ALT*4B: Cumulative impacts would be similar to *ALT*2.
Water Quality	*U.S., LA, SA:* CWA (1977), NEPA (1969), CZMA and Estuary Protection Act provide institutional recognition to restore and protect water bodies, especially with respect to point sources. Non-point sources still unregulated. *SA:* Development of lands adjacent to the study area and within its contributing area. Canal construction increases drainage into study area.	*U.S. & LA:* Continued institutional recognition. Increasing human populations and industrialization result in increased potential for water quality problems. *SA:* Wastewater and polluted runoff from urban areas enters the *SA* through drainage and tidal action. Both suspended particles and nutrients exceed the applicable criteria. Continued loss of emergent wetlands impacts the marshes ability to absorb and reduce air and water pollutants.	*US, LA, & SA:* Continued institutional recognition. Increasing human populations and industrialization result in increased potential for water quality problems. *SA:* Increasing human populations and industrialization result in increased potential for water quality problems. Increased potential for accidental discharges due to exposure of infrastructure from wetland losses.	*US & LA:* Continued institutional recognition. Increasing human populations and industrialization result in increased potential for water quality problems *ALT*2: This alternative would have positive synergistic effects on water quality when combined with other Federal, state, local, and private restoration efforts in the Blind River and Maurepas Swamp. There would be temporary negative impacts (e.g., increased turbidity, decreased dissolved oxygen) during construction. Minimal cumulative impacts on Lower Mississippi River water quality would result. *ALT*4: Cumulative impacts would be similar to *ALT*2. *ALT*6: Cumulative impacts would be similar to *ALT*2. *ALT*4B: Cumulative impacts would be similar to *ALT*2

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	**Past Actions** **(Historic Conditions)**	**Present Actions** **(Existing Conditions)**	**The No-Action Alternative** (Future Without Project)	**Cumulative Impacts** **(Comparison of Future With Proposed Action Impacts)**
Water Quality-Salinity	*US, LA, SA:* Increase in salinity levels inland due to saltwater intrusion from sea level rise, human alterations, and wetland losses. *SA:* Reduced freshwater input and flows due to human-modifications allow higher salinity levels in study area surface waters and soil, reducing forest health.	*US , LA, & SA:* Increases in salinity levels inland due to saltwater intrusion from sea level rise, human alterations, and wetland losses. *SA*: Reduced freshwater input and impoundment due to human-modifications allow higher salinity levels in study area surface waters and soil, reducing forest health.	*US, LA, & SA:* Increases in salinity levels inland due to saltwater intrusion from sea level rise, human alterations, and wetland losses. *SA:* RSLR and reduced freshwater input and impoundment due to human-modifications allow higher salinity levels in study area surface waters and soil, reducing forest health.	*US & LA:* Increase in salinity levels inland due to salt water intrusion from wetland loss and reductions in freshwater inflow. *ALT*2: This alternative would have synergistic effects on salinity when combined with other Federal, state, local, and private restoration efforts decreasing concentrations in the Blind River, Maurepas Swamp, and Lake Maurepas. This alternative is unlikely to affect salinity in the Lower Mississippi River. *ALT*4: Cumulative impacts would be similar to *ALT*2. *ALT*6: Cumulative impacts would be similar to *ALT*2. *ALT*4B: Cumulative impacts would be similar to *ALT*2

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Noise	*U.S., LA & SA:* Institutional recognition via Noise Control Act of 1972. *SA:* Development along ridges and water bodies accompanied by rail, automobile, and boat traffic.	*U.S. & LA:* Continued institutional recognition; continued human population growth and development causes some noise pollution. *SA:* Ambient noise from automobile, train, and motorboat traffic and other human activities may cause some minimal and temporary disturbances in the study area.	*US, LA, and SA:* Continued institutional recognition; continued human population growth and development would generate more noise exposure. *SA:* Localized noise exposure from automobile, train, and motorboat traffic produce temporary and infrequent disturbances in the study area.	U.S. & LA: Continued institutional recognition; continued human population growth and development would cause some noise pollution. *ALT* 2: This alternative would cause localized and temporary increases in noise during construction activities. Long term benefits include wetland building processes and maintenance and growth of the forest canopy which would act as a buffer to noise in the study area. *ALT* 4A: Cumulative impacts would be similar to *ALT* 2. *ALT* 6: Cumulative impacts would be similar to *ALT* 2. *ALT* 4B: Cumulative impacts would be similar to *ALT* 2.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	**Past Actions** **(Historic Conditions)**	**Present Actions** **(Existing Conditions)**	**The No-Action Alternative** (Future Without Project)	**Cumulative Impacts** **(Comparison of Future With Proposed Action Impacts)**
Air Quality	*U.S., LA & SA:* Institutional recognition via Clean Air Act of 1963. *LA & SA:* Institutional recognition via Louisiana Environmental Quality Act of 1983. Formation of USEPA and LDEQ. *SA:* Development along ridges and water bodies.	*U.S., LA, & SA:* Continued institutional recognition; deterioration of air quality in the region due to increases in human populations and industry, coupled with loss of wetlands and air filtration services they provide. *SA:* Development of surrounding areas. In non-attainment area for ozone.	*US, LA, & SA:* Continued institutional recognition; air quality would likely decline due to continued population growth and increased industrialization. Loss of LA coastal resources would reduce air filtration services provided by this resource.	*U.S. & LA*: Continued institutional recognition; however, air quality would likely decline due to continued population growth and increased industrialization. *ALT 2*: This alternative would have positive synergistic effects on air quality when combined with other Federal, state, local, and private restoration efforts. This alternative would restore wetland building processes which may filter air and improve air quality. *ALT 4A*: Cumulative impacts would be similar to ALT 2. *ALT 6*: Cumulative impacts would be similar to ALT 2. *ALT 4B*: Cumulative impacts would be similar to ALT 2.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Vegetation Resources	*US, LA, and SA*: Natural processes form coastal vegetation resources. Invasive plant species, intentionally and unintentionally released and displace native vegetation in some habitats *LA and SA:* Extensive overharvest of old growth forests primarily from 1890-1925. *SA*: Regeneration of primarily baldcypress-tupelo forests. Although there were no significant shifts in habitat type since 1956, the swamps have become increasingly stressed.	*U.S., LA, & SA:* Deterioration and loss of wetlands nationwide and statewide. Spread of invasive plant species. *SA:* Present vegetation resources include approximately 20,188 acres of baldcypress-tupelo swamp, 1,823 acres of bottomland hardwood forest, 253 acres of bottomland scrub-shrub, 146 acres fresh marsh, and 27 acres of aquatic floating bed. Although there have been no significant shifts in habitat type, the swamps have become increasingly stressed.	*U.S. & LA:* Continued deterioration and loss of vegetated wetland habitat acreage due to natural and human-induced processes. *SA:* Continued degradation and loss of existing wetland vegetative habitats, in concert with insufficient freshwater, nutrient, and sediment inflows to sustain the interdependent processes of plant production and vertical maintenance necessary for persistence of a stable ecosystem. Small Diversion at Hope Canal would reduce the risk of saltwater intrusion but fail to ameliorate problems related to increased flood duration, stage, and impoundment.	*US & LA:* Continued deterioration and loss of vegetated wetland habitat and further introduction and spread of invasive plant species. Wetland protection, creation, and restoration, as well as invasive species control, reduce these trends somewhat. *ALT*2: This alternative would prevent a shift to fresh marsh and open water thus having positive synergistic effects on coastal vegetation resources when combined with other Federal, state, local, and private restoration efforts. *ALT*4: Cumulative impacts would be similar to *ALT*2. *ALT*6: Cumulative impacts would be similar to *ALT*2. *ALT*4B: Cumulative impacts would be similar to *ALT*2.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	**Past Actions** **(Historic Conditions)**	**Present Actions** **(Existing Conditions)**	**The No-Action Alternative** (Future Without Project)	**Cumulative Impacts** **(Comparison of Future With Proposed Action Impacts)**
Wildlife Resources	*U.S., LA & SA*: Wetland dependent wildlife populations respond primarily to natural population-regulating mechanisms.	*U.S., LA, and SA:* Continued nationwide degradation and loss of wetlands leads to decline of wetland-dependent wildlife populations. *SA:* Continued wetland degradation and loss leads to increased competition between local wetland-dependent wildlife populations for decreasing resources; displacement to other more suitable wetland areas; and localized decline in wetland-dependent wildlife populations.	*U.S., LA:* Nationwide degradation and loss of wetlands continues to adversely impact wetland-dependent wildlife populations. *SA:* An expected 9,836 acres of wetlands lost from the *SA* at a rate of 1,167 acres per year over the next 50 years leads to increased competition between local wetland-dependent wildlife populations for decreasing resources; displacement to other more suitable wetland areas; and localized decline in wetland-dependent wildlife populations.	US & LA: Nationwide degradation and loss of wetlands continues to adversely impact wetland-dependent wildlife populations. *ALT*2: Creation, restoration, and protection of wetlands leads to increased habitat for wetland-dependent wildlife; decreased competition for resources; localized stabilization or improvement in wetland-dependent wildlife populations. *ALT*4: Cumulative impacts would be similar to *ALT2* with potentially more adverse construction impacts initially due to the South Bridge diversion. *ALT*6: Cumulative impacts would be similar to *ALT4*. *ALT*4B: Cumulative impacts would be similar to *ALT4*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Fisheries	*U.S. & LA:* Reduction in fisheries habitat while catches increased, placing greater pressure on fishery resources. Formation of the National Marine Fisheries Service. *SA:* Levee construction and channelization reduced freshwater input; as a result, increased impoundment and limited circulation degraded habitat suitability for fish species.	*U.S. & LA:* Regulated catch; habitat loss decreased somewhat by coastal restoration efforts; yet continued net habitat loss. *SA:* Degraded habitat conditions lead to low species evenness and frequent fish kills.	*U.S., LA & SA*: Continued loss of fishery resources unless intensified efforts to protect them locally, statewide, and nationally. Small Diversion at Hope Canal would enhance fishery resources in the lower reaches of the Blind River.	*US & LA:* Continued loss of fishery resources unless intensified efforts to protect them locally, statewide, and nationally. *ALT*2: This alternative would have positive synergistic effects on fishery resources when combined with other Federal, state, local, and private restoration efforts increasing fish populations in the Blind River and Maurepas Swamp. Additionally, decreases in salinity in Lake Maurepas from other diversion projects could increase fresh water fish species in the area which may increase populations in the Blind River and Maurepas Swamp *ALT*4: Cumulative impacts would be similar to *ALT*2. *ALT*6: Cumulative impacts would be similar to *ALT*2. *ALT*4B: Cumulative impacts would be similar to *ALT*2. .

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	**Past Actions** **(Historic Conditions)**	**Present Actions** **(Existing Conditions)**	**The No-Action Alternative** (Future Without Project)	**Cumulative Impacts** **(Comparison of Future With Proposed Action Impacts)**
Aquatic Resources-Plankton	*US & LA:* Populations respond to natural conditions. *SA:* Construction of Mississippi River levees prevented the exchange of organisms and water between the MS River and swamp.	*US:* Populations respond to natural and human-induced perturbations. *LA:* Populations in LA are shifting towards more saline-oriented species as land loss and saltwater intrusion into interior regions continues. *SA:* Plankton population changes associated with conversion of swamp habitat to freshwater marsh and open water.	*US:* Populations continue to respond to natural and human-induced perturbations. *LA:* Populations in LA are shifting towards more saline-oriented species as land loss and saltwater intrusion into interior regions continues. *SA:* Conversion of swamp to fresh marsh and open water may shift populations.	*US & LA:* Continued nationwide loss of vegetated wetlands continues to adversely impact plankton populations. *ALT*2: This alternative would have positive synergistic effects on plankton resources when combined with other Federal, state, local, and private restoration efforts. Wetland creation and nourishment would result in greater resources for plankton organisms due to the export of dissolved organic compounds. *ALT*4: Cumulative impacts would be similar to *ALT*2. *ALT*6: Cumulative impacts would be similar to *ALT*2. *ALT*4B: Cumulative impacts would be similar to *ALT*2.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Aquatic Resources - Benthic Resources	*US, LA, & SA:* Benthic populations respond to natural and manmade conditions. *SA:* Construction of Mississippi River levees prevent exchange of benthic organisms and water between the River and the swamp.	*US & LA:* Benthic populations respond to natural and human-induced perturbations with shift towards more saline-oriented species as land loss and saltwater intrusion into interior regions continues . *SA:* Benthic population changes associated with conversion of swamp habitat to freshwater marsh and open water. The amount of habitat available for use by benthic species assemblages that typically utilize swamp or marsh edge habitats is reduced due to degraded conditions. Limited availability of nutrients and detritus from the decomposing swamp vegetation due to low productivity.	*US & LA:* Benthic populations respond to natural and human-induced perturbations with shift towards more saline-tolerant species as land loss and saltwater intrusion into interior region continues. *SA:* Conversion of swamp to freshwater marsh and open water may shift benthic populations. The amount of habitat available for use by benthic species assemblages that typically utilize swamp or marsh edge habitats would decrease. The availability of nutrients and detritus from the decomposing swamp vegetation would initially increase, and then decrease.	*US & LA:* Benthic populations respond to natural and human-induced perturbations with shifts towards more saline-oriented species as land loss and saltwater intrusion into interior regions continues. *ALT2*: This alternative would have positive synergistic effects on benthic resources when combined with other Federal, state, local, and private restoration efforts. Wetland restoration and nourishment would result in greater resources for benthic organisms due to the export of dissolved organic compounds and detritus from wetlands. *ALT*4: Cumulative impacts would be similar to *ALT*2. *ALT*6: Cumulative impacts would be similar to *ALT*2. *ALT*4B: Cumulative impacts would be similar to *ALT*2.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Essential Fish Habitat (EFH)	*U.S., LA & SA*: General decrease in quality of EFH beginning in the mid 1900s. Institutional recognition of decline in EFH quality; passage of Magnuson-Stevens Fishery Conservation and Management Act.	*U.S. & LA*: Continued institutional recognition; continued wetland loss and decline in quality of EFH. *SA*: There is no EFH in the SA. CWPPRA shoreline protection projects such as PO-30 and other restoration projects protect some existing EFH. Continued wetland loss converts high-quality EFH to lower quality categories (e.g., emergent wetlands to open water bottoms).	*U.S. & LA*: Continued institutional recognition; continued wetland loss and decline in quality of EFH. *SA*: There is no EFH in the SA. CWWPRA shoreline protection projects such as PO-30 and other restoration projects protect some existing EFH. Continued wetland loss converts high quality EFH to lower quality categories (e.g., emergent wetlands to open water bottoms).	*US & LA:* Continued loss of EFH. *ALT*2: There is not EFH in the SA. The diversion may result in a shift or decrease in EFH in Lake Maurepas. *ALT*4: Cumulative impacts would be similar to *ALT*2. *ALT*6: Cumulative impacts would be similar to *ALT*2. *ALT*4B: Cumulative impacts would be similar to *ALT*2.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Threatened and Endangered Species	*US, LA, SA*: Institutional recognition of decline in listed species via the Endangered Species Act. Decrease in some animal and plant populations and their critical habitat including loss of wetlands.	*U.S LA.*: Continued institutional recognition of decline in listed species; continued wetland loss. *SA*: Continued loss of wetlands that are used by many listed species.	*U.S.*: Continued institutional recognition of decline in listed species; continued loss of wetlands. *LA & SA*: Continued coastal land loss and deterioration of critical coastal habitats is anticipated to impact all associated listed species.	US & LA: Continued institutional recognition of decline in listed species; continued loss of wetlands and critical coastal habitats. *ALT2*: USFWS guidelines will be followed and there will be no impacts to the Gulf sturgeon, manatee, or bald eagle. There may be impacts to pallid sturgeon. *ALT*4: Cumulative impacts would be similar to *ALT*2. *ALT*6: Cumulative impacts would be similar to *ALT*2. *ALT*4B: Cumulative impacts would be similar to *ALT*2.
Cultural & Historic Resources	*U.S., LA & SA:* Institutional recognition via National Historic Preservation Act (and others). Historic and cultural resources subjected to natural processes and man-made actions.	*U.S., LA & SA:* Continued institutional recognition. Human activities as well as natural processes can potentially degrade or destroy historic and natural resources. *SA:* Increased water levels, human activities, and impoundment activities potentially degrade or destroy these resources.	*US, LA, & SA:* Continued institutional recognition. Potential loss of resources due to natural and human causes. *SA:* Increased impoundment, water levels, and swamp degradation threaten the preservation of these resources.	U.S. & LA: Potential loss of resources due to natural and human causes. *ALT 2*: This alternative would provide additional restorative and regenerative ecological potential for the Blind River and Maurepas Swamp, which would continue to provide protection to the cultural resources in the project area. *ALT4A*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Aesthetics	*U.S., LA & SA:* Technical recognition via 1988 USACE Visual Resources Assessment Procedure. Institutional recognition via Wild and Scenic Rivers Act, Scenic Byways and others. *LA & SA:* Visual aesthetics shaped by human activities (e.g., development, flood control and forestry) and natural alterations (e.g., hurricanes) to the landscape.	*U.S., LA & SA:* Continued institutional recognition. Visual resources have been destroyed, enhanced, or preserved by human activities and natural processes. *LA & SA:* Continued wetland loss may have an adverse effect on the visual complexity of the swamp.	*US, LA, & SA*: Continued institutional recognition. US & LA: Continued human population growth and development and other human activities have the potential to destroy, enhance, or preserve visual resources. *SA:* Increasing rates of swamp degradation and periods of impoundment could diminish the value of the viewscape.	US & LA: Continued institutional recognition. Preservation of existing swamp aesthetics in some areas, improvement of swamp aesthetics in some of the degraded areas, and potentially continued degradation of the swamp in any areas not benefitted by the project. *ALT2*: This alternative would have positive synergistic effects on aesthetics when combined with other Federal, state, local, and private restoration efforts. There would be minimal visual impact in the areas of the diversion culverts and canal. This alternative would provide additional restorative and regenerative ecological potential for the Blind River and the Maurepas Swamp, which would continue to provide benefits to aesthetics in the study area. *ALT4A*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Recreation Resources	*U.S. & LA, SA*: Public lands institutionally recognized by Federal Water Project Recreation Act, Land and Water Conservation Act, and National Wildlife Refuge System Acts. *SA:* Recreation activities in study area based on ecosystem services. A portion of the Maurepas Swamp WMA is located within the SA.	U.S. & LA: Continued institutional recognition. increased recreational activities impact national and state wetlands. *SA*: Recreation activities in study area based on ecosystem services. Ecosystem degradation impedes ability to provide some services at historical levels.	*US, LA, & SA:* Continued institutional recognition. Potential inability to provide ecosystem services to support recreation due to degradation and loss of freshwater swamp.	*U.S. & LA*: Loss of recreational resources due to continued wetland and coastal degradation. *ALT2*: This alternative would have positive synergistic effects on recreation resources when combined with other Federal, state, local, and private restoration efforts, including the Hope Canal and Amite River diversions. The proposed action would preserve and enhance natural habitats, and thereby enable the continuation and even expansion of existing recreational activities within the SA and region as a whole. *ALT4A*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.
Socioeconomic and Human Resources – ***Displacement of Population and Housing***	*U.S.*: Population increasing in some areas and decreasing in others. *LA:* Hurricanes Katrina and Rita adversely affected populations throughout state. *SA:* Development along ridges and water bodies. Populations within Ascension and St. John the Baptist increasing and St. James relatively stable.	*U.S.:* Increasing population with over 300 million people. *LA:* Slight decrease (3.9%) in population from 2000-2007. *SA:* Study area remote and uninhabited. Adjacent populations are increasing in St. John the Baptist and Ascension Parishes, with rapid growth in the latter.	*U.S. & LA:* Increasing populations worldwide. *SA:* Study area should remain uninhabited. Populations are projected to rise in Ascension Parish and decline in St. James Parish. Nearby populations would be adversely impacted by continued habitat degradation and conversion to fresh marsh and open water.	*U.S. & LA*: Continued wetland and coastal degradation could lead to population shifts. Population growth expected. *ALT2*: There would be no cumulative impacts to populations from this alternative. *ALT4*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Socioeconomic and Human Resources – ***Employment, Business, and Industrial Activity***	*U.S. & LA:* Increased habitation, employment and tourism. *LA:* Slight increase in employment in Louisiana. Hurricanes Katrina and Rita have an adverse effect on employment and personal income. Rebuilding efforts provide some new job opportunities. *SA:* Area remote and uninhabited. Employment and income provided through timber, railroad, oil and gas, and other infrastructure related industries.	*U.S. & LA:* Increasing population growth and employment and personal income opportunities. Economic activity related to wetland resources negatively affected by loss of these resources. *SA:* Development along ridges and water bodies. Employment and income resources are primarily in manufacturing and education services, and health care and social assistance.	*U.S. & LA:* Increasing population growth and employment and income opportunities. Economic activity related to wetland resources would be adversely affected by the degradation and loss of these resources. *SA:* Development along ridges and water bodies. Total employment and income in St. James Parish expected to increase.	*U.S. & LA*: Continued wetland degradation would adversely impact the economic activities tied to the fish and wildlife found within the natural wetland habitats. *ALT2*: This alternative would have positive synergistic effects on employment, business, and industrial activity when combined with other Federal, state and local restoration efforts. Alternative 2 would serve to slow or reverse the trend of swamp degradation and habitat conversion in the study area and to protect and enhance fish and wildlife habitats. Economic activities dependent upon such habitats, and the fish and wildlife it supports, would be maintained and possibly increased, leading to a rise in fishery and wildlife-related employment and income. *ALT4A*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Socioeconomic and Human Resources– ***Public Facilities and Services***	*US & LA:* Increasing population growth increases demand on public facilities and services. *SA:* Public facilities and services generally serve residents and recreational visitors.	*US & LA:* Increasing population growth increases demand on public facilities and services. *SA:* Public facilities and services generally serve residents and recreational visitors.	*US & LA:* Increasing population growth increases demand on public facilities and services. *SA:* Public facilities and services generally serve residents and recreational visitors. However, as the wetland habitat continues to degrade, the lure for recreational visitors, as well as residents, will decrease, lowering demand on public facilities and services.	*US & LA:* Continued population growth increases demand on public facilities and services. *ALT2*: This alternative would have synergistic effects on public facilities and services, when combined with other Federal, state and local restoration efforts. Alternative 2 would serve to slow or reverse the trend of swamp degradation and habitat conversion in the study area. The lure for recreational visitors and renters would be maintained, thereby sustaining the demand on public facilities and services within the SA. *ALT4*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	**Past Actions** **(Historic Conditions)**	**Present Actions** **(Existing Conditions)**	**The No-Action Alternative** (Future Without Project)	**Cumulative Impacts** **(Comparison of Future With Proposed Action Impacts)**
Socioeconomic and Human Resources– ***Transportation***	*US & LA:* Increasing population growth increases demand on the transportation network. *SA:* Hwy 61/I-10 runs through the project area, as does the Kansas City Southern Railway and the Blind River. Travel within the study area has generally been done by boat or by foot.	*US & LA:* Increasing population growth increases demand on the transportation network. *SA:* Hwy 61 / I-10 runs through the project area, as does the Kansas City Southern Railway and the Blind River. Travel within the study area is generally done by boat or by foot.	*US & LA:* Continued population growth increases demand on the transportation network. *SA:* Wetland land loss would potentially lead to a population shift, which would increase demand on the transportation network that runs through the SA. In addition, the continued habitat degradation would hamper pedestrian or water travel within the SA.	*US & LA:* Continued population growth increases demand on the transportation network. *ALT2*: This alternative would have synergistic effects on transportation , when combined with other Federal, state and local restoration efforts. Alternative 2 would serve to slow or reverse the trend of swamp degradation and habitat conversion in the study area, facilitating foot and boat travel within the study area. In addition, the proposed action would serve to protect and enhance essential natural habitats and coastal lands. Thus, the potential population shift as a result of land loss could be lessened, leading to a proportionately lesser degree of demand on the existing transportation network. *ALT4*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	**Past Actions** **(Historic Conditions)**	**Present Actions** **(Existing Conditions)**	**The No-Action Alternative** (Future Without Project)	**Cumulative Impacts** **(Comparison of Future With Proposed Action Impacts)**
Socioeconomic and Human Resources– ***Disruption of Desirable Community and Regional Growth (including Community Cohesion)***	*US:* Increasing population leads to greater community and regional growth. Community cohesion is affected by community and infrastructure development. *LA:* Increasing population increases community and regional growth. Hurricanes Katrina and Rita adversely affected community cohesion in southern portions of the state. Community cohesion is affected by infrastructure development. *SA:* The SA is sparsely populated.	*US:* Increasing population leads to greater community and regional growth. Community cohesion is affected by community and infrastructure development. *LA:* Hurricanes Katrina and Rita adversely affected community and regional growth in southern portions of the state. Infrastructure development has affected community cohesion. *SA:* The SA is sparsely populated.	*US & LA:* Increasing population leads to greater community and regional growth. Community cohesion will continue to be affected by infrastructure and community development. *SA:* The SA will continue to be sparsely populated with several rental and seasonal properties. However, as the wetland habitat continues to degrade, the lure for seasonal visitors and renters will decrease, adversely impacting community development.	*US & LA:* Increasing populations nation- and statewide will in turn increase opportunity for infrastructure and community development. *ALT2*: This alternative would have synergistic effects on community and regional growth, when combined with other Federal, state and local restoration efforts. Alternative 2 would serve to slow or reverse the trend of swamp degradation and habitat conversion in the study area. The lure for seasonal visitors and renters would be maintained. In addition, the proposed action would serve to protect and enhance essential natural habitats and coastal lands. Thus, the potential population shift as a result of land loss could be lessened, leading to a proportionately lesser degree of community and regional growth. *ALT4*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	**Past Actions** **(Historic Conditions)**	**Present Actions** **(Existing Conditions)**	**The No-Action Alternative** (Future Without Project)	**Cumulative Impacts** **(Comparison of Future With Proposed Action Impacts)**
Socioeconomic and Human Resources– ***Tax Revenue and Property Values***	*US & LA & SA:* Increasing population growth increases tax revenue and property values.	*US & LA & SA:* Increasing population growth increases tax revenue and property values.	*US & LA:* Increasing population growth increases tax revenue and property values. *SA:* The property value of the private lands within the SA could decline due to the allowance of the continued degradation of the wetland habitat.	*US & LA:* Continued population growth increases tax revenue and property values. *ALT2*: This alternative would have synergistic effects on tax revenues and property values, when combined with other Federal, state and local restoration efforts. Alternative 2 would serve to slow or reverse the trend of swamp degradation and habitat conversion in the study area, which would maintain or potentially increase the property values of the private lands within the SA. *ALT4*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Socioeconomic and Human Resources – ***Infrastructure***	*U.S. & LA:* Increasing population growth and supporting infrastructure in the form of roads, bridges, pipelines, homes and businesses, and decreases in coastal and other wetlands. *SA:* Federal and state roads, active and relict railroad grades, overhead distribution lines, and underground pipelines and telecommunications lines traverse the study area.	*U.S.:* Increasing population growth and supporting infrastructure contributes to degradation and loss of coastal and other wetlands, which contribute to increased maintenance costs of infrastructure. However, loss of wetlands due to infrastructure should be mitigated. *LA:* Extensive damages to infrastructure due to Hurricanes Katrina and Rita which is still being repaired. *SA:* Federal and state roads, active and relict railroad grades, overhead distribution lines, and underground pipelines and telephone lines traverse the study area.	*U.S. & LA:* Continued population growth and supporting infrastructure contributes to degradation and loss of coastal and other wetlands. Wetland degradation and loss contribute to increased maintenance costs of infrastructure. *SA:* Wetland loss potentially threatens infrastructure passing through area and results in increased maintenance.	*U.S. & LA*: Continued population growth and supporting infrastructure contributes to degradation and loss of coastal and other wetlands. Degradation and loss of wetlands contribute to expansion of infrastructure as well as increased maintenance costs. *ALT2*: This alternative would have positive synergistic effects on infrastructure when combined with other Federal, state and local restoration efforts. This proposed action would work in conjunction with the other restoration efforts of the region to preserve and enhance natural habitats and coastal lands. Thus, the potential population shift as a result of land loss could be lessened, leading to a proportionally lesser demand on the area's infrastructure as well as lessening the maintenance costs due to substrate deterioration. *ALT4*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Socioeconomic and Human Resources – ***Environmental Justice***	*US:* Institutional recognition via Executive Order 12898. *LA:* Hurricanes Katrina and Rita adversely affected Environmental Justice resources in the state. *SA:* Population in the vicinity is 30.8% minority and 15.8% below poverty level.	*US & LA:* Continued institutional recognition; increasing Environmental Justice resources as a result of increase in population and decrease in economic output from 2000-2009. *SA:* Environmental Justice resources in the vicinity of the swamp appear stable.	*US & LA:* Continued institutional recognition; potential increase in Environmental Justice resources as a result of continued economic recession. *SA:* There may be further construction and an increase in the population near the study area. Environmental Justice resources may increase; these resources would be adversely impacted by continued habitat degradation and conversion.	*U.S. & LA*: Continued wetland degradation would adversely impact the economic activities tied to the fish and wildlife found within the natural wetland habitats, which in turn could lower the income levels of local residents. *ALT2*: This alternative would have positive synergistic effects on employment and income, and thereby environmental justice populations, when combined with other Federal, state and local restoration efforts. Alternative 2 would serve to slow or reverse the trend of swamp degradation and habitat conversion in the study area. The proposed action would serve to protect and enhance fish and wildlife habitats. Economic activities dependent upon such habitats, and the fish and wildlife it supports, would be maintained and possibly increased, leading to a rise in fishery and wildlife-related employment and income levels. *ALT4*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Socioeconomic and Human Resources – ***Navigation***	*U.S., LA* & *SA*: Navigation interests have historically been a critical factor to national, state, and local interests. Growth of port facilities and inland waterways and traffic. *LA & SA:* Hurricanes Katrina and Rita impact navigation infrastructure and investments. Public and private reinvestment to rebuild navigation, port facilities, and inland waterways. *SA:* One federal navigation channel, the Blind River, exists within the study area.	*U.S., LA* & *SA*: Continued investment in port facilities and inland waterways. Navigation continues to be an important part of the national transportation and commerce activities. *SA:* Blind River is primarily used for recreational navigation.	*US, L.A. & SA:* Continued investment in port facilities and inland waterways. Navigation continues to be an important part of the national transportation and commerce activities. *SA:* Blind River will likely continue to primarily be used for recreational navigation.	U.S. & LA: Continued investment in port facilities and inland waterways. Navigation continues to be important part of the national transportation and commerce activities. *ALT2*: This alternative would have positive synergistic effects on navigation when combined with other Federal, state and local restoration efforts. Alternative 2 would serve to slow or reverse the trend of swamp degradation and habitat conversion in the study area. The proposed action would serve to protect and enhance wetland in the study area which would in turn protect the Blind River and navigation channels. *ALT4*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	**Past Actions** **(Historic Conditions)**	**Present Actions** **(Existing Conditions)**	**The No-Action Alternative** (Future Without Project)	**Cumulative Impacts** **(Comparison of Future With Proposed Action Impacts)**
Socioeconomic and Human Resources – Land Use ***Agriculture***	*US & LA:* Agriculture is important to the economy of the US and coastal Louisiana. *LA:* Important crops include sugar cane, rice, and soybeans. *SA:* The study area includes agricultural areas along the diversion routes.	US & LA: Agriculture continues to be important to the economy of the US and coastal Louisiana. *LA:* Important crops include sugar cane, rice, and soybeans. *SA:* The study area includes agricultural areas along the diversion routes.	*US & LA:* Agriculture will continue to be important to the economy of the US and Coastal Louisiana. *SA:* The study area includes agricultural areas along the diversion routes.	*U.S. & LA*: Continued importance of agriculture to the economy of the US and coastal Louisiana. Agricultural lands may be adversely impacted by habitat conversion and land loss. *ALT2*: This alternative would result in small loss of land currently in agricultural production. *ALT4*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2* with the following exceptions. There would be a slightly larger loss of a small amount of land currently in agricultural production associated with the two diversion routes. *ALT4B*: Cumulative impacts would be similar to *ALT2*.
Socioeconomic and Human Resources – Land Use ***Forestry***	*US & LA:* Timber production is important to the economy of the US and Louisiana. *LA:* Timber has historically been important to the economy of Ascension and St. James Parishes. *SA:* The study area was harvested extensively before 1940.	*US & LA:* Timber production continues to be important to the economy of the US and Louisiana. *LA:* Timber continues to be important to the economy of Ascension and St. James Parishes. *SA:* Increased interest in harvesting within the study area in recent years, but no harvesting is currently occurring.	*US & LA*: Timber production will continue to be important to the economy of the US and Louisiana. *LA:* Timber will continue to be important to the economy of Ascension and St. James Parishes. *SA*: Limited timber harvesting will likely take place in the future in the study area. Continued habitat degradation will negatively affect timber resources.	*U.S. & LA*: Continued importance of timber production to the economy of the US and Louisiana. Timber lands may be adversely impacted by habitat conversion and land loss. *ALT2*: This alternative would have positive synergistic effects on forestry when combined with other Federal, state, local, and private restoration efforts. Proposed action would preserve and enhance forested wetlands within the study area. However, it is unlikely that these forests will be harvested in the future. *ALT4*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Socioeconomic and Human Resources – Land Use ***Public Lands***	*US&LA:* Institutional recognition through Forest Reserve Act of 1891, Organic Act of 1897, and others; creation of National Forest Service, National Park Service, U.S. Fish &Wildlife Service, Bureau of Land Management and others. Expansion of the federal public land system. *LA:* Designation since 1959 of nearly 462,000 acres as state Wildlife Management Areas, managed by LDWF. *SA:* LDWF incorporated 17,079 acres of *SA* into Maurepas Swamp WMA in August 2001.	*US&LA:* Continued institutional recognition and expansion of the federal public land system. *LA:* Continued management and growth of state owned public lands. *SA:* Continued management of 17,079 acres of *SA* as Maurepas Swamp WMA.	*US&LA:* Continued institutional recognition and expansion of the federal public land system. *LA:* Continued management and growth of state owned public lands. Potential loss of coastal areas due to RSLR and land loss. *SA:* Conversion of portions of *SA* from swamp land to open water degrades value of area to people and wildlife.	*U.S. & LA*: Loss of public lands due to continued wetland and coastal degradation. *ALT2*: This alternative would have positive synergistic effects on public land when combined with other Federal, state, local, and private restoration efforts. Proposed action would preserve and enhance the public lands within the study area and region as a whole. *ALT4*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Socioeconomic and Human Resources – ***Water Supply & Use***	*US & LA:* Public use of surface waters is important to the US and LA. *SA:* No significant public use of surface waters (other than for recreation) has been identified in the study area.	*US & LA:* Public use of surface waters continue to be important to the US and LA. *SA:* There is still little significant public use of surface waters (other than for recreation) in the study area.	*US & LA:* Public use of surface waters will still be important to the US and LA. *SA:* There will still be little significant public use of surface waters (other than for recreation) in the study area.	*U.S. & LA*: Continued increasing demands on surface water use and supply due to increasing human populations, agriculture, and industry uses. *ALT2*: This alternative would have positive synergistic effects water supply and use when combined with other Federal, state and local restoration efforts. Alternative 2 would improve water quality in the study area by assimilating nutrients. *ALT4*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.
Socioeconomic and Human Resources – Man-Made Resources ***Oil, Gas and Utilities***	*U.S., LA & SA:* Development of extensive network of oil and gas pipelines in mid-1900s. *SA:* Western Maurepas swamp experiences significant oil and gas exploration, primarily northwest of the study area.	*U.S., LA & SA:* Increasing operations and maintenance (O&M) costs as well as increasing investment for oil and gas production facilities and pipelines due to increasing vulnerability to widespread coastal wetland loss.	*U.S., LA, & SA:* Increasing O&M costs as well as increasing investment in oil and gas production facilities and pipelines; increasing vulnerability of pipelines and other infrastructure due to widespread coastal wetland loss.	*U.S. & LA*: Continued investment in oil, gas, utilities, and pipelines. *ALT2*: This alternative would have positive synergistic effects on oil, gas, and utilities when combined with other Federal, state and local restoration efforts. Alternative 2 would serve to slow or reverse the trend of swamp degradation in the study area. This would protect oil, gas and utilities from future storm surges. *ALT4*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	**Past Actions** **(Historic Conditions)**	**Present Actions** **(Existing Conditions)**	**The No-Action Alternative** (Future Without Project)	**Cumulative Impacts** **(Comparison of Future With Proposed Action Impacts)**
Socioeconomic and Human Resources – Man-Made Resources ***Flood Control & Hurricane Protection***	*US & LA:* Flood of 1927 initiated national construction of hurricane and flood control levees, pump stations and control structures. Hurricanes Katrina and Rita caused significant widespread damages to existing hurricane and flood control structures. *SA:* Municipal and parish flood control measures, including drainage canals, are present in the study area.	*U.S. & LA:* Largest national restoration effort of hurricane and flood control in nation's history. *SA:* Municipal and parish flood control measures, including drainage canals, are present in the study area.	*US & LA:* As populations continue to migrate to coastal communities, increasing investment in hurricane and flood control levees, pump stations, and other flood control facilities. *SA*: Continued degradation of wetlands will result in localized storm surge and storm wave increases. Municipal and parish flood control measures, including drainage canals are present in the study area.	*U.S. & LA:* Continued loss of flood control and hurricane protection due to continued coastal and wetland degradation and loss. *ALT2:* This alternative would have positive synergistic effects on flood control and hurricane protection when combined with other Federal, state, local, and private restoration efforts. The proposed action would nourish and enhance swamp that is currently converting to open water and will leave adjacent areas less vulnerable to storm surges. *ALT4:* Cumulative impacts would be similar to *ALT2*. *ALT6:* Cumulative impacts would be similar to *ALT2*. *ALT4B:* Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	**Past Actions** **(Historic Conditions)**	**Present Actions** **(Existing Conditions)**	**The No-Action Alternative** (Future Without Project)	**Cumulative Impacts** **(Comparison of Future With Proposed Action Impacts)**
Socioeconomic and Human Resources – Natural Resources ***Commercial Fisheries***	*U.S., LA & SA:* Institutional recognition, formation of NMFS and LDWF; Magnusson-Stevens Fishery Conservation amendments. Reduction in fisheries habitat, increased commercial catches, catch regulations. *LA:* Commercially important species, including brown and white shrimp, blue crabs, eastern oysters, and menhaden abundant. *SA*: Study area may provide some habitat for striped mullet, menhaden and blue crab but no commercial fishery present.	U.S., LA & *SA*: Continued institutional recognition and regulation of commercial fisheries maintains a billion dollar industry. About 90% of the world's seafood resources have been depleted in the past century; 38% of the depleted species have declined by more than 90 percent; 7% of the species of fish studied by researchers have become extinct (Worm et al. 2006). *SA*: Study area provides habitat for striped mullet, blue crab, and menhaden but no commercial fishery present.	*U.S.:* Continued institutional recognition; commercial fisheries decline expected as overfishing and habitat degradation and loss continues unless concerted efforts to protect, restore and regulate a sustainable industry. *LA & SA:* Loss of commercial fishery habitat due to loss of wetland habitats and salinity changes.	U.S. & LA: Institutional recognition continues; commercial fisheries decline expected as overfishing and habitat degradation and loss continues unless concerted efforts to protect, restore, and regulate a sustainable industry. *ALT 2*: This alternative would have positive synergistic effects on commercial fisheries when combined with other Federal, state and local restoration efforts. Alternative 2 would serve to slow or reverse the trend of swamp degradation in the study area and increase productivity. This would increase fisheries populations in the area and consequently increase commercial fisheries. *ALT4*: Cumulative impacts would be similar to *ALT2*. *ALT6:* Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.

Table 5-1: Comparison of Cumulative Impacts*.

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Socioeconomic and Human Resources – Natural Resources ***Oyster Leases***	*US, LA:* General increase in acreage leased, production limited by saltwater intrusion in areas with no freshwater introduction. *SA:* No oyster leases are in the study area.	*US, LA & SA*: Production has been stable for the last 50 years. Long-term sustainability threatened by reductions of marsh habitat. *SA*: No oyster leases are in the study area.	*US:* Only major leasing program is in LA. *LA:* Production from leases would likely decline due to loss of habitat. *SA:* No oyster leases are in the study area.	*US:* Only major oyster leasing program is in LA. *LA:* Production from leases would likely decline due to loss of habitat. *ALT*2: This alternative would have no cumulative impacts on oyster leases. *ALT4*: Cumulative impacts would be similar to *ALT2*. *ALT6*: Cumulative impacts would be similar to *ALT2*. *ALT4B*: Cumulative impacts would be similar to *ALT2*.
Hazardous, Toxic, and Radioactive Wastes	*US, LA, & SA:* Institutional recognition under ER 1165-2-132. Establishment of the USEPA and LDEQ agencies. *SA:* Few potential HTRW sites are located near or within the study area.	*US, LA, & SA:* Continued institutional recognition. Increasing human populations and industrialization result in increased potential for HTRW problems. *SA:* Few potential HTRW sites are located near or within the study area.	*US, LA, & SA:* Continued institutional recognition. Increasing human populations and industrialization result in increased potential for HTRW problems.	*US & LA:* Continued potential for HTRW issues. *ALT2:* The potential for cumulative impacts is low under this alternative *ALT4:* Cumulative impacts would be similar to *ALT*2 except for potential underground storage tank issues along the South Bridge diversion. *ALT6:* Cumulative impacts would be similar to *ALT4*. *ALT4B:* Cumulative impacts would be similar to *ALT4*.

5.1 Soils and Water bottoms

5.1.1 No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, not implementing a freshwater diversion into the southeastern Maurepas Swamp, would have no direct impacts on soil resources. Existing conditions would persist, including no net vertical accretion of soil deposition and continued subsidence over the 50-year period of analysis.

Indirect

The indirect impacts of the No Action Alternative would be the advanced degradation of soils within the distribution area. Soils within the distribution area would remain nutrient poor and exhibit atypically low bulk densities for forested wetlands due to insufficient sediment content. With increased duration of flooding and impoundment, net primary productivity within the Study Area would continue to decline, and existing wetland vegetation would continue to diminish. Declines in primary productivity would reduce organic matter accretion rates and thus exacerbate subsidence. Increased physiological stress would make plants more susceptible to further damage by biotic (e.g., herbivory and infection) and abiotic (e.g., wind damage) factors. Eventual mortality of woody and herbaceous vegetation and the accompanying decomposition of belowground biomass would further elevate subsidence rates and result in a change in habitat from vegetated wetlands to open water.

Cumulative

Cumulative impacts of the projected loss of soil resources from the Study Area would be in addition to the loss of soil resources throughout Louisiana. The LCA Study (LCA 2004) estimated coastal Louisiana would continue to lose land at a rate of approximately 6,600 acres per year (2,671 ha/year) over the next 50 years. It is estimated that an additional net loss of 328,000 acres (132,737 ha) may occur by 2050, which is almost 10 percent of Louisiana's remaining coastal wetlands. However, these wetland soil losses in the Louisiana Study Area would be offset to some extent by other Federal, state, local, and private restoration efforts as described in the 2004 LCA Report.

In addition, more recent restoration efforts would also cumulatively interact to help offset losses of soil resources in the Study Area including the following:

- LCA Small Diversion at Hope Canal (1,000 – 5,000 cfs)
- LCA Amite River Diversion Canal Modification Project (Volume II)

Although these projects will help offset losses of soil resources in the Upper Pontchartrain Sub-basin, the resulting benefits to soil resources will be localized and will not affect processes within the Study Area.

5.1.2 Alternative 2

Direct

Direct impacts of Alternative 2 include increased delivery of sediments to the swamp that will enhance accretion (swamp building) and benefit soils within the study area. There would be 106.9 acres of permanent impact to prime and unique farmland based on NRCS data. These areas would be loss due to the construction of the Romeville Transmission Pathway.

Indirect

Indirect impacts of Alternative 2 include increases in overall accretion rates that would prevent the conversion of swamp to fresh marsh and open water and thus prevent an increase in acreage of water bottoms. Nutrient content and bulk density of the soils within the distribution areas would increase. Increased primary productivity within the study area would increase organic matter accretion rates and thus decrease subsidence. Day et. Al. (2006) estimated a net gain in elevation between 15 and 30 cm over the next 50 years for Maurepas Swamp based on diversions associated with the LCA Small Diversion at Hope Canal. Based on vertical accretion data from a swamp system that received sewage effluent in another basin in Louisiana, if river water is diverted into the area south of Lake Maurepas, accretion will likely increase to levels greater than the rate of relative water level rise so that the area will become progressively less flooded (Day et al. 2006) Under Alternative 2, soils and waterbottoms in the distribution area would benefit from the restoration of 21,369 acres of swamp.

Cumulative

Cumulative impacts would be the synergistic effects of implementing the No Action Alternative combined with the beneficial impacts of other Federal, state, local and private restoration efforts as detailed in Section 5.1.2. including CWPPRA 33,690 acres (13,634 ha); Parish Coastal Wetlands Restoration Project 14 acres (6 ha) state 2,543 acres (1,029 ha); Mitigation Civil Works 4,990 acres (2,019 ha); Mitigation Regulatory Permits 6,411 acres (2,594 ha); Vegetation 535 acres (217 ha); Section 204/1135, Beneficial Use 226 acres (92 ha); WRDA 16,000 acres (6,475 ha), for a total of 64,409 acres (26,065 ha) (Table 5-2).

Alternative 2 would work synergistically with other projects within the general area to benefit soil resources and restore and protect the Maurepas Swamp to a greater extent than would be expected from the individual efforts.

5.1.3 Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. There would be 121.7 acres of impacts to prime and unique farmland due to the construction of the Sunshine Bridge Transmission Pathway.

Indirect
The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exception. Under Alternative 4 soils and waterbottoms in the distribution area would benefit from the restoration of 21,206 acres of swamp.

Cumulative
The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.1.4 Alternative 6

Direct
The direct impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions there would be a total of 228.6 acres of impacts to prime and unique farmland due to the construction of dual transmission pathways.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions Under Alternative 6 soils and water bottoms in the distribution area would benefit from the restoration of 21,243 acres of swamp.

Cumulative
The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.1.5 Alternative 4B

Direct
The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect
The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions Under Alternative 4B, soils and waterbottoms in the distribution area would benefit from the restoration of 21,243 acres of swamp.

Cumulative
The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Table 5-2: Net Acres Created, Restored, and/or Protected by Other Federal, State, Local, and Private Restoration Efforts (USACE, 2004).

	Subprovince 1 (acres)	Subprovince 2 (acres)	Subprovince 3 (acres)	Subprovince 4 (acres)	Totals (acres)
Breaux Act CWPPRA[1]	33,690	44,913	25,057	30,486	134,146
State	2,543	9,043	5,200	1,972	18,758
PCWRP[2]	14	41	371	31	457
Mitigation Civil Works Projects[3]	4,990	0	5,000	0	9,990
Mitigation Regulatory Permits[1]	6,411	3,199	2,635	2,983	15,228
Vegetation[4]	535	878	1,785	1,931	5,129
Section 204/1135, Beneficial Use	226	414	1,293	3,525	5,458
WRDA[5]	16,000	33,000	0	0	49,000
Other[6]	0	2,000	50,000	3,226	55,226
TOTALS	64,409	93,488	91,341	44,154	293,392

Source: The state, parish, FEMA, vegetation, WRDA, Sections 1135/204, and beneficial use are from Belhadjali, Robertson, and Balkum (2002), Coastal Restoration Division Annual Project Reviews: December 2002. CWPPRA (Breaux Act) acres are from the District's November 2003 Task Force book and have been furnished by USFWS. Permit mitigation is from the District's Regulatory Branch database. Civil works mitigation is from the District's files. Other is 50,000 acres (20,234 ha) of non-mitigation land bought in fee in the Atchafalaya Basin by the District.

1 - CWPPRA acreages are based upon 20-year project life; all other acreages are 50 years.

2 – PCWRP = Parish Coastal Wetlands Restoration Program (“Christmas Tree Program”).

3 - In the best-case scenario, compensatory mitigation (for civil works projects and regulatory permits) results in no net loss of wetlands. Hence, it is not the intent to imply that compensatory mitigation acreages would contribute to a net increase in wetlands as a result of the Clean Water Act Section 404 program. Rather, these figures represent an accounting of the various cumulative impacts to coastal wetlands from Federal, state, local, and private restoration efforts.

4 – Vegetation = LDNR/NRCS/Soil and Water Conservation Committee Vegetation Planting Program.

5 – WRDA = Completed Federal Water Resources Development Act projects, including the Davis Pond and Caernarvon diversions.

6 - Includes 30,558 acres (12,366 ha) restored and 340,348 (137,734 ha) acres enhanced by North American Wetlands Conservation Act (NAWCA), administered by the USFWS; unable to determine exact locations.

5.2 Hydrology

5.2.1 Flow and Water Levels

5.2.1.1 Lower Mississippi River

No Action Alternative (Future without Project Conditions)
Direct, Indirect, Cumulative

Under the No Action Alternative for this study, no direct or indirect impacts on flows and water levels in the Lower Mississippi River would occur.

Alternative 2

Direct

The direct impact of the diversion of water from the Mississippi River at Romeville would be a very small decrease in the flow in the Mississippi River at this intake location because the amount of diverted flow is a small portion of the flow in the Mississippi River at this location. Based on data from 1978 to 2008, the average annual, spring, and summer-fall discharge rates at Tarbert Landing are 566,123 $\pm$ 306,846, 813,333 $\pm$ 283,377, and 283,925 $\pm$ 113,984 cfs (Mean $\pm$ SD), respectively, vs. a diversion rate of 3,000 cfs. The small decrease in flow at this intake location will have no impact on water levels in the Mississippi River at this intake location because the amount of diverted flow is a small portion of the flow in the Mississippi River at this location.

Indirect

The indirect impact of the diversion of water from the Mississippi River at Romeville would be a very small decrease in the flow in the Mississippi River downstream of this intake location because the amount of diverted flow is a small portion of the flow in the Mississippi River downstream of this intake location. The small decrease in flow at this intake location will have no impact on water levels in the Mississippi River downstream of this intake location.

Cumulative

The cumulative impact of the diversion of water from the Mississippi River at Romeville would be a very small decrease in the flow further downstream in the Mississippi River because the amount of diverted flow is a small portion of the flow in the Mississippi River at this location. The small decrease in flow at this intake location will have no cumulative impact on water levels further downstream in the Mississippi River. Combined withdrawal of Mississippi River water from this diversion and LCA Small Diversion at Hope Canal would have minimal impacts on Mississippi River flow and water levels.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect
The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative
The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct
The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect
The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative
The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct
The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect
The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative
The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.2.1.2 Blind River and Maurepas Swamp

No Action Alternative (Future Without Project Condition)

Direct
Under the No Action Alternative, not implementing a freshwater diversion into the southeastern Maurepas Swamp would have no direct impacts on flow or water levels within in Blind River and Maurepas Swamp.

Indirect

Indirect impacts of the No Action Alternative would result in the persistence of existing conditions, including a limited ability to for the swamp to drain and persistent flooding that conflicts with historic drying cycles in the swamp, short circuiting of the natural drainage patterns, ponding and stagnant waters in some areas, and minimal contribution and circulation of nutrients and sediments in the swamp. Blind River and Maurepas Swamp would continue to deteriorate. Minimal soil building and moderately high subsidence rates that resulted in a net lowering of ground surface elevation would continue and the swamp will continue to be persistently inundated. The limited ability to drain and the persistent flooding that exists in the swamp would continue. Under the existing conditions the frequency of dryout conditions (water levels below 0.5 ft) would occur only 1 percent of the time. This occurrence would limit seedling survival and recruitment.

The No Action Alternative would allow the existing swamp to function with minimal circulation of water, nutrients, and sediment. The sediment deficit has and would continue to result in both subsidence and a disruption of natural processes that promote productivity and diversity in the swamp ecosystem. Increases in relative sea level due to continued subsidence and sea level rise would continue to extend flood duration and elevate flood stage within Maurepas Swamp, accompanied by impoundment of hypoxic, nutrient-deficient water.

Current guidance for incorporating the direct and indirect physical effects of projected future sea level change in all aspects of USACE projects (i.e., managing, planning, engineering, designing, constructing, operating, and maintaining) is established by Circular No. 1165-2-211, dated July 1, 2009. Under this direction, the no-action and action alternatives must be evaluated under "low," "intermediate," and "high" projected rates of future sea level change. Scenarios differ in whether and how eustatic sea level rise accelerates over time. Accordingly, the low estimate is based on an extrapolation of the historic rate of RSLR for the Study Area. Based on daily stage data from 1959 to 2009 for the West End at Lake Pontchartrain Gauge (85625), the estimated historic rate of relative sea level rise for the project area is 0.0302 ft yr^{-1} (9.20 mm yr^{-1}) with a standard error of 0.65 ft (198.12 mm). Intermediate and high rates are based on modified NRC curves I and III, respectively (NRC 1987), in which the current global mean sea level change is set at 0.00558 ft yr^{-1} (1.7 mm yr^{-1}) (IPCC, 2007). The following formula is used to estimate the total rise in eustatic sea level for the intermediate and high rate scenarios of sea level rise over the project life:

$$E(t_2) - E(t_1) = 0.0017(t_2 - t_1) + b(t_2^2 - t_1^2)$$

where:

b is the acceleration factor related to NRC curves I and III or 2.36E-5 and 1.005E-4 respectively,

t1 is the time in years between the project's construction date and 1986, and

t2 is the time between a future date at which one wants an estimate for sea level rise and 1986.

Eustatic estimates are then added to the historic local subsidence rate (0.0246 ft yr-1 or 7.50 mm yr-1) to calculate the total RSLR for the intermediate and high rate scenarios. All scenarios were evaluated at 5-year increments over the 50-year project life (2012-2062). Direct, indirect, and cumulative effects for future without project conditions were evaluated for the intermediate scenario. Projected RSLR over the 50-year period of analysis for low, intermediate, and high scenarios is presented in Table 5-3 and Figure 5-1.

Table 5-3: Projected relative sea level rise (feet) over the project life (2012-2062) in 5-year increments for low, intermediate, and high scenarios in the project area based on West End at Lake Pontchartrain tide gauge daily stage data from 1959-2009 and USACE Circular No. 1165-2-211 (2009)

	RSLR (feet)		
YEAR	**LOW**	**INTERMEDIATE**	**HIGH**
2012	0	0	0
2017	0.15	0.17	0.24
2022	0.30	0.35	0.51
2027	0.45	0.53	0.78
2032	0.60	0.72	1.08
2037	0.75	0.90	1.39
2042	0.91	1.10	1.72
2047	1.06	1.29	2.06
2052	1.21	1.49	2.42
2057	1.36	1.70	2.80
2062	1.51	1.90	3.19

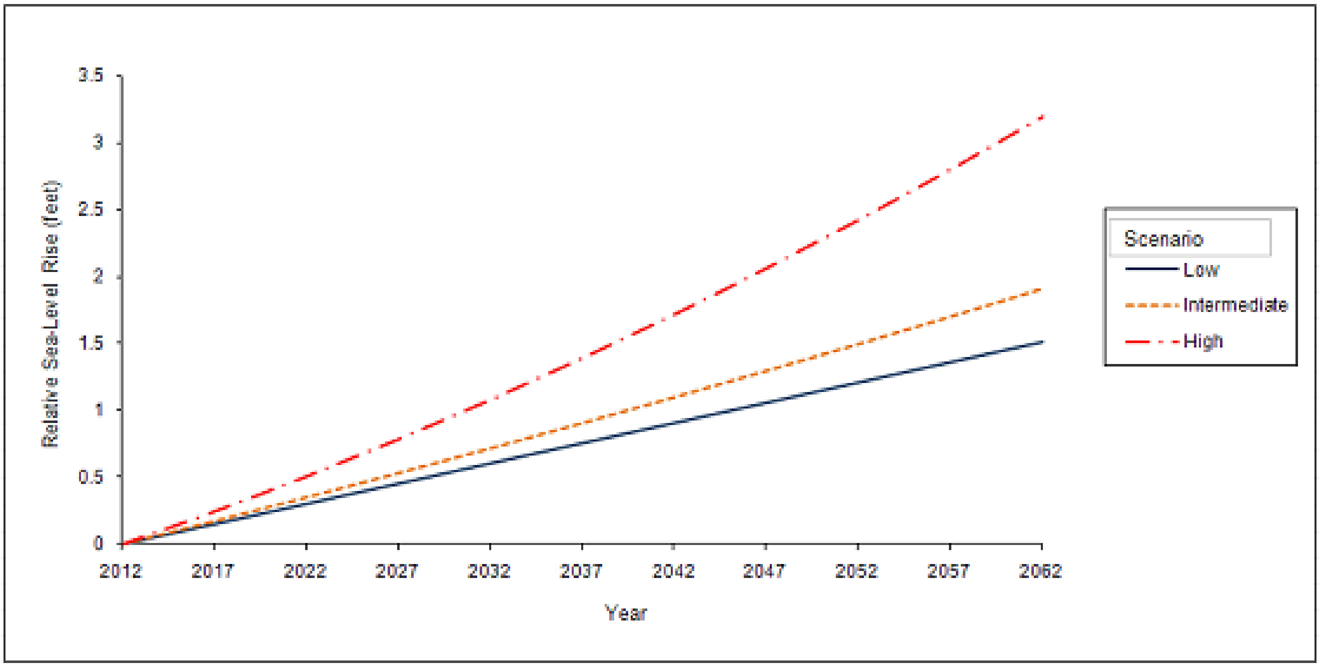

Figure 5-1: Projected relative sea level rise (feet) over the project life (2011-2061) in 5-year increments for low, intermediate, and high scenarios.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on flow and water levels with the additive combination of similar wetland degradation and wetland loss impacts to flow and water levels throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal swamp restoration projects in the vicinity. The Small Diversion at Hope Canal would freshen the surrounding waters, albeit to an unknown extent, and slightly alter the flow patterns in and near the Study Area, but would not likely affect water levels in the Study Area. Development patterns indicate increased urbanization that may increase the total volume of freshwater input into the Study Area from runoff.

Alternative 2

Direct

The direct impact of Alternative 2 includes berm gaps that would allow greater connectivity and water exchange between the St. James Parish canal system and the swamp at lower flows. However, the connectivity would allow greater backflow from the lake to enter the swamp when inflows to the swamp are low.

Four hydrologic metrics were evaluated in Blind River and Maurepas Swamp (**Appendix L.2.10**); freshwater throughput (ac-ft), annual average water depth (ft), backflow prevention (%), and frequency of dry-out conditions (%). Diversion occurs when the swamp stage is less than the lake stage and the lake stage is greater than

0.5 ft. The analysis was performed for the low, intermediate, and high sea level rise scenarios for 20-years, 30-years and 50-years. The results for annual average water depth (ft), backflow prevention (%), and frequency of dry-out conditions (%) are presented in **Table 5-4** for the FWOP and the TSP/Recommended Plan.

Table 5-4. Metric Analysis Summary for Average Annual Water Depth, Frequency of Dryout, and Backflow Prevention for Sea Level Rise (SLR) over 20, 30 and 50 years for the entire project site [FWOP=Future Without Project, FWTSP = Future with TSP (Alt 2)]

		Low SLR		Intermediate SLR		High SLR	
	Project Life (yr)	**FWOP**	**FWTSP**	**FWOP**	**FWTSP**	**FWOP**	**FWTSP**
Average Annual Water Depth (ft)	20	1.74	1.46	1.75	1.54	1.79	1.79
	30	1.76	1.67	1.79	1.80	1.94	2.26
	50	1.88	2.11	2.02	2.42	2.77	3.46
Frequency of Dryout Conditions (%) (< 0.5ft)	20	1%	8%	1%	6%	1%	2%
	30	1%	4%	1%	2%	1%	1%
	50	1%	1%	1%	1%	1%	0%
Backflow Prevention (%)	20	55%	38%	49%	36%	30%	33%
	30	38%	34%	29%	33%	9%	29%
	50	13%	31%	7%	28%	2%	21%

The net freshwater throughput is calculated as the total inflow minus the inflow volume attributed to backflow from Lake Maurepas. The direct impact of the diversion of water from the Mississippi River at Romeville would be an increase in throughput. The results indicate that Alternative 2 can substantially increase throughput over the range of potential relative sea level rise conditions. Total system throughput is slightly higher for Alternative 2 because more frequent diversions are required to counter backflow.

The direct impact of the diversion of water from the Mississippi River at Romeville for the low sea level rise scenario would be a reduction in the average water depth relative to the existing condition in the Blind River and Maurepas Swamp for 20 years and 30 years. For the intermediate sea level rise scenario there would be a reduction in the average water depth relative to the existing condition for 20 years. For the high sea level rise scenario there would be no reduction in the average water depth relative to the existing condition. As sea level rises water depth can be expected to increase accordingly throughout the swamp.

The direct impact of the diversion of water from the Mississippi River at Romeville for the low, intermediate, and high sea level rise scenarios would be a reduction in backflow prevention relative to the existing condition in the Blind River and Maurepas Swamp for 20 years. For 30 and 50 years there would be an increase in backflow prevention for the three sea level rise scenarios. The results indicate that Alternative 2 can prevent backflow over the range of potential relative sea level rise scenarios.

The direct impact of the diversion of water from the Mississippi River at Romeville for the low and intermediate sea level rise scenarios would be an increase in frequency of dry out relative to the existing condition in the Blind River and Maurepas Swamp for 20 years and 30 years, and for the high seas level rise scenario for 20 years. The results indicate that Alternative 2 can provide dryout conditions for the range of potential relative sea level rise conditions but as sea level rises, this potential is expected to diminish over time.

Indirect

The indirect impact of Alt. 2 would be increased hydrologic connectivity throughout the system. Excavation of berm gaps would increase the flow of water out of the swamp and reduce water levels during low stage periods in Lake Maurepas, at which time diversion inflow would be halted. Under this alternative, the frequency of dry out conditions necessary for tree seedling survival (water levels below 0.5 feet) would occur from 8% after 20 years and would reduce to 1% after 50 years. . With accretion these percentages will increase. This would allow for increased recruitment of baldcypress and water tupelo. Additionally, pulsing of the system would enhance productivity and nutrient assimilation in the swamp and thereby improve water quality in Blind River. Increased delivery of freshwater to the swamp will provide nutrients and sediments to the swamp that will enhance productivity and accretion (swamp building). It will also increase circulation of water in the swamp and in Blind River.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 in combination with the impacts and benefits for overall net wetland acres improved and protected by Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. The Small Diversion at Hope Canal would freshen the surrounding waters, albeit to an unknown extent, and slightly alter the flow patterns in and near the study area, but would not likely affect water levels in the study area.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. Under this alternative, the frequency of dry out conditions necessary for tree seedling survival (water levels below 0.5 feet) would occur less than for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions: Under the alternative, the frequency of dry out conditions necessary for tree seedling survival (water levels below 0.5 feet) would occur less than for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.2.1.3 Lake Maurepas

No Action Alternative (Future without Project Conditions)

Direct, Indirect

Under the No Action Alternative no direct or indirect direct impacts on flows and water levels in Lake Maurepas would occur.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on flow to and water levels in Lake Maurepas as increased runoff in the watersheds that drain into the lake from increased future development would likely lead to an increase in water levels in Lake Maurepas. LCA Small Diversion at Hope Canal will result in a significant freshening of the Lake and approximately double the turnover rate (Lee Wilson & Associates et al. 2001).

Alternative 2

Direct

Under Alternative 2 there would be no direct impacts to flows and water levels in Lake Maurepas.

Indirect

The indirect impacts of Alternative 2 include berm gaps and the diversion would decrease the backflow in Blind River from Lake Maurepas which could lead to a slight increase in the water level in the lake. The average volume of Lake Maurepas is 533,741 acre-feet and the freshwater replacement time is 2.65 months (Battelle 2005) Estimates of the decrease in the freshwater replacement time of Lake Maurepas with a 1,500 cfs diversion are 1.83 months (Battelle 2005). Thus alternative 2 would likely result in a further decrease in the freshwater replacement time.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 combined with the implementation of other projects (Amite River and Hope Canal) that will affect backflow in Blind River and in turn flow to and water levels in Lake Maurepas to an unknown extent.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.2.2 Sedimentation and Erosion

5.2.2.1 Lower Mississippi River

No Action Alternative (Future without Project Conditions)
Direct, Indirect, Cumulative

Under the No Action Alternative, no direct or indirect impacts on sedimentation and erosion in the Lower Mississippi River would occur.

Alternative 2

Direct

The direct impact of the diversion of water from the Mississippi River at Romeville would be a very small decrease in the sediment load in the Mississippi River at this intake location. Based on water year 2002 through 2008, the average daily measured suspended sediment load at this location was 334,000 tons/day; the daily measured suspended sediment load varies from 39,000 to 119,000 tons/day.

Indirect

The indirect impact of the diversion of water from the Mississippi River at Romeville would be a very small decrease in the flow in the sediment load in the

Mississippi River downstream of this intake location because the amount of diverted sediment load is a small portion of the load in the Mississippi River downstream of this intake location. The small decrease in sediment load at this intake location will have no impact on sedimentation and erosion in the Mississippi River downstream of this intake location.

Cumulative

The cumulative impact of the diversion of water from the Mississippi River at Romeville would be a very small decrease in the load further downstream in the Mississippi River because the amount of diverted load is a small portion of the load in the Mississippi River at this location. The small decrease in load at this intake location will have no cumulative impact on water levels further downstream in the Mississippi River.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The direct impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.2.2.2 Blind River and Maurepas Swamp

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative would have no direct impacts on flow or water levels within in Blind River and Maurepas Swamp.

Indirect

Indirect impacts of the No Action Alternative would result in the persistence of existing conditions, including a limited ability of the swamp to drain and persistent flooding that conflict with historic drying cycles in the swamp, short circuiting of the natural drainage patterns, ponding and stagnant waters in some areas, and minimal contribution and circulation of nutrients and sediments in the swamp. Under the No Action Alternative (not implementing a freshwater diversion into the Study Area in southeast Maurepas Swamp) Blind River and Maurepas Swamp would continue to deteriorate. Maurepas Swamp and Blind River have been virtually cut off from periodic overflows from the Mississippi River that brought freshwater, sediment and nutrients to the swamp. Minimal soil building and moderately high subsidence rates that resulted in a net lowering of ground surface elevation would continue and the swamp will continue to be persistently inundated. The limited ability to drain and the persistent flooding that exists in the swamp would continue.

The No Action Alternative would allow the existing swamp to function with minimal circulation of water, nutrients, and sediment. The sediment deficit has and would continue to result in both subsidence and a disruption of natural processes that promote productivity and diversity in the swamp ecosystem. Increases in relative sea level due to continued subsidence and sea level rise would continue to extend flood duration and elevate flood stage within Maurepas Swamp, accompanied by impoundment of hypoxic, nutrient-deficient water.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on flow and water levels with the additive combination of similar wetland degradation and wetland loss impacts to flow and water levels throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal swamp restoration projects in the vicinity.

Alternative 2

Direct

The direct impact of Alternative 2 on sedimentation and erosion would include increases in sediment in the Blind River and Maurepas Swamp. Based on estimates from 3,000 cfs diversion supplying 16 kg/s of sediment continuously throughout the year, the annual estimate of sediment load to Blind River and Maurepas Swamp would be approximage 505,000,000 kg/yr. Because the diversion would not be operated continuously, this estimate is higher than the sediment load under the likely diversion operation schedule.

Indirect

The indirect impact of Alternative 2 would include increases in productivity and sediment accretion that would increase swamp building in the distribution area. These increases in productivity would provide stability in areas that would otherwise erode. There could potentially be erosion in areas near the diversion entry point into the distribution area where sediment control measures could be used. The reduction in erosion due to increases in productivity would be small.

Cumulative

Cumulative impacts would e the synergistic effects of implementing the No Action Alternative combined with the beneficial impacts of other Federal, state, local and private restoration efforts as detailed in Section 5.1.2.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.2.2.3 Lake Maurepas

No Action Alternative (Future without Project Conditions)

Direct

Under the No Action Alternative (no diversion into the southeastern Maurepas Swamp) no direct impacts on sedimentation and erosion in Lake Maurepas would occur.

Indirect

Under the No Action Alternative (no diversion into the southeastern Maurepas Swamp) no indirect impacts on sedimentation and erosion in Lake Maurepas would occur.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on sedimentation and erosion in Lake Maurepas as increased runoff in the watersheds that drain into the lake from increased future development would likely lead to an increase in sedimentation in Lake Maurepas.

Alternative 2

Direct

There would be no direct impacts of Alternative 2 on sedimentation and erosion in Lake Maurepas.

Indirect

There would be no indirect impacts of Alternative 2 on sedimentation and erosion in Lake Maurepas.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of the implementation of other projects as discussed in **Section 5.1.2.**

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.2.3 Groundwater

No Action Alternative (Future without Project Conditions)

Direct

Under the No Action Alternative (no diversion into the southeastern Maurepas Swamp), no direct impacts to groundwater would occur.

Indirect

Under the No-Action Alternative, no indirect impacts to groundwater would occur.

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative combined with the benefits and impacts of other state and federal projects in the vicinity, as detailed in **Section 5.1.2**.

Alternative 2

Direct

There would be no direct impacts of Alternative 2 on groundwater.

Indirect

Indirect impacts of Alternative 2 include minor variations in groundwater seepage due to head gradients created by the diversion and improved drainage of Maurepas Swamp. These changes would be within the range of ambient conditions and therefore would have little effect on groundwater seepage.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 combined with the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.3 Water Quality and Salinity

5.3.1 Lower Mississippi River

No Action Alternative (Future without Project Conditions)

Direct

Under the No Action Alternative (no diversion into the southeastern Maurepas Swamp), no direct impacts to water quality of the Mississippi River would occur.

Indirect

Indirect impacts of not implementing a freshwater diversion into the southeastern Maurepas Swamp would result in the persistence of existing conditions with the Mississippi River continuing to carry high nutrient loads that contribute to the Gulf of Mexico "dead zone" due to eutrophication.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative combined with the wetland loss and increased runoff due to increased urbanization of the Pontchartrain Basin, as well as the benefits and impacts of other state and federal projects in the vicinity, as detailed in **Section 5.1.2**. Water quality trends could continue along the current trajectory with minimal effects on water quality in the Lower Mississippi River from other wetland restoration project in the region

Alternative 2

Direct

The direct impacts of this alternative include the construction and installation of intake structures and the reduction in discharge in the Lower Mississippi River during active diversion periods. During construction there would be increases in turbidity, suspended sediments, BOD and a decrease in DO. These impacts from construction would be temporary and localized to the construction area. Water quality would return to ambient conditions quickly after the termination of construction. The diversion of river water would result in minimal decreases in the load of nutrients, sediments, and pesticides in the Lower Mississippi River. The diversion of water is unlikely to change the concentrations of water quality parameters in the Lower Mississippi River. This minimal decrease in the load of sediments in the Lower Mississippi River indicated that additional modeling for river shoaling was not required.

Indirect

Because of the relatively small percentage of water that would be diverted from the Mississippi River, there would be minimal if any indirect impacts to water quality in the Lower Mississippi River. Over the long term, total loads of nutrients, sediments, and pesticides transported by the Lower Mississippi River would be reduced compared to without a diversion. The relatively small quantity of water diverted from the Mississippi River represents a small portion of the total discharge and would most likely have a negligible effect on offshore hypoxia (Day et al. 2004). These reductions would have minimal impacts on the concentration of water quality parameters. The diversion would not be expected to change nutrient ratios in the Mississippi River (Battelle 2005).

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 combined with the impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. The additive effect of multiple diversion projects would reduce the overall loads carried by the Lower Mississippi River that enter the Gulf of Mexico and could have the potential to reduce the area of offshore hypoxia. The scale of reduction in load depends on the overall number of diversion projects conducted in the future.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. There would be construction and installation of two intake structures for the two diversions that would result in more temporary impacts to water quality as described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.3.2 Blind River

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, not implementing a freshwater diversion into the study area in southeastern Maurepas Swamp, would have no direct impacts on water quality in Maurepas Swamp and the Blind River.

Indirect

Indirect impacts of not implementing restoration features would result in the persistence of existing conditions. Under the No Action Alternative, the current water quality conditions would persist; wetlands would still be affected by natural and man-made factors that would have both beneficial and detrimental effects on water quality conditions. Existing wetland communities would continue to diminish. Increased impoundment and limited circulation due to limited freshwater inputs and RSLR would continue to result in anoxic conditions, detrimental to fish and other aquatic organisms.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on water quality combined with similar water quality impacts throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. These other diversion projects would work to offset some of the changes in water quality such as decreases in DO and nutrients. Because of the spatial separation between these diversion projects and the Blind River/Maurepas Swamp, the effects of these diversion projects on the study area would be minimal.

Alternative 2

Direct

Direct impacts to water quality would result from impacts associated with construction activities in the Maurepas Swamp including the installation of control structures, culverts under Highway 61, improvement of the berm cuts, and the addition of new 500-foot wide berm cuts. These impacts would result in temporary increases in turbidity and BOD with concomitant decreases in DO. These impacts would be localized to the construction area and would be temporary. Water quality would return to ambient conditions quickly after the termination of construction. Additional direct impacts to water quality would be potential changes in concentration of certain water quality parameters in the Blind River and Maurepas Swamp. In general, concentrations of DO, hardness, pH, sulfate, TSS, turbidity, atrazine, and nitrate are higher in the Mississippi River compared to the Blind River. The concentration of these parameters could increase in the Blind River due to the diversion. However, studies have found that based on outfall management, nutrient concentrations would not change significantly from ambient conditions (Day et al. 2004). In Maurepas Swamp, concentrations of DO are expected to increase (Battelle 2005). Although concentrations of atrazine are elevated in the Mississippi River, this pesticide is not expected to have negative impacts on wildlife in the Maurepas Swamp (Battelle 2005). Concentrations of TOC, copper, and lead are lower in the Mississippi River compared to the Blind River. Therefore, the diversion would likely reduce concentrations of these constituents in the Blind River. The diversion is not expected to significantly change the risk of chemical exposure to wildlife (Battelle 2005). Increases in contaminants should remain similar to region trends in an industrialized area.

Indirect

The indirect impacts of Alternative 2 would be the persistence of changes to water quality due to the diversion over time. There have been many studies of the relationship between the nutrient loading rate into wetlands and associated removal efficiency. The most comprehensive studies of wetland nutrient removal efficiency have been of wastewater wetland treatment systems. In these systems the predominant form of nitrogen is ammonium. Mississippi River water contains predominantly nitrate, which will be denitrified in the swamp. When the nitrate: ammonium ration is less than 1 the average nitrogen removal efficiency ranges from 95 to 100%. The Mississippi River has an average molar nitrate: ammonium ratio of 18 (Lane et al., 1999). Therefore the removal efficiency of nitrogen in the swamp is expected to be higher than documented for wetland wastewater studies.

Lane et al., (1999) indicate that the Mississippi River has an approximate average nitrate concentration of 1.5 mg-N/L (that generally ranges between 0.75 and 2.0 mg-N/L (Lane et al., 1999)) and the average ammonium concentration for the Mississippi River is less than 0.1 mg-N/L. TN in the Mississippi River was generally between 1.0 and 2.0 mg-N/L. Lane et al. (1999) indicate that the average TP concentrations in the Mississippi River were similar to TP concentrations in the swamps evaluated. The average value was 0.055 mg-P/L, and the range was (0.022-0.424 mg-P/L). The following values for the Mississippi River at Belle Chasse, compared well with the data presented above.

TN	average 2.26 mg-N/L (0.57 – 4.50 mg-N/L) n=190
Nitrate	average 1.73 mg-N/L (1.15 – 2.73 mg-N/L) n=19
Ammonium	average 0.08 mg-N/L (0.01 – 0.31 mg-N/L) n=95
TP	average 0.22 mg-P/L (0.06 – 0.51 mg-P/L) n=198

Nutrient load reduction provided by the swamp for nitrate, total nitrogen (TN), and total phosphorus (TP) was estimated using the following equation.

Load Reduction = Input Load x Concentration Reduction

Where:

Input Load = Diversion Flow to Swamp x Average Diversion Flow Concentration

The concentration reduction was estimated based on the first order k-C* model equation (Kadlec and Knight, 1996).

$$Co = C^* + (Ci - C^*) \exp(-kA / 0.0365 \times Q)$$

Where:

Co = swamp outflow concentration in mg/L
A = swamp area in hectares
Q = inflow rate in m3/d
k = first order areal rate constant in m/yr
Ci = swamp inflow concentration in mg/L
C* = swamp background concentration in mg/L

And: *Concentration Reduction = (Ci – Co) / Ci*

Table 5-5 provides a summary of the values used for the first-order areal rate constant (k) for nitrate, TN, and TP, as well as the wetland background concentrations (Co) and average concentrations (Ci) in the Mississippi River. The average concentration values are based on water quality data collected at the USGS station at Belle Chasse (USGS 07374525 Mississippi River at Belle Chasse, LA).

Table 5-5: Nutrient Concentrations and Areal Rate Constants

	Background Concentration, C* (mg/L)	Average Concentration, Ci (mg/L)	k (m/yr)
Nitrate	0.008	1.73	35
TN	0.58	2.26	22
TP	0.034	0.22	5

The nutrient load reduction for Alternative 2: Romeville Diversion-3,000 cfs was estimated as follows:

The total average diversion flows to the swamp, as computed by the engineering calculations (**Appendix L, Section 2.2.4**), were used to estimate the inflow nutrient loading for Alternative 2 under existing, 20-year, 30-year, and 50-year sea level rise conditions. A summary of the diversion flows for Alternative 2 is provided in **Table 5-6**.

Table 5-6: Average Diversion Flows to Blind River Project swamp Area for Alternative 2

	No Sea Level Rise	20-year Sea Level Rise	30-year Sea Level Rise	50-year Sea Level Rise
Cfs	1080	1628	1802	2011

The percent load reduction for the four sea level rise scenarios for nitrate and TN ranged from 82-96% and 50-65%, respectively. The percent load reduction for the four sea level rise scenarios for TP ranged from 19-32%. These values are a little less than removal efficiency estimates provided by Day et al. (2006), that were based on Lane et al. (2003), which were73% for TN and 43% for TP for removal efficiency as a function of loading rates for data from both Mississippi River diversions and wetland wastewater treatment systems. The loading rates evaluated here for nitrate, TN, and TP were 18-34 g-N/m2/yr, 24-45 g-N/m2/yr, and 2-4 g-P/m2/yr, respectively, and were greater than the loading rates presented by Day et al. (2006). The lower removal efficiency estimates presented here reflect the fact that maximum removal efficiency occurs at low loading rates and decreases at higher loading rates. Wetlands also provide assimilation of metals. Increased delivery of freshwater to the swamp will also increase circulation and dissolved oxygen levels in the swamp and in Blind River.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres improved and protected by other Federal, state, local, and private restoration efforts such as Hope Canal and others as summarized in Section **5.1.2**. While the best available data were used to simulate the combined effects of a diversion and other restoration projects in the study area on water quality changes (**Appendix L, Section L2.10.1.2**), the installation of piezometers throughout the interior swamp south of US Highway 61 has been completed as part of this study and data is being collected to supplement existing swamp water quality data. A multi-directional flow gauge with water quality sensors that collects hourly data has also been installed on the Blind River near US Highway 61 and data is being collected from this gauge. Long-term data over variable conditions will provide a better understanding of flow and water quality fluctuations within the Study Area. The additional data from these monitoring stations will be used to refine predictive water quality modeling during the PED phase.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2. Nutrient load reduction provided by the swamp for nitrate, total nitrogen (TN), and total phosphorus (TP) was estimated as described for Alternative 2. The nutrient load reduction for Alternative 4: Southbridge Diversion-3,000 cfs was estimated as follows:

The total average diversion flows to the swamp, as computed by the engineering calculations (**Appendix L, Section 2.2.4**), was used to estimate the inflow nutrient loading for Alternative 4 under existing, 20-year, 30-year, and 50-year sea level rise conditions. A summary of the diversion flows is provided for Alternative 4 in **Table 5-7**.

Table 5-7: Average Diversion Flows to Blind River Project swamp Area for Alternative 4

	No Sea Level Rise	20-year Sea Level Rise	30-year Sea Level Rise	50-year Sea Level Rise
Cfs	801	1175	1323	1575

The percent load reduction for the four sea level rise scenarios for nitrate and TN ranged from 89-98% and 56-70%, respectively. The percent load reduction for the four seal level rise scenarios for TP ranged from 23-40%. These values are a little less than estimates provided by Day et al. (2006) that were based on Lane et al. (2003), which were73% for TN and 43% for TP for removal efficiency as a function of loading rates for data from both Mississippi River diversions and wetland wastewater treatment systems. The loading rates evaluated here for nitrate, TN, and TP ranged from 14-27 g-N/m^2/yr, 18-35 g-N/m^2/yr, and 2-3 g-P/m^2/yr, respectively, and were greater than the loading rates presented by Day et al. (2006). The lower removal efficiency estimates presented here reflect the fact that maximum removal efficiency occurs and low loading rates and decreases at higher loading rates. Wetlands also provide assimilation of metals.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2. Nutrient load reduction provided by the swamp for nitrate, total nitrogen (TN), and total phosphorus (TP) was estimated as described for Alternative 2. The nutrient load reduction for Alternative 6: Romeville Diversion-1,500 cfs, Southbridge Diversion-1,500 cfs was estimated as follows:

The total average diversion flows to the swamp, as computed by the engineering calculations (**Appendix L, Section 2.2.4**), was used to estimate the inflow nutrient loading for Alternative 6 under existing, 20-year, 30-year, and 50-year sea level rise conditions. A summary of the diversion flows for Alternative 6 is provided in **Table 5-8**.

Table 5-8: Average Diversion Flows to Blind River Project swamp Area for Alternative 6

	No Sea Level Rise	20-year Sea Level Rise	30-year Sea Level Rise	50-year Sea Level Rise
Cfs	999	1473	1630	1857

The percent load reduction for the four sea level rise scenarios for nitrate and TN ranged from 85-97% and 52-66%, respectively. The percent load reduction for the four seal level rise scenarios for TP ranged from 20-34%. These values are a little less than estimates provided by Day et al. (2006) that were based on Lane et al. (2003), which were73% for TN and 43% for TP for removal efficiency as a function of loading rates for data from both Mississippi River diversions and wetland wastewater treatment systems. The loading rates evaluated here for nitrate, TN, and TP ranged from 17-32 g-N/m^2/yr, 22-41 g-N/m^2/yr, and 2-4 g-P/m^2/yr, respectively, and were greater than the loading rates presented by Day et al. (2006). The lower removal efficiency estimates presented here reflect the fact that maximum removal efficiency occurs and low loading rates and decreases at higher loading rates. Wetlands also provide assimilation of metals.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2. Nutrient load reduction provided by the swamp for nitrate, total nitrogen (TN), and total phosphorus (TP) was estimated as described for Alternative 2. The nutrient load reduction for Alternative 4B: Southbridge Diversion-3,000 cfs (with split flows) was estimated as follows:

The total average diversion flows to the swamp, as computed by the engineering calculations (**Appendix L, Section 2.2.4**), was used to estimate the inflow nutrient loading for Alternative 6 under existing, 20-year, 30-year, and 50-year sea level rise conditions. A summary of the diversion flows for Alternative 4B is provided in **Table 5-9**.

Table 5-9: Average Diversion Flows to Blind River Project swamp Area for Alternative 4B

	No Sea Level Rise	20-year Sea Level Rise	30-year Sea Level Rise	50-year Sea Level Rise
Cfs	975	1428	1580	1801

The percent load reduction for the four seal level rise scenarios for nitrate and TN ranged from 86-97% and 53-67%, respectively. The percent load reduction for the four seal level rise scenarios for TP ranged from 21-34%. These values are a little less than estimates provided by Day et al. (2006) that were based on Lane et al. (2003), which were73% for TN and 43% for TP for removal efficiency as a function of loading rates for data from both Mississippi River diversions and wetland wastewater treatment systems. The loading rates evaluated here for nitrate, TN, and TP ranged from 17-31 g-N/m^2/yr, 22-40 g-N/m^2/yr, and 2-4 g-P/m^2/yr, respectively, and were greater than the loading rates presented by Day et al. (2006). The lower removal efficiency estimates presented here reflect the fact that maximum removal efficiency occurs and low loading rates and decreases at higher loading rates. Wetlands also provide assimilation of metals.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2. 5.3.3 Lake Maurepas

Section 5.3.3 Maurepas Swamp
No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp, would have no direct impacts on water quality in Lake Maurepas.

Indirect

Indirect impacts of No Action Alternative (not implementing a freshwater diversion into the study area in southeast Maurepas Swamp) would result in the persistence of existing conditions. Under the No Action Alternative, the current water quality conditions would persist; wetlands would still be affected by natural and man-made factors that would have both beneficial and detrimental effects on water quality conditions in Lake Maurepas. Existing wetland communities would continue to deteriorate. Increased impoundment and limited circulation due to limited freshwater inputs would continue to result in anoxic conditions, detrimental to fish and other aquatic organisms.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative combined with the impacts and benefits for overall net acres improved and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. Nutrient concentrations would remain the same in the future based on assimilation rates in the swamp. The cumulative impacts of these restoration efforts could increase DO in the lake.

Alternative 2

Direct

There would be no direct impacts of Alternative 2 on water quality in Lake Maurepas.

Indirect

There would be few indirect impacts of Alternative 2 on water quality in Lake Maurepas because of the assimilation capacity of the wetlands around the lake. Nutrient levels in the lake would most likely remain near ambient levels (Day et al 2005). Concentrations of DO would likely increase in the lake. Although concentrations of atrazine are elevated in the Mississippi River, this pesticide is not expected to have negative impacts on wildlife in Lake Maurepas (Battelle 2005).

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 in combination with the impacts and benefits for overall net acres improved and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. Because most of the nutrients from the diversion would be retained in the swamp (Day et al 2005), adverse impacts on nutrient levels in Lake Maurepas resulting from diversions is unlikely. Based on the cumulative effects of other restoration projects adjacent to Lake Maurepas, DO concentrations would increase in the future. The potential cumulative impacts on water quality in Lake Maurepas from combined diversions and other restoration projects will be further addressed in the PED phase. Water monitoring data from recently installed piezometers and gauges, along with additional data from other projects (as they are further developed) will be used to develop a more refined water quality model to simulate the water quality effects in the project area, downstream, and in Lake Maurepas.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.3.4 Salinity

5.3.4.1 Lower Mississippi River

No Action Alternative (Future without Project Conditions)

Direct

Under the No Action Alternative (no freshwater diversion into the study area in southeast Maurepas Swamp), no direct impacts to salinity in the Lower Mississippi River would occur.

Indirect

Under the No Action Alternative (no freshwater diversion into the study area in southeast Maurepas Swamp), no indirect impacts to salinity in the Lower Mississippi River would occur.

Cumulative

Cumulative impacts would be the synergistic effect of taking the No Action Alternative on salinity combined with the wetland loss and increased runoff due to increased urbanization, as well as the benefits and impacts of other state and federal projects in the vicinity, as detailed in **Section 5.1.2**. Salinity trends would continue along the current trajectory with minimal effects on water quality in the Lower Mississippi River from other wetland restoration project in the region.

Alternative 2

Direct

There would be no direct impacts of this alternative on salinity in the Lower Mississippi River.

Indirect

The indirect impacts of Alternative 2 include a reduction in discharge which could contribute to the upstream movement of the saltwater wedge. The dominant factor in the movement of the saltwater wedge is discharge with flow duration. Channel slope, wind velocity and direction, tides, and water temperature also affect movement of the wedge. If the saltwater wedge migrated up to Belle Chase, Louisiana which is 100 miles south of the study area, then the USACE would likely build a sill to prevent upstream migration. The sill was previously constructed under an existing authority and is part of the USACE efforts to protect public water supply from excessive chloride concentrations. Additionally, the diversion of water from the Mississippi River would not occur during low flow or low stage conditions when saltwater wedge movement occurs. Therefore, it is unlikely that the diversion would contribute to the movement of the wedge.

Cumulative

The cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. The additive effects of other diversion projects could decrease flow in the Mississippi River and increase the rate of movement of the saltwater wedge. However, it is unlikely that these diversions would occur during low flow periods.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.3.4.2 Blind River and Maurepas Swamp

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, no freshwater diversion into the Maurepas Swamp would have no direct impacts on salinity regimes within Maurepas Swamp and the Blind River.

Indirect

Indirect impacts of the No Action Alternative (not implementing a freshwater diversion into the study area in southwest Maurepas Swamp) would result in the persistence of existing conditions including increases in salinity within the study area.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on salinity regimes in combination with similar water quality impacts throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. Dependent on the flow rate and timing of discharge, the Hope Canal project would likely result in extensive freshening of Lake Maurepas, especially when operating during late-summer and early fall—low flow periods during which high salinity and saltwater intrusion present the greatest threat. Modeling efforts indicate that about 40 percent of water diverted through Hope Canal would flow westward across Maurepas swamp into Blind River and then into Lake Maurepas (Lee Wilson & Assoc. et al. 2001). Therefore, inflow from Lake Maurepas into southeastern Maurepas Swamp would likely exhibit decreased risk of salinity-related ecosystem damage.

Alternative 2

Direct

Direct impacts of Alternative 2 include decreases in salinity in the study area due to the contribution of freshwater from the diversion (Battelle 2005).

Indirect

Indirect impacts of Alternative 2 include present and future decreases in salinity due to the contribution of freshwater from the diversion (Battelle 2005).

Cumulative

Cumulative impacts would be the synergistic effect of Alternative 2 on salinity regimes combined with similar water quality impacts throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. The cumulative impacts would be similar to those described in the No Action Alternative with the added decreases in salinity associated with Alternative 2.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.3.4.3 Lake Maurepas

No Action Alternative (Future without Project Conditions)

Direct

Under the No Action Alternative (no freshwater diversion into the southeastern Maurepas Swamp), no direct impacts to salinity in the Lake Maurepas would occur.

Indirect

Under the No Action Alternative (no freshwater diversion into the southeastern Maurepas Swamp), the indirect impacts to salinity in the Lake Maurepas include potential increases in concentrations in the future.

Cumulative

Cumulative impacts would be the synergistic effect of Alternative 2 on salinity regimes combined with similar water quality impacts throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. The cumulative impacts would be similar to those described in the No Action Alternative for Blind River and Maurepas Swamp.

Alternative 2

Direct

There would be no direct impacts of this alternative on salinity in Lake Maurepas.

Indirect

The indirect impacts of this alternative include future decreases in salinity in Lake Maurepas due to the contribution of freshwater from the diversion (Battelle 2005). Based on a diversion of 1,500 cfs, the freshwater replacement time of Lake Maurepas would decrease from 2.65 months to 1.83 months (Battelle 2005). Kelso et al. (2005) estimated that a 2,500 cfs diversion could decrease salinity by 30% in Lake Maurepas. Therefore, a diversion of 3,000 cfs would likely result in a further decrease s in salinity.

Cumulative

Cumulative impacts would be the synergistic effect of Alternative 2 on salinity regimes in combination with similar water quality impacts throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. The cumulative impacts would be similar to those described in the No Action Alternative for Blind River and Maurepas Swamp with the added decreases in salinity associated with Alternative 2. The mean annual salinities for Pass Manchac (1951-2000) shown in Figure 4-12, show average salinities ranging from slightly above 0 to 3,5; the likelihood exists for the Alternative 2 diversion in combination with other local area projects such as Hope Canal to reduce salinities in this location by as much as 30 %. However, additional water quality monitoring and refined water quality modeling during PED will be done to establish quantitative change in salinity levels at various locations.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.4 Air Quality

No Action Alternative (Future without Project Conditions)

Direct

Under the No Action Alternative, no freshwater diversion in the Maurepas Swamp would have no direct impacts on air quality.

Indirect

Indirect impacts of not implementing a diversion would result in the persistence of existing conditions. Air quality would continue to be subject to institutional recognition and further regulations. However, air quality in the study area would likely decline for the following reasons: continued population growth, further commercialization and industrialization, increased numbers of motor vehicles, and increased emissions from various engines. These impacts would be coupled with the continued loss of Louisiana coastal wetland vegetation that would no longer be available to remove gaseous pollutants. Nevertheless, air quality degradation is not anticipated to be a significant problem in the study area under the No Action Alternative.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on air quality combined with similar air quality impacts from wetland loss and degradation throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal projects in the vicinity as summarized in **Section 5.1.2**.

Alternative 2

Direct

Direct impacts to ambient air quality would include temporary localized construction impacts as well impacts that would last the lifetime of the project. An air applicability determination analysis was extrapolated from previously completed similar projects based upon direct emission fro estimated construction hours. It has been shown that total emissions for the project (regardless if individual work items determined separately or even when all work items calculated cumulatively) generally do not exceed the threshold limit applicable to volatile organic compounds (VOC) for parishes where the most stringent requirement (approximately 50 tons per year or 49.38 metric tons per year in serious non-attainment parishes is in effect). The VOC emissions for the proposed construction would total approximately 42 tons for all construction features. The construction would take from 18 to 24 months to complete, so the VOC emissions would be approximately 24 to 29 tons per year. These emissions would be classified as de minimus, and no further action would be necessary. It is likely that indirect emissions, if they occur, would be negligible.

The construction impacts would result from the emissions of construction equipment within the study area and construction and fugitive dust. These effects to air quality would be temporary. Air quality would return to pre-construction conditions soon after the completion of construction activities. For the life of the project, the control structure(s) would be operated by a diesel or gasoline generator.

Indirect

Bringing freshwater, sediment, and nutrients to the swamp at strategic times of the year may improve air quality by protecting, creating and nourishing the Maurepas Swamp. Common wetland plants can naturally produce oxygen and filter out air pollutants such as ozone, sulfur dioxide and carbon monoxide. Although unlikely to greatly impact air quality alone, the study area would provide some air quality improvement from the effects of creating, nourishing and protecting the swamp in conjunction with other restoration efforts in the area.

Cumulative

Cumulative impacts would be the synergistic effect of implementing this alternative with the additive combination of impacts and benefits for overall nets acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in Section 5.1.2.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.5 Noise

No Action Alternative (Future without Project Conditions)

Direct

Under the No Action Alternative (no freshwater diversion into the southeastern Maurepas Swamp) would result in the persistence of existing conditions. The study area is predominantly remote forested swampland. The noise from nearby urban areas has little, if any, impact on the study area. Limited noise impacts from boat navigation in Blind River and connecting channels, automobile traffic on I-10 and U.S. Highway 61, and railroad transport would be expected to continue in the foreseeable future.

Indirect

There would be no indirect impacts of the No Action Alternative (no freshwater diversion into the southeastern Maurepas Swamp) on noise.

Cumulative

There would be no cumulative impact of the No Action Alternative on noise.

Alternative 2

Direct

The direct impacts of Alternative 2 would be a temporary increase in the noise level in the study area. However, the study area is remote and unpopulated so the noise level would not affect any nearby human communities. Once construction activities are completed noise levels would be slightly above the pre-construction levels due to the operation of control structures.

Potential noise impacts concerns may be expected from construction activities, although construction equipment is limited in the level of noise that can be emitted per regulations for Occupational Noise Exposure (29 CFR Part 1910.95) under the Occupational Safety and Health Act of 1970, as amended.

Indirect

Indirect impacts of Alternative 2 include increases in productivity and growth of the forest canopy which would buffer noise levels in the study area.

Cumulative

The cumulative impacts would principally be related to the potential short-term disruption of fish and wildlife species and similar impacts by other similar Federal, state, local and private restoration activities as well as other human-induced noise disruptions to these organisms. Cumulative impacts would be a synergistic effect of implementing this alternative with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts would be similar to Alternative 2 with the following exception. Post construction noise levels would increase due to the use of a portable vacuum pump used to operate the siphon. The noise levels would increase anytime the pump would lose prime. This would typically happen at low water level situations.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.6 Vegetative Resources

No Action Alternative (Future without Project Conditions)

Direct

The no Action Alternative would have no direct impacts on coastal vegetation resources.

Indirect

Indirect impacts of not implementing a freshwater diversion would result in the persistence of existing conditions. Both man-made and natural processes would contribute to the continued loss of vegetated wetland habitats, including loss of bald cypress-tupelo and bottomland hardwood resources, increased saltwater intrusion, increased flood duration and impoundment, and increased herbivory.

Exceedance of stress thresholds due to permanent inundation for species in existing plant communities would result in extensive mortality and a change in habitat from vegetated wetlands to open water under the No Action Alternative. Modeling efforts run over a 100-year time span for southern Maurepas Swamp support marsh persistence and swamp-to-marsh conversion (Hoeppner 2008). A chronosequence of swamp degradation processes nearer Lake Maurepas, however, suggests that bald cypress-tupelo swamp would change to open water. Based on field observations, Lee Wilson & Assoc. et al. (2001) support the following trajectory: mortality of herbaceous vegetation with limited conversion to more salt-tolerant species, reduced tree basal area and stem density, followed by mortality and transition to open water.

Across the Upper Pontchartrain Sub-Basin, the Coast 2050 Report (LCWCRTF & WCRA 1999) projects a loss of approximately half of swamp habitat, which includes both bald cypress-tupelo and bottomland hardwood habitats, by 2050 without restoration efforts (Table 5-10).

Projections were based on observed rates of wetland loss from 1974-1990 by habitat type in each mapping unit. Land cover of the Amite/Blind River Mapping Unit in 1990 included 138,900 acres (56,211 ha) of swamp (bottomland hardwood and bald cypress-tupelo) and 3,440 acres (1,392 ha) of fresh marsh. Based on observed annual rates of loss for swamp (0.83 percent per year) and fresh marsh (0.02 percent per year) in this unit, approximately 42 percent (or 58,338 acres [23,609 ha]) of swamp and one percent (or 40 acres [16 ha]) of fresh marsh would be lost over 50 years. Within the Study Area, these rates of wetland loss would result in the conversion of 9,139 acres (3,698 ha) of bald cypress-tupelo forest and 697 acres (282 ha) of bottomland hardwood, or a total loss of 9,836 acres (3,980 ha) of swamp to fresh marsh and open water for the interval from 2012 to 2062.

These conservative estimates are based upon the assumptions that wetland loss rates are static in time and loss occurs continuously. Empirical evidence suggests that the rate of relative sea level rise may likely increase in the future, as may the frequency of extreme weather events (ie., tropical storms, hurricanes, and droughts) (IPCC, 2004), Consequently, flood duration, saltwater influx, and wind damage may also increase in the future, forcing elevated rates of swamp to marsh/open water conversion.

Table 5-10. Projected Land Loss from 1990 to 2050 for the Upper Pontchartrain Sub-Basin by General Habitat Type (LCWCRTF & WCRA, 1999)

Mapping Unit	Habitat Type	1990	2050	% Land Loss
Amite/Blind	swamp	138,930	69,430	50%
	Marsh	3,440	3,400	1%
	TOTAL	142,370	72,830	49%
Tickfaw River Mouth	swamp	22,840	11,340	50%
	Marsh	2,350	0	0%
	TOTAL	25,190	11,340	55%

West Manchac	swamp	8,550	4,280	50%
	Marsh	2,950	2,890	2%
	TOTAL	11,500	7,170	38%

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of coastwide wetland loss and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity. Dependant on the flow rate and timing of discharge, the LCA Small Diversion at Hope Canal would likely result in extensive freshening of Lake Maurepas, especially when operating during late-summer and early fall—low flow periods at which high salinity and saltwater intrusion present the greatest threat (Lee Wilson & Assoc. et al. 2001; Day et al. 2006). Modeling efforts for that project indicate that 40 percent of water diverted through Hope Canal will flow westward across Maurepas Swamp into Blind River and then into Lake Maurepas (Lee Wilson & Assoc. et al. 2001). Therefore, inflow from Lake Maurepas into southeastern Maurepas Swamp would likely exhibit decreased risk of salinity-related vegetation damage. Nonetheless, this project would not adequately increase sediment and nutrient delivery to the Study Area necessary to offset relative sea level rise and the indirect negative impacts of increased flood duration and stage on wetland vegetation resources.

Alternative 2

Direct

The direct impacts of Alternative 2 include construction impacts to approximately 53 acres (21 ha) of forested wetland along the transmission canal. These negative direct impacts would be more than offset by positive impacts to forested wetlands in the distribution area. An increase in forest health and primary productivity would occur due to increased nutrient availability. The introduction of nutrients with diverted freshwater has been shown to potentially increase tree (Mitsch and Ewel, 1979; Browns and van Peer, 1989; Myers et al. 1995; Hesse et al. 1998; Effler et al. 2007; Brantley et al. 2008) and herbaceous (Shaffer et al. 2001; Effler et al 2007) growth and overall primary productivity (Brown, 1981; Rybczyk et al. 1996) in nutrient limited baldcypress-tupelo and other forested swamp systems. Increased nutrient availability would also promote baldcypress seedling growth, and consequently survival, by reducing the risk of mortality caused by complete submergence (Meyers et al. 1995). Lowered stage and reduced impoundment would further promote tree productivity and seedling survival. Hydrologic benefits are largely related to in-swamp management measures. Therefore, these benefits are relatively equivalent between alternatives.

Indirect

Indirect impacts of Alternative 2 include diverse benefits that synergistically would promote the health of the swamp over time. Swamp building (accretion) would approximately offset subsidence and eustatic sea level rise. Indirectly, this process would minimize the further degradation of wetland vegetation resources in the distribution area due to impoundment and support increased productivity. By maintaining relatively lower water levels in the study area, an increase would be realized in the probability of baldcypress and water tupelo seedling survival, recruitment, and thus forest stability. Forest productivity would also increase substantially due to the greater frequency of periodic drawdown and flow through the system. Drawdown would create opportunities for baldcypress and water tupelo germination and growth. Flow through of diverted water would facilitate seed dispersal. An increase in nutrient availability and productivity would indirectly increase wetland plant resistance to and recovery from herbivore, parasite, disease, and other damage. An increase in forest health would sustain and increase the relatively high basal areas observed throughout most of the study area, which indirectly would reduce the risk of windthrow damage to midstory and understory wetland plants in storms events (Shaffer et al. 2007; personal communication, Dr. Gary Shaffer, 2009).

The Wetland Value Assessment Methodology swamp Model (WVA) was used to contrast the effects of each alternative on wetland vegetation resources within the distribution area over the 50-year project life. Model runs were based on assumptions derived from trends discussed above, field sampling efforts in the study area and Maurepas Swamp, hydrologic modeling, and mapping of habitat conditions in the distribution area. A general description of the WVA is provided in Section 3.5, with more detailed description in **Appendix K**. Field sampling data and hydrologic modeling are described in **Appendices L**. Alternative 2 would provide benefits to approximately 21,369 acres (8,648 ha) of forested wetland. Under the WVA methodology, this alternative would yield a net gain of 6,421 average annual habitat units (AAHUs) over the No Action Alternative. Net benefits are the difference of total benefits (6,462 AAHUs) less total impacts (41 AAHUs) for Alternative 2.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 combined with coastwide wetland loss and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. Restoration activities in the vicinity of the study area would offset to some degree losses of wetland vegetation resources in the Upper Pontchartrain Sub-Basin. However, the interrelatedness between these systems is poorly understood (i.e. feedback mechanisms, thresholds, patch dynamics, etc.).

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 with the following exception. Construction impacts would affect approximately 271 acres (110 ha) of forested wetlands—108 acres (44 ha) along the transmission canal and 163 acres (66 ha) within the distribution area.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. Alternative 4 would provide benefits to approximately 21,206 acres (8,582 ha) of forested wetland. Under the WVA methodology, this alternative would provide a net gain of 6,124 AAHUs over the No Action Alternative. Net benefits are the difference of total benefits (6,302 AAHUs) less total impacts (178 AAHUs) for Alternative 4.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 4 with the addition of the direct impacts associated with the construction of the Romeville transmission canal. In total, 287 acres (116 ha) of forested wetland would be directly impacted—126 acres (51 ha) in the distribution area and 161 acres (65 ha) along the two transmission canals.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. Alternative 6 would provide benefits to approximately 21,243 acres (8,597 ha) of forested wetland. Under the WVA methodology, this alternative would provide a net gain of 7,114 AAHUs over the No Action Alternative. Net benefits are the difference of total benefits (7,313 AAHUs) less total impacts (199 AAHUs) for Alternative 6.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 4 with the following exception. Increased conveyance of flow from the outfall point to the southeast would require the expansion of the St. James Parish canal. Therefore, construction impacts would increase to an affected area of approximately 306 acres (124 ha) of forested wetlands: 126 acres (51 ha) in the northern section of the distribution area, 77 acres (31 ha) adjacent to the St. James Parish canal, and 108 acres (44 ha) along the South Bridge transmission canal.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. Alternative 4B would provide benefits to approximately 21,243 acres (8,597 ha) of forested wetland. Under the WVA methodology, this alternative would provide a net gain of 7,103 AAHUs over the No Action Alternative. Net benefits are the difference of total benefits (7,313 AAHUs) less total impacts (210 AAHUs) for Alternative 4B.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.6.1 Upland Vegetation Resources

No Action Alternative (Future without Project Conditions)
Direct, Indirect

The No Action Alternative would have no direct or indirect impacts on upland vegetation.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on upland vegetation combined with coastwide upland vegetation losses and degradation, as well as the benefits and impacts of other state and federal projects in the vicinity.

Alternative 2

Direct

The direct impacts of Alternative 2 on upland vegetation resources would include construction impacts to approximately 94 acres (38 ha) of upland habitat, of which approximately 86 acres (35 ha) are in cultivated crops and the remainder developed. Direct impacts to this resource would exclusively occur along the transmission canal.

Indirect

There would be no indirect impacts of Alternative 2 on upland vegetation.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on upland vegetation combined with coastwide upland vegetation losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**.

Alternative 4

Direct

The direct impacts of Alternative 4 on upland vegetation resources would include construction impacts to approximately 101 acres (41 ha) of upland habitat, of which approximately 68 acres (28 ha) are in cultivated crops, 3 acres (1.2 ha) in scrub/shrub, and the remainder (30 ac [12 ha]) low intensity development. Direct impacts to this resource would exclusively occur along the transmission canal.

Indirect

There would be no indirect impacts of Alternative 4 on upland vegetation.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on upland vegetation combined with coastwide upland vegetation losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in Section 5.1.2.

Alternative 6

Direct

The direct impacts of Alternative 6 on upland vegetation resources would include construction impacts to approximately 195 acres (79 ha) of upland habitat, of which approximately 154 acres (62 ha) are in cultivated crops, 4 acres (1.6 ha) in scrub/shrub, and the remainder (36 ac [15 ha]) low intensity development. Direct impacts to this resource would exclusively occur along the two transmission canals.

Indirect

There would be no indirect impacts of Alternative 6 on upland vegetation.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on upland vegetation combined with coastwide upland vegetation losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in Section 5.1.2.

Alternative 4B

Direct

The direct impacts of this alternative would be the same as for Alternative 4.

Indirect

There would be no indirect impacts of Alternative 4B on upland vegetation.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on upland vegetation combined with coastwide upland vegetation losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in Section 5.1.2.

5.6.2 Invasive Species - Vegetation

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative would have no direct impacts on invasive vegetation resources.

Indirect

The No Action Alternative, not implementing a diversion into the Study Area in southeastern Maurepas Swamp, would have minimal to no indirect impacts on invasive vegetation resources. Several invasive non-indigenous plant species (NIPS) are established in the Study Area. Based on field observations, however, these species do not appear to be displacing native species and dominating communities that are converting to marsh. Under the No Action Alternative, reduced species diversity and removal of native vegetation is likely. Such disturbance (i.e., increased water levels or stochastic event such as storm-related influx of saltwater) may facilitate the spread of invasive plant species in the Study Area (e.g., Theoharides and Dukes, 2007).

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on invasive vegetation with the additive combination of impacts from coastwide native vegetation losses and degradation on the transport, colonization, establishment, and spread of invasive plant species, as well as the benefits and impacts of other state and Federal projects in the vicinity.

Alternative 2

Direct

There would be minimal and localized direct impacts of Alternative 2 on invasive vegetation. Because of similar invasive aquatic plant species currently inhabit the Lower Mississippi River and the Maurepas Swamp, introduction of freshwater from the River to the swamp would likely not result in the transport of new invasive aquatic plant species into the study area. Habitat fragmentation and propagule transport due to construction activities may result in localized colonization of invasive plant species in these areas. Best management practices implemented in construction activities would limit the occurrence of such events.

Indirect

Indirect impacts of this alternative on invasive vegetation would be minimal. Increased resource availability due to the introduction of nutrients would increase productivity, maintain diversity, and consequently promote the resistance of existing swamp communities to invasion, which is unlikely under the No Action Alternative (e.g., Theoharides and Dukes, 2007). Outbreaks of common salvinia within parish canals and the Blind River would continue and may be exacerbated; however, such events would continue to be restricted to these areas.

Cumulative

Cumulative impacts would be the synergistic effect of Alternative 2 on invasive vegetation combined with impacts from coastwide native vegetation losses and degradation on the transport, colonization, establishment, and spread of invasive plant species, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would e similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.7 Wildlife and Habitat

5.7.1 Birds

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, not implementing a freshwater diversion to the study area in southeastern Maurepas Swamp, would have no direct impacts on bird resources.

Indirect

Indirect impacts of not implementing a freshwater diversion would result in the persistence of existing conditions which includes the gradual conversion of existing forested wetlands used by birds for foraging, nesting, and over-wintering habitat to severely degraded and fragmented swamp forest habitats. Based on the habitat condition classes for the study area (20-3- years to marsh and 30-50 years to marsh), this includes the conversion of 11,228 acres of forested swamp to marsh. As interior forested wetlands convert to marsh and open water, there would be an expected loss of habitat for species dependent on swamp forest habitat.

The LCWCRTF & WCRA (1999) projects increases in bald eagles, while all other wildlife species are projected to remain stable under the No Action Alternative. However, more recent data indicates that degraded baldcypress-tupelo habitat in southeastern Maurepas supports significantly lower overall mean forest songbird species richness and abundance and lower mean abundance of prothonotary, northern parula, and yellow-throated warblers (Stouffer et al. 2005). This finding is consisting with more recent trends documented by Partners In Flight (PIF) (PIF) 2009. As such, continued degradation of swamp habitat in the study area would eventually result in decreased forest songbird abundance under the No Action Alternative. Significant loss of forest songbirds would have effects on the entire Maurepas Swamp ecosystem. Emerging insect pests of baldcypress and water tupelo have moderately to severely defoliated the Maurepas Swamp since about 1993 (Goyer and Chambers 1997). Declines in forest bird species richness and abundance may result in decreased functionality of insectivorous birds, increased caterpillar herbivory, and an accelerated rate at which swamp transitions into open marsh. Bird assemblages present would likely transition to species more typical of open water habitats.

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative combined with coastwide wildlife habitat losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity. Adverse cumulative impacts on bird species would be offset, to some degree, by the positive impacts of implementing other state and Federal projects as detailed in **Section 5.1.2**. Without the restoration and protection of the Maurepas Swamp, the dense populations of wading birds, waterfowl, raptors, and songbirds that breed, rest, and forage there would decline over an increasing area as trees die due to flooding, salinity, and defoliation stressors. If this trend continues, many of the populations of bird species observed will be detrimentally impacted.

Alternative 2

Direct

Direct impacts include temporary and localized alteration and disturbance of foraging habitat (i.e., forest and canal edge habitat) associated with construction activities. This activity would have negative impact to species such as egrets, herons, common yellowthroat, killdeer, and mockingbird. There would be construction impacts to approximately 53 acres (21 ha) of forested wetland along the transmission canal. Construction activities would also represent temporary disturbances to a small area of available waterfowl habitat. These impacts would be temporary as waterfowl and foraging wading birds would most likely abandon the area during construction activity, and return after construction ends and water clarity improves.

Depending on the time period of construction, installation of a control structure may impact some breeding bird species of the area. Temporary increases in noise and turbidity could impact birds sensitive to noise or dependent on clear water for foraging. These temporary impacts would be localized to the control structure area.

Indirect

Indirect impacts include increases in primary productivity of the Maurepas Swamp ecosystem (Stouffer et al. 2005) which would benefit wading bird populations by restoring diminishing suitable swamp forest habitat and increasing abundance of forage fish and crayfish in the study area. Under Alternative 2, bird population in the distribution area would benefit from the restoration of 21,369 acres of swamp. Indirect impacts to bird species from chemical contaminants in diverted water are unlikely (Battelle 2005; Stouffer et al. 2005). Overall, birds would benefit in the longer term from the healthier swamp forest ecosystem that would provide better food sources and nesting sites than currently exist.

An additional indirect impact of diversion canal construction and maintenance may be increased brown-headed cowbird nest-parasitism of breeding songbirds. Brown-headed cowbirds could utilize maintained levees (i.e., forest openings) to probe deeper into forested habitat (Rich et al. 1994). However, populations of songbirds appear to be reproducing with relatively high success rates, and it is unlikely that increased nest parasitism in a portion of the swamp will cause major population declines of host species (Stouffer et al. 2005). In the long-term, indirect impacts of Alternative 2 could result in a decrease access points for cowbirds due to enhanced swamp growth and regeneration.

The diversion is expected to decrease salinity in the Maurepas Swamp, which should have positive effects on bald eagles. Watts et al. (2006) found population growth, nesting density and productivity of Bald Eagles was negatively correlated with salinity due to long term effects of saltwater intrusion on forest health and nest tree survival.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 combined with impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. Reducing salinity and improving forest health will benefit cypress-tupelo swamp forts nesting species such as vireous (e.g., red-eyed, white-eyed, and yellow-throated) and woodpeckers (e.g. downy, hairy, northern flicker, pileated, and red-bellied), Salinity reduction from several projects in the area would maintain and benefit local populations of fish eating birds such as bald eagle, belted kingfisher, great-blue heron, and osprey by improving habitat and increasing the populations of preferred, freshwater forage fish (Stoufferet al. 2005).

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. The construction of the South Bridge diversion could negatively impact birds dependent on those forest habitats temporarily.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. The indirect impacts of clearing forested swamp for the South Bridge diversion would negatively impact birds dependent on those forest habitats and would persist into the future. Under Alternative 4 bird populations in the distribution area would benefit from the restoration of 21,206 acres of swamp.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. The loss of forested swamp due to the South Bridge diversion would be added to the overall loss of forested swamp habitat in the region. Increases in swamp productivity would benefit bird populations in the future.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 4 with the following exception. There would be construction impacts to approximately 287 acres (116 ha) of forested wetland along the transmission canals.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 4 with the following exceptions. Under Alternative 6, bird populations in the distribution area would benefit from the restoration of 21,243 acres of swamp.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 4.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 4 with the following exceptions. There would be construction impacts to approximately 306 acres (124 ha) of forested wetland along the transmission canal.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 4 with the following exception Under Alternative 4B, bird populations in the distribution area would benefit from the restoration of 21,243 acres of swamp.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 4.

5.7.2 Mammals

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp, would have no direct impacts on mammal species.

Indirect

Indirect impacts of the No Action Alternative (no freshwater diversion into the southeastern Maurepas Swamp) would result in the continued degradation, conversion, and eventual loss of important wetland habitats used by many different mammalian species. Based on the habitat condition classes for the study area (20-3-

years to marsh and 30-50 years to marsh), this includes the conversion of 11,228 acres of forested swamp to marsh.

The Coast 2050 Plan shows the status, functions of interest, trends, and projections through 2050 for furbearers and game mammals across the state by mapping units (LCWCRTF & WCRA 1999). The Amite/Blind mapping unit encompasses the interior southeastern Maurepas Swamp (study area). Under the No Action Alternative, declines in rabbit, deer, and squirrel populations are predicted by 2050, with all other wildlife species remaining stable.

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative combined with coastwide wildlife habitat losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity. Adverse cumulative impacts on mammal species would be offset, to some degree, by the positive impacts of implementing other state and Federal projects as detailed in **Section 5.1.2**. This would include possible migration of mammal species out of the study area to areas of higher habitat quality.

Alternative 2

Direct

Direct impacts from construction would have minimal to no affect on deer and other mammals due to the high mobility of these species. Some resident mammals would be temporarily displaced by construction and would utilize large tracts of similar habitat nearby. Along the diversion corridor, several mammals that live in den sites within agricultural areas (e.g. coyote) or along existing ditches or canals (e.g. mink, otter) may be temporarily displaced. There would be construction impacts to approximately 53 acres (21 ha) of forested wetland along the transmission canal.

Indirect

Indirect impacts of Alternative 2 include improvement and creation of habitat for a variety of mammalian species associated with the freshwater and sediment inputs. Additionally, increased vegetative productivity and forest health will provide additional browse and shelter for mammals. Under Alternative 2, mammal populations in the distribution area would benefit from the restoration of 21, 369 acres of swamp.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 combined with impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. The restoration of significant areas of coastal wetlands throughout coastal Louisiana would improve connectivity of mammal populations once fragmented by areas of deep water and habitat degradation.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. The construction of the South Bridge diversion would impact approximately 271 acres (110 ha) of forested wetlands. The direct impacts associated with construction would be more extensive due to the longer South Bridge diversion route including a small loss of forested swamp habitat.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. Under Alternative 4 mammal populations in the distribution area would benefit from the restoration of 21,206 acres of swamp.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 4 the following exceptions. There would be construction impacts to approximately 287 acres (116 ha) of forested wetland along the transmission canals.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. Under Alternative 6 mammal populations in the distribution area would benefit from the restoration of 21,243 acres of swamp.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 4.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 4 with the following exceptions. There would be construction impacts to approximately 306 acres (124 ha) of forested wetland along the transmission canal.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 4.

5.7.3 Reptiles

No Action Alternative (Future without Project Conditions)

Direct

Under the No Action Alternative (no freshwater diversion into the southeastern Maurepas Swamp) no direct impacts to reptile species in the study area would occur.

Indirect

Indirect impacts of the No Action Alternative include potential decreases in population sizes that result from decreased forest health and degradation. Based on the habitat condition classes for the study area (20-30 years to marsh and 30-50 years to marsh), this includes the conversion of 11,228 acres of forested swamp to marsh. Hibernation and nest habitat will become increasingly scarce as ridges are flooded and swamp vegetation is replaced with dense herbaceous vegetation typical of open marsh. Food sources will continue to decrease due to poor water quality, low nutrient availability, and low levels of productivity.

The Coast 2050 Plan shows the status, functions of interest, trends, and projections through 2050 for reptiles across the state by mapping units (LCWCRTF & WCRA 1999). The Amite/Blind mapping unit encompasses the interior southeastern Maurepas Swamp (study area). While increases in alligators are projected to 2050, all other reptile species are to remain stable under the No Action Alternative. However, if habitat degradation continues, wildlife assemblages present would likely transition to species more typical of open water habitats, provided such species are able to immigrate into the study area. Observations provide evidence that the ridges and hummocks that are becoming exceedingly rare in the Blind River ecosystem are critical reptile habitat (Gosselink 1984; Stouffer 2005; Tinkle 1955).

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative combined with coastwide wildlife habitat losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity. Adverse cumulative impacts on reptile species would be offset, to some degree, by the positive impacts of implementing other state and Federal projects as detailed in **Section 5.1.2**.

Alternative 2

Direct

The direct impacts of Alternative 2 include temporary effects on alligator abundance and displacement of some reptile species during construction of a diversion canal and control structures (Stouffer et al. 2005). Alligators and other reptiles would most likely leave the construction area and return after the disturbance has ended. There would be construction impacts to approximately 53 acres (21 ha) of forested wetland along the transmission canal.

Indirect

The indirect impacts of Alternative 2 include Benefits to reptile populations in the distribution area from the restoration of 21,369 acres of swamp, The indirect impacts also include increases reptile prey abundance and positive impacts on reptile densities due to increased nutrient availability, swamp productivity, and dissolved oxygen associated with the diversion.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 combined with impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. The additive combination of all the restoration projects in the vicinity of the study area will be an increase in reptile populations due to improved habitat conditions, prey availability, and connectivity across the region.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. The construction of the South Bridge diversion would impact approximately 271 acres (110 ha) of forested wetlands.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions, Under Alternative 4, reptile populations in the distributions area would benefit from the restoration of 21,206 acres of swamp.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 the following exceptions. There would be construction impacts to approximately 287 acres (116 ha) of forested wetland along the transmission canals

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.7.4 Amphibians

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, not implementing a diversion in southeastern Maurepas Swamp, would have no direct impact amphibian species.

Indirect

The indirect impacts of the No Action Alternative (no freshwater diversion into the southeastern Maurepas Swamp) includes the continued degradation of swamp habitat and increased conversion of swamp into open freshwater marsh which will alter amphibian species composition presently observed in the area. Open freshwater marsh habitats are favored by larger anuran species like the bullfrog, pig frog, and southern leopard frog (Dundee and Rossman 1989). However the large numbers of small, vocal frogs that prefer the dense swamplands will be unable to transition and thus populations would decline. Populations of some salamanders like the lesser siren and three-toed amphiuma would increase due to increases in open marshland habitat; however, other species such as the southern dusky salamander that utilize the swamp habitat would have population declines.

Decreases in amphibian populations would also be associated with increases in salinity in the future. Amphibians cannot tolerate the increasing salinity that has been reported in baldcypress-tupelo swamps throughout southern Louisiana (Dundee and Rossman 1989). With continued habitat degradation, assemblages present would likely transition to species more typical of open water habitats, provided such species are able to immigrate into the study area.

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of coastwide wildlife habitat losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity. Adverse cumulative impacts on amphibians would be offset, to some degree, by the positive impacts of implementing other state and Federal projects as detailed in **Section 5.1.2**.

Alternative 2

Direct

The direct impacts of Alternative 2 include temporary effects on amphibian abundance and displacement of some amphibian species during construction of a diversion canal and control structures.

Indirect

The indirect impacts of Alternative 2 include increases in current amphibian populations due to the increases in productivity, decreases in salinity, and increases in habitat from the diversion.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. The cumulative impact of the restoration projects in coastal Louisiana will be the conservation of local amphibian species dependent on areas of swamp forest for shelter, forage, and reproductive needs.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. The construction of the south Bridge diversion would impact approximately 271 acres (110 ha) of forested wetlands.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions, Under Alternative 4, reptilepopulations in the distribution area would benefit from the restoration of 21,206 acres of swamp.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 the following exceptions. There would be construction impacts to approximately 287 acres (116 ha) of forested with the following exceptions. There would be the added direct impacts of two diversions including the temporary impacts to amphibians associated with construction activities.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 4.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 4.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 4.

5.7.5 Invasive Wildlife Species

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, not implementing a diversion in southeastern Maurepas Swamp, would have no direct impacts on invasive species.

Indirect

The indirect impacts of the No Action Alternative (no freshwater diversion into the southeastern Maurepas Swamp) include increases in the populations and distribution of nutria due to the conversion of swamp into open water and freshwater marsh. There is evidence that nutria prefer fresh marsh and open areas within swamp forests (LDWF 2009), and the No Action Alternative would create optimal nutria habitat.

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of coastwide wildlife habitat losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity as detailed in **Section 5.1.2**.

Alternative 2

Direct

Under Alternative 2, there would be no direct impacts on invasive wildlife species.

Indirect

Indirect impacts of Alternative 2 could include a decrease of current nutria populations due to increases in swamp productivity and maintenance of forested swamp habitat which could prevent the development of optimal nutria habitat.

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of coastwide wildlife habitat losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity as detailed in **Section 5.1.2**

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.8 Fisheries

5.8.1 Lower Mississippi River

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, not implementing a diversion into the study area in southeastern Maurepas Swamp, would have no direct impacts on fishery resources in the Lower Mississippi River.

Indirect

The No Action Alternative, not implementing a freshwater diversion into the study area in southeastern Maurepas Swamp, would have no indirect impacts on fishery resources in the Lower Mississippi River.

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. Although these projects will benefit fishery resources in the Lake Pontchartrain Basin, they will be spatially limited to this basin and are unlikely to impact fishery resources in the Lower Mississippi River.

Alternative 2

Direct

The direct impacts of Alternative 2 include a small loss of fish habitat and potential direct fish mortality due to the placement of an intake structure and associated construction in the Mississippi River. These direct impacts would be temporary and localized. Structures associated with Alternative 2 will have openings to allow fish to migrate in the drainage canals as they have historically, and the low salinity that results from local rain runoff will not change species selectivity.

Indirect

The indirect impacts of Alternative 2 include fish mortality due to the long-term presence of an intake location. Another indirect impact is the potential loss of habitat due to reduction in discharge and sediment and nutrient load associated with the withdrawal of 3,000 cfs from the river during various times of the year. These reductions in discharge and nutrient and sediment load are minor compared to the overall load carried by the Mississippi River. Therefore, these indirect impacts will have little to no effect on the fishery resources in the Mississippi River.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. The cumulative impacts of this alternative also include impacts to fishery resources from other water withdrawals and discharges in the Mississippi River. The additional effects of decreases in river discharge and reductions in nutrient and sediment load from this alternative are comparatively small. The cumulative impacts of this alternative are unlikely to significantly affect fishery resources in the Lower Mississippi River.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. There would be two intake locations placed in the Mississippi River that could potentially result in direct fish mortality and small losses in fish habitat.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. There would be two intake locations that could result in fish mortality in the future.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.8.2 Blind River and Maurepas Swamp

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp, would have no direct impacts on fishery resources in the Blind River and Maurepas Swamp.

Indirect

Indirect impacts of not implementing a freshwater diversion would result in the persistence of existing conditions. The persistence of low oxygen conditions could contribute to fish kills and low species diversity in the Blind River. Persistence of existing conditions would also include continued loss of fragmented and deteriorating transitional wetland habitats used by fish for shelter, nesting, feeding, cover, nursery, and other life requirements; and increased inter- and intra-specific competition between resident and migratory fish species.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative with the additive combination of coastwide fishery habitat losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. The Small Diversion at Hope Canal would freshen the surrounding waters, albeit to an unknown extent, and slightly alter the flow patterns in Blind River, which might enhance aquatic habitat for fishery resources in its lower extent. Predictions from the Coast 2050, Habitat Switching and Land-Building models were used to assess changes in fisheries habitat. The models predict changes in marsh-type and marsh loss and gain, which, combined with other factors, were used to predict habitat suitability and fisheries productivity for Louisiana coastal areas. Sharp declines are predicted in fisheries productivity under the No Action Alternative (Minello et al. 1994; Rozas and Reed et al 1993; in LCA 2004). The LCA Study (USACE, 2004) estimated a net loss of 328,000 acres (132,734 ha) of coastal wetland habitats may occur by 2050. This is almost 10 percent of Louisiana's remaining coastal wetlands, which is utilized by various fish species for shelter, foraging, cover, nursery, and other life requirements.

Other cumulative impacts to fishery resources would include impacts to aquatic habitat suitability. Aquatic habitat suitability for fishery resources varies by species and depends primarily on different water quality and substrate parameters. Hence, impacts to water quality (such as salinity, dissolved oxygen and temperature) as well as wetland development activities (dredge/fill); habitat conversion (e.g., wetland to upland); and blockage of ingress and egress access would adversely impact fishery resources in the study area. These factors would likely affect aquatic habitat and fishery species diversity, population size, and harvest rates of fisheries.

Alternative 2

Direct

The direct impacts of Alternative 2 include negative effects on fishery resources from temporary increases in turbidity and BOD and decreases in DO associated with construction activities in the Maurepas Swamp. These impacts would be localized to the construction area and would be temporary. The presence of control structures in the interior canals of Maurepas Swamp could limit migration of fish species. These control structure would only be operated during certain stages and thus would restrict migration for short time periods.

Indirect

The indirect impacts of Alternative 2 include the possible displacement of some fish species due to changes in salinity (Caffey and Schexnayder 2002). Consequentially, fish populations in some areas may decline as certain species migrate to other areas. Another indirect impact would be benefits to fishery resources in the long term due to augmentation of food webs and increases larval fish habitat associated with the diversion (Caffey and Schexnayder 2002). The presence of control structures would restrict fish migration during certain time periods in the future.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. The benefits of other diversion projects in the area will also increase productivity, which would increase fish populations. This may increase fish populations in the Blind River and Maurepas Swamp due to migration. Additionally, decreases in salinity in Lake Maurepas from other diversion projects could increase freshwater fish species in the area which may increase populations in the Blind River and Maurepas Swamp. These projects will result in positive cumulative impacts in fishery resources in the Lake Pontchartrain Basin. Overall increases in fish populations will not be spatially localized to individual project areas due to migration of fish within the basin.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 with more extensive direct impacts due to the additional construction associated with the widening of the St. James Parish canal by 100 feet. This would have temporary negative effects on local fish populations due to decreases in DO and increases in turbidity and BOD.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. The widening of the St. James Parish canal would increase habitat for freshwater fish species.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.8.3 Lake Maurepas

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, no freshwater diversion in the southeastern Maurepas Swamp, would have no direct impacts on fishery resources in Lake Maurepas.

Indirect

The indirect impacts of the No Action Alternative (no freshwater diversion into the southeastern Maurepas Swamp) would be similar to those described for the No Action Alternative for the Blind River and Maurepas Swamp with the following exceptions. There would be population increases of saline-tolerant fish species due to increases in salinity levels in Lake Maurepas. Consequentially, populations of freshwater fish species in the lake would decline.

Cumulative

The cumulative impacts of the No Action Alternative would be similar to those described for the No Action Alternative for the Blind River and Maurepas Swamp. Wetland conversion to open water would continue which would result in decreases in habitat for larval fish and increases in habitat for some fish species. These processes would be slowed by other diversion projects in and around Lake Maurepas. Statewide changes in fisheries would be related to trends within the region as well as the beneficial impacts of other Federal, state, local, and private restoration efforts, as summarized in **Section 5.1.2**.

Alternative 2

Direct

There would be no direct impacts of this alternative on fishery resources in Lake Maurepas.

Indirect

Indirect impacts of this alternative would be similar to those described for Alternative 2 for the Blind River and Maurepas Swamp. Changes in salinity would result in population decreases in saline-tolerant fish species and increases in populations of freshwater fish species. Increases in productivity in the Blind River and Maurepas Swamp would benefit overall fish populations in the future.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2 for Blind River and Maurepas Swamp.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.9 Aquatic Resources

5.9.1 Plankton

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative (no freshwater diversion in the southeastern Maurepas Swamp) would have no direct impacts on plankton resources.

Indirect

Indirect impacts of not implementing the diversion into the southeastern Maurepas Swamp would result in the persistence of existing conditions in the distribution area including the continued degradation and eventual loss of forested wetlands. This loss of wetlands would lead to a shift in plankton populations to species assemblages that prefer open water habitats. There would be no indirect impacts to plankton populations in the Lower Mississippi River.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on plankton resources with the additive combination of similar wetland degradation and wetland loss impacts to plankton resources throughout southern Louisiana, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**.

Alternative 2

Direct

The direct impacts of Alternative 2 include the negative effects of some plankton populations due to construction activities associated with dredging and installation of structures in the study area. During construction, there would be a localized and short-term decrease in DO concentrations and an increase in turbidity, temperature, and BOD. Following construction activities, the area would return to ambient conditions and be decolonized by plankton populations.

Indirect

The indirect impacts of Alternative 2 would benefit plankton populations due to increases in the planktonic food web in Maurepas Swamp and the Blind River associated with increases in DO, nutrients and detritus from the diversion. Indirect impacts to plankton also include localized changes in population's assemblages due to the diversion.

Cumulative

Cumulative impacts to plankton resources would primarily be associated with the incremental impacts due to increased nutrients, oxygen and sediment being provided into the river and swamp. Cumulative impacts would be the synergistic effect with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. Alternative 2 would synergistically interact with other restoration projects to provide more a complete addition of freshwater, nutrients, oxygen and sediments necessary to improve and help restore the Blind River and Maurepas Swamp. As a result, this would enhance and provide important energy inputs to the planktonic food web.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

Direct impacts will be similar to Alternative 2 with the following exceptions. Construction activities would occur at two intake locations in the Lower Mississippi River.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.9.2 Benthic Resources

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, not implementing a freshwater diversion into the study area in southeastern Maurepas Swamp, would have no direct impacts on benthic resources.

Indirect

The indirect impacts of the No Action Alternative (no freshwater diversion into the southeastern Maurepas Swamp) include conversion of existing forested wetlands to emergent or open water bottoms that would decreases populations of benthic species assemblages that typically utilize or require wetland habitats. Other indirect impacts include a decrease in benthic populations due to decreases of available nutrients and detritus. The conversion of primarily wetland dependent benthic species assemblages to more emergent and open water benthic species assemblages would also occur.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative with the additive combination of similar forested wetland degradation and conversion to emergent and open water habitats and resultant impacts to benthic resources throughout southern Louisiana, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2.**

Alternative 2

Direct

The direct impacts of Alternative 2 include direct mortality of slow-moving, sessile or benthic organisms during construction activities in the Lower Mississippi River and Maurepas Swamp. Other benthic species using these areas would likely be displaced to more suitable habitats. Any such impacts would initially cause increased inter- and intra-specific competition between various benthic species for nearby available habitat resources. There would also be a shift in species composition to those benthic species more tolerant of disturbance. The settlement of sediment out of the water column during the introduction of freshwater into the river and swamp would also cause temporarily and localized impacts to some sessile and benthic species. However, the prolific nature of the benthic community is expected to result in rapid re-colonization of substrates once construction is completed. Short-term disturbance to benthic species would likely occur from increased turbidity, temperature and BOD and decreased DO due to installation of control structures. These direct impacts would generally be localized and temporary as benthos would quickly re-colonize areas disturbed by construction activities. The diversion of water from the Mississippi could result in the introduction of the zebra mussel to the Lake Pontchartrain Basin.

Indirect

The indirect impacts of Alternative 2 would benefit benthic resources by providing increased dissolved oxygen and nutrients that would provide food and energy resources for benthic organisms due to the diversion. This would eventually increase local epifauna which, in turn, would serve as important sources of food for birds, nekton, and people (Day et al., 1989).

Cumulative

Cumulative impacts would be the synergistic effect with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2** Alternative 2 would work synergistically with those projects to provide freshwater, nutrients and sediments which provide energy inputs to the benthic food web.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. Construction activities would occur in two separate areas in the Lower Mississippi River and Maurepas Swamp which would cause some additional temporary impacts to benthic populations.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.10 Essential Fish Habitat (EFH)

No Action Alternative (Future without Project Conditions)

Direct

There is no EFH located within the study area. Lake Maurepas is EFH for red drum and white shrimp. Therefore, potential impacts to EFH in the lake are considered. The No Action Alternative, not implementing a freshwater diversion into the study area in southeastern Maurepas Swamp, would have no direct impacts on EFH in Lake Maurepas.

Indirect

The indirect impacts of the No Action Alternative no freshwater diversion into the southeastern Maurepas Swamp would result in the persistence of existing conditions resulting in the continued conversion of marsh to open water and increases in salinity in and around Lake Maurepas. Continued increases in salinity levels in Lake Maurepas could shift or increase the optimal habitat for red drum and white shrimp closer to the outlet of the Blind River. Conversion of emergent marsh to open water would represent a loss of EFH for juvenile life cycle requirements of both white shrimp and red drum.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative with the additive combination of coastwide fishery habitat losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. The Small Diversion at Hope Canal along with other diversion projects would freshen the surrounding waters, albeit to an unknown extent, and slightly alter the flow patterns, which might shift or decrease EFH in Lake Maurepas. Predictions from the Coast 2050, Habitat Switching and Land-Building models were used to assess changes in fisheries habitat. The models predict changes in marsh-type and marsh loss and gain, which, combined with other factors, were used to predict habitat suitability and fisheries productivity for Louisiana coastal areas (LCWRTE WCA 1999). Sharp declines are predicted in fisheries productivity under the No Action Alternative (Minello et al. 1994; Rozas and Reed et al 1993; in LCA 2004). The LCA Study (USACE, 2004) estimated a net loss of 328,000 acres (132,737 ha) of coastal wetland habitats may occur by 2050. This is almost 10 percent of Louisiana's remaining coastal wetlands, which is utilized by various fish species for shelter, foraging, cover, nursery, and other life requirements. These losses would represent a reduction in EFH for juvenile life cycle requirements of both white shrimp and red drum.

Alternative 2

Direct

There would be no direct impacts of Alternative 2 on EFH in Lake Maurepas.

Indirect

The indirect impacts of Alternative 2 include a potential shift or decrease in the optimal habitat for red drum and white shrimp towards the east in Lake Maurepas due to decreases in salinity. Other indirect impacts include an increase in EFH for juvenile life cycle requirements of both white shrimp and red drum due to the increase and maintenance of swamp habitat from the diversion. Increases in productivity resulting from Alternative 2 would benefit populations of red drum and white shrimp in Lake Maurepas.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of coastwide fishery habitat losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. The cumulative impacts of Alternative 2 with other diversion projects include decreases in salinity in Lake Maurepas which would shift or decrease optimal habitat for red drum and white shrimp in the lake. Wetland building processes resulting from other diversions in addition to Alternative 2 could result in an increase in EFH for juvenile life cycle requirements of both white shrimp and red drum. Increases in productivity resulting from other diversion projects and Alternative 2 would benefit populations of red drum and white shrimp in Lake Maurepas.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.11 Threatened and Endangered Species

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative would have no direct impacts on listed (endangered or threatened) species or their critical habitat in the Study Area.

Indirect

Indirect impacts of not implementing the diversion into the Study Area in southeastern Maurepas Swamp would result in the continued degradation, conversion, and eventual loss of important wetland habitats used by threatened and endangered species for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements.

Cumulative

Cumulative impact would be the synergistic effect of implementing the No Action Alternative with the additive combination of coastwide wildlife habitat losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity. Adverse impacts on listed species from not implementing this project would be offset, to some degree, by the positive cumulative impacts of implementing other state and Federal projects.

Alternative 2

Direct

The direct impacts of Alternative 2 include potential entrainment of pallid sturgeon at the intake location. The entrainment risk is low for juveniles due to low likelihood of occurrence in the study area, and moderate for sub-adults and adults due to presumed lower limits on swimming capabilities of some individual fish.

Additional direct impacts include temporary displacement of manatees (although they are exceptionally rare) during construction activities in the study area. The manatees, if present, would likely move to other areas for foraging or resting purposes.

Indirect

The indirect impacts of Alternative 2 include creation of structures beneficial to pallid sturgeon. Pallid sturgeon in the Mississippi River is frequently found in the vicinity of man-made structures that provide shelter from main channel water velocities. They also provide hard, permanent substrates for benthic invertebrates and fish eaten by pallid sturgeon (Hoover et al. 2007).

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. There would be two intake locations which could result in entrainment of pallid sturgeon.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. There would be two intake locations which could provide habitat for the pallid sturgeon.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.12 Cultural and Historic Resources

No Action Alternative (Future without Project Conditions)

Direct, Indirect

Under the No Action Alternative (Future Without Project conditions), no direct or indirect impacts to cultural and historic resources in Study Area would occur.

Cumulative

Cumulative impacts would be the synergistic effect with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other federal, state, local, and private restoration efforts as summarized for coastal Louisiana, as well as the benefits and impacts of other state and federal projects in the vicinity, as detailed in **Section 5.1.2.**

Alternative 2

Direct

Direct impacts could result from construction activities if there were cultural resources present. A preliminary Cultural Resources Survey has been conducted to identify sites of significance that may or may not be directly impacted by the implementation of the freshwater diversion and its associated structures. No archaeological or historical resources in the study area were identified in the Cultural Resources Survey, and therefore no affect to any cultural resource is expected to occur. Forthcoming Phase I survey results will be considered, to avoid any direct impacts with existing cultural resources that could be identified.

Indirect

Indirect impacts on cultural resources include depositing sediments and restoring the health of the swamp in the distribution area. Deposition of sediment can change the environment of an existing site by providing additional protection to the site. This alternative could benefit cultural resources by protecting them against impacts such as flooding, land subsidence and/or erosion from annual storms.

Cumulative

Cumulative impacts would be the synergistic effect with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized for coastal

Louisiana, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. This alternative would provide additional restorative and regenerative ecological potential for the Blind River and the Maurepas Swamp, which would continue to provide protection to the cultural resources in the study area.

Alternative 4

Direct

Direct impacts from this alternative would potentially impact some archaeological and historical resources. Records indicate the probable presence of some archaeological sites, as well as the location of the Tippecanoe Plantation within the proposed corridor for this alternative.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

Cumulative impacts would be similar to Alternative 2, but with the exception that potential direct impacts to archaeological and historical resources along the South Bridge transmission canal could occur.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 4.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 4.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 4.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 4.

5-13 Aesthetics

No Action Alternative (Future without Project Conditions)

Direct

Under the No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp, no directs impacts to aesthetics in the study area would occur.

Indirect

The indirect impacts of the No Action Alternative no freshwater diversion into the southeastern Maurepas Swamp include continued swamp degradation and conversion of existing wetlands to fresh marsh and open water habitats. This would result in decreased structural complexity and habitat diversity, limiting the aesthetic appeal of the study area.

Along the Blind River, the continued conversion to marsh and open water habitats would directly and dramatically affect the viewscape. Viewers on the Blind River would be able to see through the vegetation and preview the adjacent areas before arriving at them. Large baldcypress trees would be lost and not replaced, negatively impacting the aesthetic quality of the river. The surrounding environment would change from shaded with partial canopy cover to a brighter and more open river. Changes in vegetation may also result in a change in wildlife viewable by the user which adds to the loss or reduction of many of the qualities that qualified the Blind River as a Scenic River. This loss would also be evident along the canals, although to a somewhat lesser extent due to man-made effects already seen (e.g. straightness, side cast berms, and petroleum pipeline easements).

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on aesthetic resources with the additive combination of similar impacts from wetland loss and degradation throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. Other restoration projects near Lake Maurepas would maintain and enhance the aesthetic quality of the swamps around the lake. These benefits would primarily be localized to those project areas and would not directly improve aesthetics in the study area.

Alternative 2

Direct

The direct impacts of Alternative 2 include the installation of the diversion structures adjacent to the Mississippi River that would add industrial-looking elements at the levee. Visual impacts from the diversion structure would be minimal because they would be similar to the industrial aesthetics of the nearby oil refineries on River Road (Highway 44). The nearest residences are a minimum of approximately 0.2 miles from the diversion culvert location; the shape of the neighborhoods and a bend in River Road would hide the diversion structure from most of the nearby residences. The berm and canal construction of the diversion route would be aesthetically similar to canal and railroad features that currently existing along the diversion corridor.

Visual impacts within the distribution area are expected to be minimal. The control structures are likely to be gates or weirs that would only be visible in their immediate vicinity. Furthermore, these structures would only be operated in the closed position periodically and would be below the water surface in the open position. Improvements in the berm cuts and the addition of new berm cuts would either have negligible impacts or could even improve the nearby viewshed by improving views into the swamp from the canals and removing some of the visually unappealing berms.

Indirect

The indirect impacts of Alternative 2 include the improvement of the visual aesthetics of the study area through restoration of the forested swamp where it has been deteriorating within the study area.

Cumulative

Cumulative impacts would be the synergistic effect of the Alternative 2 on aesthetic resources with the additive combination of similar impacts from wetland loss and degradation throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. Restoration and preservation of the study area around Lake Maurepas from other diversion projects would maintain and enhance the aesthetic quality of the region.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. Within Maurepas Swamp, the visual impacts of the diversion canal would be slightly greater than Alternative 2 because the canal would cut through a section of swamp that is relatively undisturbed. The viewshed in this area would not be considerably affected because the canal would be hidden by trees and access is limited.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. The direct impacts associated with the South Bridge diversion described in Alternative 4 would also be present.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 4.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.14 Recreation

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, not implementing a freshwater diversion into the Study Area in southeastern Maurepas Swamp, would have direct impacts on recreational resources. The recreational experience of the site is related to the condition of the area's natural resources. The continued water quality degradation of existing marsh and wetlands would diminish the wildlife habitat of the area, which in turn would adversely impact the recreational opportunities of the Study Area.

The existing recreation benefit of the Study Area is estimated by way of the Unit Day Value (UDV) method, employed in compliance with the USACE Economics

Guidance Memorandum, 09-03. The natural and built resources of the study site are analyzed and assigned points based on five criteria:

- Recreation Experience: Based on the number of activities available at the site and whether they are unique to the site;
- Availability of Opportunity: Based on how many other areas for fishing and hunting are within 30 minutes, 45 minutes, 1 hour and 2 hours travel time of the study site;
- Carrying Capacity: Based on a rating of the facilities on site: minimum, basic, adequate, optimum and ultimate;
- Accessibility: Based on a rating of the accessibility to the site and within the site: limited; fair and good; and
- Environmental: Based on aesthetic factors such as geology, topography, water and vegetation, air pollution, water pollution, poor climate, and adjacent views.

The following table (Table 5-11) demonstrates the guidelines for assigning points within the UDV method.

Table 5-11. Guidelines for assigning points within the Unit Day Value Method

Criteria	Judgement Factors				
Recreation experience Total Points: 30	Two general activities	Several general activities	Several general activities; one high quality value activity	Several general activities; more than one high quality high activity	Numerous high quality value activities; some general activities
Point Value: 13	0-4	5-10	11-16	17-23	24-30
Availability of opportunity Total Points 18	Several within one hour travel time; a few within 30 minutes travel time	Several within one hour travel time; none within 30 minutes travel time	One or two within one hour travel time; none within 45 minutes travel time	None within one hour travel time	None within 2 hour travel time
Point Value: 6	0-3	4-6	7-10	11-14	15-18
Carrying capacity Total Points 14	Minimum facility for developmen t for public health and safety	Basic facility to conduct activity(ies)	Adequate facilities to conduct without deterioration of the resource of activity experience	Optimum facilities to conduct activity at site potential	Ultimate facilities to achieve intent of selected alternative

Point Value: 8	0-2	3-5	6-8	9-11	12-14
Accessibility Total Points: 18	Limited access by any means to site or within site	Fair access, poor quality roads to site; limited access within site	Fair access, fair road to site; fair access, good roads within site	Good access to good roads to site; fair access, good roads within site	Good access, high standard road to site; good access within site
Point Value: 11	0-3	4-6	7-10	11-14	15-18
Environmental Total Points: 20	Low aesthetic factors that significantly lower quality	Average aesthetic quality; factors exist that lower quality to minor degree	Above average aesthetic quality; any limiting factors can be reasonably justified	High aesthetic quality; no factors exist that lower quality	Outstanding aesthetic quality; no factors exist that lower quality
Point Value: 8	0-2	3-6	7-10	11-15	16-20

Based on project team site visits in July and September 2009 and consultation with user groups, the values were scored as follows:

- Recreation Experience: There are several general activities on site, but none unique to the site. The Study Area is predominantly navigable by water; as a result many of the activities are water-based. As a result, the point value assigned to the study site is **6**.
- Availability of Opportunity: The Elm Hall WMA is within 20 miles of the Study Area. Eight additional WMAs and National Wildlife Refuges (NWRs) are within 40 miles of the study site. Therefore, the point value assigned is **2**.
- Carrying Capacity: Facilities within the Study Area include the St. James Boat Club in Paulina, a private non-profit club with the only bathroom facilities on site; private hunting camps; and the Grand Point Boat Ramp. Facilities are characterized as basic; the points assigned are **3**.
- Accessibility: The majority of the study site is navigable only by water; the Boat Club and Grand Point Ramp serve as access points. However on occasion the water level can be too low to employ an air boat. Thus, the points assigned are 10.
- Environmental: During project team site visits in July and September 2009, debris such as televisions, tires, and bottles were noted on site, as well as an odor of animal tissue decay. Although these factors diminish the aesthetic value of the site, they can be reasonably rectified and the

overall aesthetic quality of the site is deemed above average. Thus, the points assigned are **8**.

The total points allocated to the site are 29. According to the USACE Memorandum, 29 points equates to a $6.89 UDA for general fishing and hunting.

The LDWF estimated annual use of the Maurepas Swamp WMA from July 2007 to June 2008 was 9,442, making it the second-most frequented WMA in the LDWF's Region 7. The Maurepas Swamp WMA experienced peak use in October through December, and low use in April through May. The average monthly visitation for the Maurepas WMA is 787 for the July 2007 to June 2008 timeframe. The proposed Study Area comprises of approximately half of the total WMA area. Thus, half of 787, or 394, provides an approximate average monthly use for the proposed Study Area. Three hundred and ninety-four times the $6.89 unit day value yields an estimated total monthly recreation benefit of $2,700 for the Study Area or approximately $32,400 on an annual basis.

However, if nothing is done in the future to stem the trend of degradation in the swamp (the No Action Alternative) this value will decline. Recreational resources in the Study Area that would most likely be affected by the No Action Alternative are those related to loss of wetlands/marshes and habitat diversity. Fish and wildlife abundance is related to the quantity and quality of wetlands present.

As the Maurepas Swamp continues to degrade, fragment and convert to marsh and open water habitat, the local abundance and diversity of fish and wildlife species that present utilize the existing Maurepas Swamp habitats would be expected to decline over time. More mobile fish and wildlife species would relocate to more suitable wetland habitats; migratory birds would be required to find more suitable stopover habitats on their trans-Gulf migrations. Hence, fishing and hunting opportunities would also like decline. Waterfowl populations, particularly mallards, are presently declining throughout North America. Consequently, waterfowl hunting opportunities in the Study Area would likely decline if these waterfowl population trends continue and if suitable waterfowl wintering habitat continues to degrade, fragment and decline in the Study Area. Recreational birdwatching opportunities would also likely diminish as migratory bird usage of the Maurepas Swamp declines in response to swamp habitat degradation, fragmentation and conversion to marsh and open water.

Indirect

Indirect impacts of the implementation of the No Action Alternative, not implementing a freshwater diversion intothe Study Area in southeastern Maurepas Swamp, would result from the continuing swamp degradation, fragmentation and conversion to marsh and open water. For these conditions would be expected to cause the abundance and diversity of fish and wildlife to decline over time. Lower-quality fishery spawning, nursery, and foraging habitat would translate to a decline in sport fishing opportunities in the future. Decreased use of the Study Area by game species would likewise reduce hunting opportunities. Thus, implementation of the No Action Alternative would cause the recreational value of the Study Area to decline.

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts.

In addition, more recent restoration efforts would also cumulatively interact to help offset losses of recreational resources in the Study Area by preserving and enhancing the natural habitats, thereby enabling the continuation and even expansion of existing recreational activities within the Study Area and the region as a whole.

Alternative 2

Direct

The primary direct impacts on recreational resources would result from the study area being temporarily unavailable during construction. In addition, there would be a temporary and localized decrease in the quality of recreational opportunities near construction areas.

Indirect

Alternative 2 would serve to slow or reverse the trend of swamp degradation and habitat conversion in the study area. Following construction, this freshwater swamp would provide important and essential fish and wildlife habitats that would contribute to restoring the base of organisms used for recreational activities such as fishing, bird watching and hunting.

Wildlife-dependent recreation activities would be maintained and possibly increased. Recreation activities dependent upon swamp habitats, such as hunting, fishing and bird watching, would be maintained and possibly increased. Fishing and hunting activities could continue in areas near the study site.

Taking into consideration both the direct and indirect impacts of the proposed Alternative 2, the UDV method was employed and values were scored as follows:

- **Recreation Experience**: There are several general activities, common to the region, which can be conducted on site. Many of these activities are dependent upon the freshwater the swamp provides. The addition of a diversion along the Romeville alignment would preserve and restore the freshwater habitat, enabling the quality of the recreation to increase. As a result, the implementation of Alternative 2 would result in a point value assigned to the study site as an **8**.

- **Availability of Opportunity**: The Elm Hall WMA is within 20 miles of the study area. Eight additional WMAs and National Wildlife Refuges (NWRs) are within 40 miles of the study site. The implementation of Alternative 2 would not affect this guideline category. Thus, the point value assigned would be **2**.
- **Carrying Capacity**: Facilities within the study area are characterized as basic. Alternative 2 would not involve the addition of new facilities or the improvement of existing ones. The points assigned would therefore remain as **3**.
- **Accessibility**: The implementation of Alternative 2 is designed so as to not impede accessibility. Therefore, the points assigned would remain as **10**.
- **Environmental**: Alternative 2 is designed to restore the freshwater habitat within the study area. A freshwater diversion along the Romeville alignment would reduce the salinity within the study area as well as the frequency of flooding. Habitat restoration would significantly increase the aesthetic value of the study site. Thus, the points assigned would be **14**.

The total points allocated to the site would be 37. According to the USACE Memorandum, 37 points equates to a $7.43 UDV for general fishing and hunting. The approximate average monthly use for the proposed study area is 394. Three hundred and ninety-four times the $7.43 UDV yields an estimated total annual recreation benefit of approximately $35,000 for the study area, an annual increase of $2,600 over the value of existing conditions.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**. The cumulative impacts of this alternative would be similar to those described for the No Action Alternative with the following exception. The implementation of Alternative 2 would serve to forestall further wetland and habitat deterioration in the study area, thus unlike the No Action Alternative, this proposed action would work in conjunction with the other restoration efforts of the region to preserve and enhance natural habitats.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts for this Alternative would be similar to those described for Alternative 2 with the following exceptions.

Taking into consideration both the direct and indirect impacts of the proposed Alternative 4, the UDV method was employed and values were scored as follows:

- **Recreation Experience**: There are several general activities, common to the region, which can be conducted on site. Many of these activities are dependent upon the freshwater the swamp provides. The addition of a diversion along the South Bridge alignment would preserve and restore the freshwater habitat, enabling the quality of the recreation to increase. As a result, the implementation of Alternative 4 would result in a point value assigned to the study site as an **8**.
- **Availability of Opportunity**: The Elm Hall WMA is within 20 miles of the study area. Eight additional WMAs and National Wildlife Refuges (NWRs) are within 40 miles of the study site. The implementation of Alternative 4 would not affect this guideline category. Thus, the point value assigned would be **2**.
- **Carrying Capacity**: Facilities within the study area are characterized as basic. Alternative 4 would not involve the addition of new facilities or the improvement of existing ones. The points assigned would therefore remain as **3**.
- **Accessibility**: The implementation of Alternative 4 is designed so as to not impede accessibility. Therefore, the points assigned would remain as **10**.
- **Environmental**: Alternative 4 is designed to restore the freshwater habitat within the study area. A freshwater diversion along the South Bridge alignment would reduce the salinity within the study area as well as the frequency of flooding. Habitat restoration would significantly increase the aesthetic value of the study site. Thus, the points assigned would be **14**.

Upon implementation of Alternative 4, the total points allocated to the site would be 37. According to the USACE Memorandum, 37 points equates to a $7.43 UDV for general fishing and hunting. The approximate average monthly use for the proposed study area is 394. Three hundred and ninety-four times the $7.43 UDV yields an estimated total annual recreation benefit of approximately $35,000 for the study area, an annual increase of $2,600 over the value of existing conditions.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 4 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts. The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts for this Alternative would be similar to those described for Alternative 2 with the following exceptions.

Taking into consideration both the direct and indirect impacts of the proposed Alternative 6, the UDV method was employed and values were scored as follows:

- **Recreation Experience**: There are several general activities, common to the region, which can be conducted on site. Many of these activities are dependent upon the freshwater the swamp provides. The addition of two diversions along the Romeville and South Bridge alignments would preserve and restore the freshwater habitat, enabling the quality of the recreation to increase. Two diversions would prevent salinity concentrations within the study area and decrease the overall salinity in the swamp at a faster rate than the installation of just one diversion. As a result, the implementation of Alternative 6 would result in a point value assigned to the study site as a **10**.
- **Availability of Opportunity**: The Elm Hall WMA is within 20 miles of the study area. Eight additional WMAs and National Wildlife Refuges (NWRs) are within 40 miles of the study site. The implementation of Alternative 6 would not affect this guideline category. Thus, the point value assigned would be **2**.
- **Carrying Capacity**: Facilities within the study area are characterized as basic. Alternative 6 would not involve the addition of new facilities or the improvement of existing ones. The points assigned would therefore remain as **3**.
- **Accessibility**: The implementation of Alternative 6 is designed so as to not impede accessibility. Therefore, the points assigned would remain as **10**.
- **Environmental**: Alternative 6 is designed to restore the freshwater habitat within the study area. Two freshwater diversions would reduce the overall salinity within the study area, reduce salinity concentrations throughout the study area, and control for flooding. Two diversions would serve to significantly facilitate habitat restoration, which in turn would significantly increase the aesthetic value of the study site. Thus, the points assigned would be **16**.

Upon implementation of Alternative 6, the total points allocated to the site would be 41. According to the USACE Memorandum, 41 points equates to a $7.70 UDV for general fishing and hunting. The approximate average monthly use for the proposed study area is 394. Three hundred and ninety-four times the $7.70 UDV yields an estimated total annual recreation benefit of $36,400 for the study area, an annual increase of $4,000 over the value of existing conditions.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 6 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts. The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts for this Alternative would be similar to those described for Alternative 2 with the following exceptions.

Taking into consideration both the direct and indirect impacts of the proposed Alternative 4B, the UDV method was employed and values were scored as follows:

- **Recreation Experience**: There are several general activities, common to the region, which can be conducted on site. Many of these activities are dependent upon the freshwater the swamp provides. The addition of a diversion along the South Bridge alignment and the modification to allow flow through the St. James Parish Canal would preserve and restore the freshwater habitat, enabling the quality of the recreation to increase. Two diversions would prevent salinity concentrations within the study area and decrease the overall salinity in the swamp at a faster rate than the installation of just one diversion. As a result, the implementation of Alternative 4B would result in a point value assigned to the study site as a **10**.
- **Availability of Opportunity**: The Elm Hall WMA is within 20 miles of the study area. Eight additional WMAs and National Wildlife Refuges (NWRs) are within 40 miles of the study site. The implementation of Alternative 4B would not affect this guideline category. Thus, the point value assigned would be **2**.
- **Carrying Capacity**: Facilities within the study area are characterized as basic. Alternative 4B would not involve the addition of new facilities or the improvement of existing ones. The points assigned would therefore remain as **3**.
- **Accessibility**: The implementation of Alternative 4B is designed so as to not impede accessibility. Therefore, the points assigned would remain as **10**.

- **Environmental**: Alternative 4B is designed to restore the freshwater habitat within the study area. A split freshwater diversion would reduce the overall salinity within the study area, reduce salinity concentrations throughout the study area, and control for flooding. Two diversions would serve to significantly facilitate habitat restoration, which in turn would significantly increase the aesthetic value of the study site. Thus, the points assigned would be **16**.

Upon implementation of Alternative 4B, the total points allocated to the site would be 41. According to the USACE Memorandum, 41 points equates to a $7.70 UDV for general fishing and hunting. The approximate average monthly use for the proposed study area is 394. Three hundred and ninety-four times the $7.70 UDV yields an estimated total annual recreation benefit of $36,400 for the study area, an annual increase of $4,000 over the value of existing conditions.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 4B with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration. The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.15 Socioeconomics and Human Resources

5.15.1 Displacement of Population and Housing

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, not implementing a freshwater diversion into the southeastern Maurepas Swamp, would have no direct impacts on the displacement of population and housing. According to the U.S. Census Bureau, Ascension Parish increased in population from 2000 to 2008 by nearly 33 percent. The Louisiana Parish Population Projections Series, 2010-2030, published by the State of Louisiana Office of Electronic Services, predicts that Ascension Parish will continue to grow exponentially, projecting an increase in population of 196,140 in 2030, or nearly 93 percent over 2008 figures. In contrast, St. James Parish's population increased by less than 1 percent from 2000 to 2008 and is projected by the State to slightly decrease in population in 2030 to 19,670, a decrease of more than 7 percent from 2008. Within the distribution area there are no permanent residents and no new residences are permitted within the WMA, which comprises much of the study area. Therefore, no displacement of population and housing is anticipated as a result of the implementation of the No Action Alternative, not implementing a freshwater diversion into the study area in southeastern Maurepas Swamp.

Indirect

As there are no permanent residents within the distribution area, there would be no indirect impacts on the displacement of population and housing from the implementation of the No Action Alternative.

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**.

Alternative 2

Direct

There are no permanent residences along the Romeville alignment involved in the proposed Alternative 2. Thus, there would be no direct impacts on the displacement of population and housing as a result of the implementation of Alternative 2.

Indirect

Since there are no permanent residences within the study area of Alternative 2, there would be no indirect impacts on the displacement of population and housing as a result of the implementation of Alternative 2.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**. The cumulative impacts of this alternative would be similar to those described for the No Action Alternative.

Alternative 4

Direct

The direct impacts of Alternative 4 include the potential displacement of at most three houses and their inhabitants along the South Bridge transmission canal.

Indirect

There would be no indirect impacts of Alternative 4 on displacement of populations or housing.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 4 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts.

Alternative 6

Direct

The direct impacts of Alternative 6 include the potential displacement of at most three houses and their inhabitants along the South Bridge transmission canal. There would be no direct impacts on populations or housing along the Romeville transmission canal.

Indirect

There would be no indirect impacts of Alternative 6 on displacement of populations or housing.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 6 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts.

Alternative 4B

Direct

Direct impacts of Alternative 4B include the potential displacement of at most three houses and their inhabitants along the South Bridge transmission canal.

Indirect

There would be no indirect impacts of Alternative 4B on displacement of populations or housing.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 4B with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts.

5.15.2 Employment, Business, and Industrial Activity

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, not implementing a freshwater diversion into the study area in southeastern Maurepas Swamp, would have no direct impacts on employment or income.

Indirect

Indirect impacts of the implementation of the No Action Alternative, not implementing a freshwater diversion into the southeastern Maurepas Swamp, would result in the persistence of existing conditions including continued wetland degradation. This continued wetland loss would have localized impacts on employment and income including a decline in forested wetland habitats which in turn could lead to potential economic decline in wetland-related employment.

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**.

Coastal Louisiana's continued wetland loss and the related depletion of wetland-dependent natural resources could likely result in a decline of job opportunities and personal income throughout rural coastal areas (USACE 2004). Other supporting economic activities such as marinas, bait and tackle shops could also be adversely impacted by the degradation and eventual loss of these wetlands and wetland-dependent resources.

The loss of wetlands could result in the need for greater expenditures for maintaining and repairing existing infrastructure. This could provide local employment and industrial activity benefits.

Alternative 2

Direct

The primary direct impacts of Alternative 2 on employment and industrial activity would result from the potential for temporary employment in the construction of the proposed action.

Indirect

Alternative 2 would serve to slow or reverse the trend of swamp degradation and habitat conversion in the study area. The proposed action would serve to protect and enhance essential fish and wildlife habitats. Economic activities dependent upon such habitats, and the fish and wildlife it supports, would be maintained and possibly increased, leading to a rise in fishery and wildlife-related employment and industrial activity.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**. The cumulative impacts of this alternative would be similar to those described for the No Action Alternative with the following exception. The implementation of Alternative 2 would serve to forestall further wetland and habitat deterioration in the study area. Thus unlike the No Action Alternative, this proposed action would work in conjunction with the other restoration efforts of the region to preserve and enhance natural habitats and thereby preserving and enhancing the economic activities tied to these habitats.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.15.3 Availability of Public Facilities and Services

No Action Alternative (Future without Project Conditions)

Direct

The implementation of the No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp, would result in no direct impacts on the availability of public facilities and services.

Indirect

The implementation of the No Action Alternative, not implementing a freshwater diversion into the southeastern Maurepas Swamp, would not indirectly impact the availability of public facilities or services within the study area, which includes the utilities, emergency services and education.

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.l.2**.

The loss of coastal land could lead to a population shift. In addition, Ascension Parish is projected to grow exponentially in population by 2030 (Louisiana Office of Electronic Services). This expected population growth, in conjunction with a potential population shift, would lead to greater demand on the existing public facilities and services. Thus, public facilities and services would be expected to expand.

Alternative 2

Direct

There would be no direct impacts of Alternative 2 on the availability of public facilities or services.

Indirect

The implementation of Alternative 2 would not indirectly impact the availability of public facilities or services within the study area.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**. The cumulative impacts of this alternative would be similar to those described for the No Action Alternative with the following exception. The implementation of Alternative 2 would serve to forestall further wetland and habitat deterioration in the study area. Unlike the No Action

Alternative, this proposed action would work in conjunction with the other restoration efforts of the region to preserve and enhance natural habitats and coastal lands. The potential population shift as a result of land loss could be lessened, leading to a proportionally lesser degree of strain on the area's public facilities and services.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.15.4 Transportation

No Action Alternative (Future without Project Conditions)

Direct

Implementation of the No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp, would result in no direct impacts on transportation in the study area.

Indirect

Implementation of the No Action Alternative, no freshwater diversion into the study area in southeastern Maurepas Swamp, would have indirect impacts on the transportation resources within the study area. The No Action Alternative would allow the continued degradation within the study area, enabling invasive species such as salvinia to grow and spread and the persistence of flooding conditions. This in turn would adversely impact travel by foot or by boat within the study area.

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**.

The loss of coastal land could lead to inland migration. In addition, Ascension Parish is projected to grow exponentially in population by 2030 (Louisiana Office of Electronic Services). This expected population growth, in conjunction with a potential population shift, would lead to greater demand on the existing transportation network. Thus, transportation infrastructure would be expected to expand.

Alternative 2

Direct

The direct impacts of Alternative 2 would include increased demands on transportation resources network during construction. The installation of culverts under US 61, LA 3125, and the Canadian National Railroad will not result in traffic delays or disruption of normal traffic flow. Detours during construction will be constructed to allow full traffic flow for both roadways and the railroad. Heavy truck traffic along US 61 could occur. However, all direct impacts would be temporary in nature.

Indirect

The indirect impacts of Alternative 2 include facilitating foot and boat travel within the study area through the restoration of the forested swamp.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**. The cumulative impacts of this alternative would be similar to those described for the No Action Alternative with the following exception. The implementation of Alternative 2 would forestall further wetland and habitat deterioration in the study area by working in conjunction with the other restoration efforts of the region to preserve and enhance natural habitats and coastal lands. Population shifts could be lessened leading to a proportionally lesser degree of strain on the area's transportation network.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The direct impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2

5.15.5 Disruption of Desirable Community and Regional Growth (including Community Cohesion)

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp would have no direct impacts on desirable community and regional growth of the study area.

Indirect

Indirect impacts of the implementation of the No Action Alternative, not implementing a freshwater diversion into the study area in southeastern Maurepas Swamp, would involve the persistence of existing conditions including continued wetland degradation. This continued wetland loss would have detrimental impacts on fishery and wildlife-related employment in the area, which could consequently impede positive community and regional growth.

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**.

The loss of coastal land could lead to a population shift. In addition, Ascension Parish is projected to grow exponentially in population by 2030 (Louisiana Office of Electronic Services). This expected population growth, in conjunction with a potential population shift, may disrupt community cohesion and affect the attainment of desirable community and regional growth.

Alternative 2

Direct

The implementation of this proposed action would not directly impact community or regional growth of the study area.

Indirect

Implementation of Alternative 2 would serve to protect and enhance essential fish and wildlife habitats. Economic activities dependent upon such habitats, and the fish and wildlife they support would be maintained and possibly increased, thereby potentially spurring community and regional growth.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**. The cumulative impacts of this alternative would be similar to those described for the No Action Alternative with the following exception. The implementation of Alternative 2 would serve to forestall further wetland and habitat deterioration in the study area. Thus, unlike the No Action Alternative, the proposed action would work in conjunction with the other restoration efforts of the region to preserve and enhance natural habitats and coastal lands. The potential population shift as a result of land loss could be lessened, leading to a proportionally lesser degree of undesirable community and regional growth.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.15.6 Tax Revenues and Property Values

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, no freshwater diversion in the southeastern Maurepas Swamp would have no direct impacts on the tax revenues and property values within the study area.

Indirect

The implementation of the No Action Alternative, not implementing a freshwater diversion into the study area in southeastern Maurepas Swamp, could indirectly cause the property value of this area to decline due to the continued degradation of southeastern Maurepas Swamp. Tax revenues within the study area are tied to property value. Property values tend to reflect the quality and condition of nearby amenities. Thus, the recreational and aesthetic resources of a community will impact the assessed value of a property.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**.

Cumulative impacts of the potential diminishment of recreational and aesthetic resources in the study area would be in addition to the loss of recreational and aesthetic resources throughout Louisiana.

In addition, more recent restoration efforts would cumulatively interact to help offset losses of recreational and aesthetic resources in the study area by preserving and enhancing the natural habitats, thereby enabling the continuation and even expansion of existing recreational activities within the study area and the region as a whole.

Thus, the implementation of the No Action Alternative would serve to partially offset the recreation and aesthetic benefits incurred by the restoration projects in the region and thereby could negatively impact localized tax revenues and property values.

Alternative 2

Direct

There would be no direct impacts of Alternative 2 on tax revenues or property values in the study area.

Indirect

The indirect impacts of Alternative 2 could cause the property value of the privately owned parcels to increase, which could in turn increase the tax revenue received by the local governments. This would be due to the proposed action protecting and enhancing the visual aesthetic of the study area and thereby increasing property values.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**. The cumulative impacts of this alternative would be similar to those described for the No Action Alternative with the following exception. The implementation of Alternative 2 would serve to forestall further wetland and habitat deterioration in the study area. Thus unlike the No Action Alternative, this proposed action would work in conjunction with the other restoration efforts of the region to preserve and enhance recreation and aesthetic resources and thereby maintain and perhaps increase property values and tax revenues.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2

5.15.7 Infrastructure

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp would have no direct impacts on infrastructure.

Indirect

Indirect impacts of no freshwater diversion into the southeastern Maurepas Swamp would result in the persistence of existing conditions including impacts related to continue coastal land loss, which would adversely impact infrastructure along and leading to the coastline.

Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**.

Ascension Parish is projected to grow exponentially in population by 2030 (Louisiana Office of Electronic Services). This expected population growth, in conjunction with a potential population shift due to coastal land loss, would lead to greater demand on the existing infrastructure. In addition, the projected continued coast-wide decline of forested wetlands (USGS) would contribute to the deterioration of substrate upon which infrastructure features (e.g., oil, gas and water pipelines and telephone and electric transmission wires) are constructed. The effects of land loss and swamp degradation and conversion to marsh and open water could lead to increased costs for maintaining and repairing existing infrastructure. The loss of storm buffering provided by wetlands (USACE 2009) could result in the need for greater expenditures for maintaining and repairing existing infrastructure. However, these impacts would be somewhat offset by the other restoration projects within the vicinity of the study area.

Alternative 2

Direct

The direct impacts of the implementation of Alternative 2 on the infrastructure within the study area would be the re-establishment of the existing berm cuts, construction of new breaks, and the installation of a transmission canal along the Romeville alignment.

Construction of the infrastructure components associated with this proposed action would serve to bring freshwater into the study area, enabling the preservation and restoration of the existing swamp habitat. No impact to the drainage structures will occur as a result of the project; the diversion flows would be stopped during significant rain events.

Indirect

The proposed action would preserve and enhance the forested wetlands within the study area; thereby decreasing the potential for substrate deterioration, which in turn would reduce the need for the relocation, repair or replacement of existing infrastructure.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**. The cumulative impacts of this alternative would be similar to those described for the No Action Alternative with the following exception. The implementation of Alternative 2 would serve to forestall further wetland and habitat deterioration in the study area, thus unlike the No Action Alternative, this proposed action would work in conjunction with the other restoration efforts of the region to preserve and enhance natural habitats and coastal lands. Thus, the potential population shift as a result of land loss could be lessened, leading to a proportionally lesser demand on the area's infrastructure as well as lessening the potential for substrate deterioration.

Alternative 4

Direct

The direct impacts of this alternative on the infrastructure within the study area would be the re-establishment of the existing berm cuts, construction of new breaks, and the installation of a transmission canal along the South Bridge alignment.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts on the infrastructure within the study area would be the re-establishment of the existing berm cuts, construction of new breaks, and the installation of a transmission canal along the two alignments.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative on the infrastructure within the study area would be the re-establishment of the existing berm cuts, construction of new breaks, and the installation of a transmission canal.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

U.S. Geological Survey, Marine and Coastal Geology Program. Louisiana Coastal Wetlands: A Resource at Risk. Accessed: http://marine.usgs.gov/fact-sheets/LAwetlands/lawetlands.html

5.15.8 Environmental Justice

No Action Alternative (Future without Project Conditions)

Direct

Minority and/or low-income communities have been identified in the study area of St. James Parish. In a future without project conditions, no anticipated disproportionately high or adverse human health or environmental effects on minority or low-income populations would occur, as no property would be acquired for construction of the proposed diversion within the study area and no construction activities would occur

Indirect

No disproportionately high or adverse human health or environmental indirect impacts on minority or low-income populations would occur.

Cumulative

There would be no cumulative impacts on minority and/or low-income communities within the study area per 2000 U.S. Census information and requirements of E.O. 12898. The No-Action Alternative would not contribute to any additional EJ issues when combined with other Federal, state, local, and private restoration efforts.

Alternative 2

Direct

Minority populations have been identified within the study area of St. James Parish, per 2000 U.S. Census information and requirements of E.O. 12898, this area should be considered for further public outreach efforts for Environmental Justice. Direct impacts from construction activities such air quality, noise, traffic, safety, etc. would occur. As there are no permanent residences along the Romeville alignment, no direct impacts on human health or environmental effects are expected for Alternative 2 (Recommended Plan)

Indirect

Under Alternative 2 (Recommended Plan) no indirect impacts on human health or environmental effects within the study area would occur.

Cumulative

While there are minority and/or low-income communities in the project vicinity, none have been identified within the proposed Romeville alignment per 2000 U.S. Census information and requirements of E.O. 12898. Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in Section 5.1.2. The cumulative impacts of Alternative 2 would be similar to those described for the No Action Alternative, however, further public outreach efforts should be made per requirements of E.O. 12898.

Alternative 4

Direct

Minority populations have been identified within the study area of St. James Parish, per 2000 U.S. Census information and requirements of E.O. 12898, this area should be considered for further public outreach efforts for Environmental Justice. Direct impacts from construction activities such as property acquisition, air quality, noise, traffic, safety, etc. would occur. With the exception of property acquisition, the concern for the aforementioned construction activities would be temporary in nature (no more than 12-24 months) and would have minimal, if any, disproportionately high or direct adverse human health or environmental impacts on minority and/or low income communities. Property acquisition may have a potential disproportionate impact on community cohesion should residents choose to relocate outside of the existing community. In order to minimize potential direct impacts to community cohesion, only 3 houses would be directly impacted from implementing the proposed action.

Indirect

No disproportionately high or adverse human health or environmental indirect impacts on minority and/or low-income populations would occur.

Cumulative

There may be synergistic cumulative impacts of implementing Alternative 4 on minority and/or low-income communities within the study area per 2000 U.S. Census information and requirements of E.O. 12898. These impacts would be the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in Section 5.1.2. The LCA Convent/Blind River project would contribute toward achieving and sustaining a coastal ecosystem that can support and protect the environment, local economy and culture of the region. Further public outreach efforts should be made per requirements of E.O. 12898.

Alternative 4B
Direct

Direct impacts of Alternative 4B would be similar to Alternative 4.

Indirect

Indirect impacts of Alternative 4B would be similar to Alternative 4.

Cumulative

Cumulative impacts of Alternative 4B would be similar to Alternative 4.

Alternative #6

Direct

Direct impacts of Alternative 6 would be similar to Alternative 4.

Indirect

Indirect impacts would be similar to Alternative 4.

Cumulative

Cumulative impacts would be similar to Alternative 4.

5.15.9 Navigation

No Action Alternative (Future without Project Conditions)

Direct

Under the No Action Alternative, no freshwater diversion into the study area in southeastern Maurepas Swamp, there would be no direct impacts to navigation in the Mississippi River, Blind River or connecting waters and tributaries in the study area.

Indirect

Under the No Action Alternative, no freshwater diversion into the study area in southeastern Maurepas Swamp, there would be no indirect impacts to navigation in the Mississippi River, Blind River or connecting waters and tributaries in the study area.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative with the additive combination of wetland loss and increased runoff due to increasedurbanization, as well as the benefits and impacts of other state and federal projects in the vicinity, as detailed in **Section 5.1.2**.

Alternative 2

Direct

The direct impacts of Alternative 2 include impediments to boat traffic on the parish canals. This impact would only occur when the control structures are in use. When the control structures are down, there would be no direct impacts to navigation. Direct impacts to navigation on the Lower Mississippi River are not anticipated per coordination with the USCG.

Indirect

There would be no indirect impacts of Alternative 2 on navigation.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative with the additive combination of wetland loss and increased runoff due to increased urbanization, as well as the benefits and impacts of other state and federal projects in the vicinity, as detailed in **Section 5.1.2**.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.15.9.1 Land Use Socioeconomics

5.15.9.2 Agriculture

No Action Alternative (Future without Project Conditions)

Direct

Under the No Action Alternative (), no direct impacts to agriculture would occur.

Indirect

Under the No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp, no indirect impacts to agriculture would occur.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative with the additive combination of wetland loss and increased runoff due to increased urbanization of the Pontchartrain Basin, as well as the benefits and impacts of other state and federal projects in the vicinity, as detailed in **Section 5.1.2**.

Alternative 2

Direct

Direct impacts to agriculture would include the loss of a small amount of land currently in agricultural production along the diversion route.

Indirect

There would be no indirect impacts of Alternative 2 on agriculture.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative with the additive combination of wetland loss and increased runoff due to increased urbanization of the Pontchartrain Basin, as well as the benefits and impacts of other state and federal projects in the vicinity, as detailed in **Section 5.1.2**.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 with the following exceptions. The loss of agricultural land associated with the construction of the South Bridge diversion would be added.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 4.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative
The cumulative impacts of this alternative would be similar to those described for Alternative 4.

5.15.9.3 Forestry

No Action Alternative (Future without Project Conditions)

Direct
Under the No Action Alternative (no freshwater diversion into the southeastern Maurepas Swamp), no direct impacts to forestry resources would occur.

Indirect
Under the No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp adverse indirect impacts would occur as a result of the continued degradation in the quality and quantity of the trees within the study area and vicinity, greatly reducing the potential for forestry activities. Conversion of forested swamp to marsh and open water would likely preclude the study area from future forestry activities.

Cumulative
Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of coastwide forest loss and degradation, as well as the benefits and impacts of other state and federal projects in the vicinity, as detailed in **Section 5.1.2**. Other restoration efforts would change the acreage of merchantable timber through the CIAP Baldcypress/Tupleo Coastal Forest Protection; Pontchartrain Basin would remove 1,762 acres from potential forestry activities.

Alternative 2

Direct
The direct impacts of the Alternative 2 include the loss of a small amount forested wetland due to the construction of the Romeville diversion.

Indirect
The indirect impacts of alternative 2 include wetland preservation and increased productivity which would benefit forest resources in the study area.

Cumulative
Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of wetland restoration and preservation, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. The cumulative impacts of Alternative 2 with other diversion projects include wetland building processes that would prevent forested

wetland degradation and increases in productivity that would increase canopy cover.

Alternative 4

Direct

The direct impacts of the Alternative 4 include the loss of a small amount forested wetland due to the construction of the South Bridge diversion which would be more extensive than Alternative 2 due to the longer length of the transmission canal.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2 with the additive direct impacts of Alternative 4.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 4.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.15.9.4 Public Lands

No Action Alternative (Future without Project Conditions)

Direct

Under the No Action Alternative, no freshwater diversion into the southeastern Maurepas Swap, no direct impacts to public lands would occur.

Indirect

Under the No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp, adverse indirect impacts could occur as a result of swamp degradation and conversion to fresh marsh open water. Continued degradation would limit the capacity of Maurepas Swamp WMA to continue to provide existing services. Specifically, continued degradation and conversion to open water would drastically reduce fish and wildlife habitat, abundance and diversity. Recreational activities, such as hunting and fishing, would be negatively impacted by decreased abundance of game animals and fisheries, as would access to this public land.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**.

Cumulative impacts of the potential diminishment of public land resources in the study area would be in addition to the loss of public land throughout Louisiana. The LCA Study (LCA 2004) estimated coastal Louisiana would continue to lose land at a rate of approximately 6,600 acres per year (2,671 ha/year) over the next 50 years. It is estimated that an additional net loss of 328,000 acres (132,737 ha) may occur by 2050, which is almost 10 percent of Louisiana's remaining coastal wetlands. However, these wetland losses in the Louisiana study area would be offset to some extent by other Federal, state, local, and private restoration efforts as described in the 2004 LCA Report (Table 4-2).

In addition, more recent restoration efforts would also cumulatively interact to help offset losses of public land resources in the study area by preserving and enhancing the natural habitats, thereby enabling the continuation and even expansion of existing recreational activities and public land access within the study area and the region as a whole.

Alternative 2

Direct

There would be no direct impacts of Alternative 2 on public lands.

Indirect

The indirect impacts of Alternative 2 include the preservation of public lands due to the diversion slowing or reversing the trend of swamp degradation and habitat conversion in the study area. Thus, the capacity of the Maurepas Swamp WMA to provide existing services would be enhanced.

Cumulative

Cumulative impacts would be the synergistic effect of Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private restoration efforts as summarized in **Section 5.1.2**. The cumulative impacts of this alternative would be similar to those described for the No Action Alternative with the following exception. The implementation of Alternative 2 would serve to forestall further wetland and habitat deterioration in the study area, thus unlike the No Action Alternative, this proposed action would work in conjunction with the other restoration efforts of the region to preserve and enhance the public lands within the area.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described in Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described in Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.15.10 Water Use and Supply

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp, would have no direct impacts on water use and supply.

Indirect

Under the No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp, indirect impacts would include continued increases in the salinity of Lake Maurepas and Lake Pontchartrain, which currently serve as a minor surface water supply source for Ascension Parish. Increased salinity levels may render this supply source unsuitable for water uptake.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on water supply and use with the additive combination of similar wetland degradation and wetland loss impacts to sediment throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. The increase in salinity in Lake Maurepas would be offset to some extent by the decreases in salinity caused by other diversion projects in the region.

Alternative 2

Direct

There would be no direct impacts of Alternative 2 on water use and supply.

Indirect

Indirect impacts of Alternative 2 on water use and supply include decreases in the salinity of Lake Maurepas which currently serves as a minor surface water supply source for Ascension Parish. Decreases in salinity would benefit this water supply.

Cumulative

Cumulative impacts would be the synergistic effect of implementing this alternative with the additive combination of impacts and benefits for overall nets acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. Cumulative impacts include decreases in salinity in Lake Maurepas and Pontchartrain from this and other diversion and restoration projects.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2

5.15.11 Man-Made Resources

5.15.11.1 Oil, Gas, Utilities

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, not implementing a freshwater diversion into the Study Area in southeastern Maurepas Swamp, would have no direct impacts on oil, gas, and utilities pipelines.

Indirect

Indirect impacts of not implementing a diversion would result in the persistence of existing conditions including swamp degradation, increased flood duration, and elevated stage levels. The effects of land loss and degradation could lead to increased costs for maintaining and repairing existing infrastructure in the Study Area.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on oil, gas, and utilities pipelines with the additive combination of similar oil, gas, and utilities pipeline impacts from wetland loss and degradation throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal projects in the vicinity. The projected continued coastwide decline of forested wetlands would contribute to the deterioration of substrate upon which oil, gas, and utilities (e.g., water pipelines, telephone, electric transmission wires, and other) are constructed. The loss of storm buffering provided by wetlands could result in the need for greater expenditures for maintaining and repairing existing infrastructure (USACE 2009). However, these impacts would be somewhat offset by other state and Federal restoration projects within the vicinity of the Study Area.

The impacts of the Deepwater Horizon oil spill on coastal Louisiana are uncertain at this time. The impacts of the oil spill as well as the various emergency actions taken to address oil spill impacts (e.g., use of oil dispersants, creation of sand berms, use of Hesco baskets, rip-rap, sheet piling and other actions) could potentially impact USACE water resources projects and studies within the Louisiana coastal area. Potential impacts could include factors such as changes to existing, future-without, and future-with-project conditions, as well as increased project costs and implementation delays. The USACE will continue to monitor and closely coordinate with other Federal and state resource agencies and local sponsors in determining how to best address any potential problems associated with the oil spill that may adversely impact project implementation. Supplemental planning and environmental documentation may be required as information becomes available. If at any time petroleum or crude oil is discovered on project lands, all efforts will be taken to seek clean up by the responsible parties, pursuant to the Oil Pollution Act of 1990 (33 U.S.C. 2701 et seq.).

Ongoing documentation of the impacts associated with the Deepwater Horizon Oil spill can be found in several governmental sources. The USFWS Situation Report for August 2, 2010

(http://www.fws.gov/home/dhoilspill/pdfs/MondayAugust22010.pdf)

indicates the following environmental-related Deepwater Horizon oil spill information: 563 personnel are actively engaged in the response, working to protect wildlife and their habitats, including 36 national wildlife refuges. They are also assessing the damage from the oil spill in preparation for the work that will be needed to restore the Gulf of Mexico. Some 1,643 visibly oiled birds have been collected alive by the U.S. Fish and Wildlife Service, the states and our partners in response to the Deepwater Horizon oil spill.

- Overall number of personnel responding: approximately 30,100
- Total vessels responding: more than 4,500
- Total boom deployed: more than 2,155 miles
- Boom available: more than 856 miles
- Oily water recovered: more than 34.7 million gallons
- Estimated 11.14 million gallons of oil burned
- Estimated total of more than 1.84 million gallons of dispersant used including:
  - Estimated more than 1.07 million gallons surface dispersant used
  - Estimated more than 771,000 gallons of sub-sea dispersant used:
- Estimated approximately 632 miles of Gulf Coast shoreline is currently oiled—approximately 365 miles in Louisiana, 111 miles in Mississippi, 68 miles in Alabama, and 88 miles in Florida.

As is evident from the numerous ongoing actions, the dynamic nature of the impacts associated with the Deepwater Horizon oil spill will likely require additional consideration in the near future for USACE Civil Works projects.

Alternative 2

Direct

There would be no direct impacts of Alternative 2 on oil, gas, and utilities.

Indirect

The indirect impacts of Alternative 2 include preventing the deterioration of substrate upon which oil, gas, and utilities are constructed associated with sediment inputs from the diversion. This would also provide better protect of the pipelines during future storm surge events.

Cumulative

Cumulative impacts would be the synergistic effect of implementing this alternative with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. Cumulative impacts include the regional prevention of land subsidence and protection from storm surge.

Alternative 4

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 6

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

Alternative 4B

Direct

The direct impacts of this alternative would be similar to those described for Alternative 2.

Indirect

The indirect impacts of this alternative would be similar to those described for Alternative 2.

Cumulative

The cumulative impacts of this alternative would be similar to those described for Alternative 2.

5.16 Flood Control and Hurricane Protection

No Action Alternative (not implementing a freshwater diversion into the study area in southeastern Maurepas Swamp)

Direct

Under the No Action Alternative (no freshwater diversion into the southeastern Maurepas Swamp), there would be no direct impacts to flood control and hurricane protection.

Indirect

Under the No Action Alternative (no freshwater diversion into the southeastern Maurepas Swamp), there would be a continued degradation of coastal forest habitat within the study area. Forested wetlands provide some unknown level of hurricane and tropical storm abatement (USACE 2009). Consequently, there could be an increase in storm surge and risk of flooding due to coastal land loss. As populations continue to migrate to coastal communities, increasing investments in hurricane and flood control levees, pump stations, and other flood control facilities would be required.

Cumulative

Cumulative impacts would include the continued degradation of wetlands, which may result in localized storm surge and increased wave heights offset to some undeterminable extent by the benefits and impacts of other state and federal projects in the vicinity, as detailed in **Section 5.1.2**.

Alternative 2

Direct

The direct impacts of Alternative 2 include the construction of a temporary levee during the construction of the intake structure and placement of a culvert in the existing east levee. After construction is complete, the levee will be restored to the previous functional dimensions.

Indirect

The indirect impacts from Alternative 2, increasing the productivity and health of the Maurepas Swamp, could provide buffering capacity against future storm surge, as suggested by current research (e.g., USACE, 2009). The extent to which storm surge protection would be provided is uncertain. In swamp management measures (i.e., berm cuts) would help distribute water throughout the swamp and lower water levels, and combined with increased swamp building, would minimize the risk of impairment to adjacent drainage ditches due to rising water levels.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on flood control and hurricane protection as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. Construction of the St. James Hurricane Protection Levee in its current alignment would provide significant protection to human and environmental resources within the study area.

Alternative 4

Direct

Direct impacts would be similar to Alternative 2.

Indirect

Indirect impacts would be similar to Alternative 2.

Cumulative

Cumulative impacts would be similar to Alternative 2.

Alternative 6

Direct

There would be no direct impacts of Alternative 6 on flood control and hurricane protection.

Indirect

Indirect impacts would be similar to Alternative 2.

Cumulative

Cumulative impacts would be similar to Alternative 2.

Alternative 4B

Direct

Direct impacts would be similar to Alternative 2.

Indirect

Indirect impacts would be similar to Alternative 2.

Cumulative

Cumulative impacts would be similar to Alternative 2.

5.17 Natural Resources

5.17.1 Commercial Fisheries

No Action Alternative (not implementing a freshwater diversion into the study area in southeastern Maurepas Swamp)

Direct

The No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp , would have no direct impacts on commercial fisheries.

Indirect

Indirect impacts would result in the persistence of existing conditions including the continued conversion of existing wetlands to open water habitats, restricted water circulation, and decreased water quality. The Coast 2050 Report (LCWCRTF & WCRA, 1999) does not predict that coastal wetland loss will impact most commercially important species within the Upper Pontchartrain Basin, projecting stable populations of blue crab and channel catfish to 2050; historical and future population trends for Gulf menhaden were unknown.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on commercial fisheries with the additive combination of coastwide fishery habitat losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**. Sharp declines are predicted in Louisiana fisheries productivity with wetland habitat loss (USACE, 2004). It is estimated that over 75 percent of Louisiana's commercially harvested fish and shellfish populations are dependent on coastal wetlands during at least some portion of their life cycle. Globally, overfishing and habitat change has resulted in the depletion of 90% of the world's seafood resources, with 38% of the species studied experiencing greater than 90% depletion, and 7% becoming extinct (Worm et al., 2006). This trend is expected to continue under the No Action Alternative. Regional benefits to commercial fisheries would be provided by other restoration projects in the area to a lesser extent than under the action alternative.

Alternative 2

Direct

There would be no direct impacts of Alternative 2 on commercial fisheries.

Indirect

Indirect impacts of Alternative 2 would be increases in fisheries productivity due to increased nutrient inputs and wetland building processes. Commercial fisheries would benefit in the long term through augmentation of food webs and increasing larval fish habitat (Caffey and Schexnayder 2002). Short term declines in some commercial fisheries may occur due to displacement.

Cumulative

Cumulative impacts would be the synergistic effect of implementing Alternative 2 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts as summarized in **Section 5.1.2**. The benefits of other diversion projects in the area will also increase productivity which would benefit commercial fisheries in the long term. These projects will result in positive cumulative impacts on commercial fishery in the Lake Pontchartrain Basin. Overall increases in commercial fisheries will be not be spatially localized to individual project areas due to migration of fish within the basin.

Alternative 4

Direct

Direct impacts would be similar to Alternative 2.

Indirect

Indirect impacts would be similar to Alternative 2.

Cumulative

Cumulative impacts would be similar to Alternative 2.

Alternative 6

Direct

Direct impacts would be similar to Alternative 2.

Indirect

Indirect impacts would be similar to Alternative 2.

Cumulative

Cumulative impacts would be similar to Alternative 2.

Alternative 4B

Direct

Direct impacts would be similar to Alternative 2.

Indirect

Indirect impacts would be similar to Alternative 2.

Cumulative

Cumulative impacts would be similar to Alternative 2.

5.17.2 Oyster Leases

No Action Alternative (Future without Project Conditions)

Direct

The No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp, would have no direct impacts on oyster leases.

Indirect

There would be no indirect impacts of the No Action Alternative on oyster leases.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on oyster leases with the additive combination of coastwide fishery habitat losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.2**.

Alternative 2

Direct

There would be no direct impacts of Alternative 2 on oyster leases.

Indirect

There would be no indirect impacts of Alternative 2 on oyster leases.

Cumulative

There would be no cumulative impact of Alternative 2 on oyster leases.

Alternative 4

Direct

Direct impacts would be similar to Alternative 2.

Indirect

Indirect impacts would be similar to Alternative 2.

Cumulative

Cumulative impacts would be similar to Alternative 2.

Alternative 6

Direct

Direct impacts would be similar to Alternative 2.

Indirect

Indirect impacts would be similar to Alternative 2.

Cumulative
Cumulative impacts would be similar to Alternative 2.

Alternative 4B
Direct
Direct impacts would be similar to Alternative 2.

Indirect
Indirect impacts would be similar to Alternative 2.

Cumulative
Cumulative impacts would be similar to Alternative 2.

5.18 Hazardous, Toxic, and Radioactive Wastes

*[Phase I ESA Findings-**Appendix M**]*

No Action Alternative (not implementing a freshwater diversion into the study area in southeastern Maurepas Swamp)

Direct
The condition with the No Action Alternative, not implementing a freshwater diversion into the study area in southeastern Maurepas Swamp, regarding the potential for HTRW is dependent on site-specific HTRW discovery. Based on previous HTRW research in the study area, and investigations for the present study, the potential to encounter HTRW is low in most of the study area. During the database search, one underground storage tank was identified adjacent to the South Bridge transmission canal route. Site access to some of the properties along this diversion route was pending as of the date the Phase I ESA was finalized and there for has not been completed in this area. A Phase I ESA has found the No Action Alternative, not implementing a freshwater diversion into the study area in southeastern Maurepas Swamp, would have no direct impacts on HTRW in the distribution area and the Romeville transmission canal route.

Indirect
The No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp, would have no indirect impacts on HTRW in the distribution area and the diversion at Romeville.

Cumulative
The No Action Alternative, no freshwater diversion into the southeastern Maurepas Swamp, would have no cumulative impacts on HTRW in the distribution area and the diversion at Romeville.

Alternative 2

Direct

Consistent with ER 1165-2-132, an HTRW investigation of the study area was conducted. Based upon findings from this investigation, the potential for direct impacts to the study area from implementation of Alternative 2 would be low.

Indirect

Consistent with ER 1165-2-132, an HTRW investigation of the study area was conducted. Based upon findings from this investigation, the potential for indirect impacts to the study area from implementation of Alternative 2 would likely continue to be low into the future.

Cumulative

Consistent with ER 1165-2-132, an HTRW investigation of the study area was conducted. Based upon findings from this investigation, the potential for cumulative impacts to the study area from implementation of Alternative 2 would likely continue to be low into the future.

Alternative 4

Direct

The direct impacts would be similar to those described in Alternative 2 with the following exceptions. During the database search, one underground storage tank was identified adjacent to the South Bridge transmission canal route. Site access to some of the properties along this diversion route was pending as of the date the Phase I ESA was finalized and therefore has not been completed in this area.

Indirect

The indirect impacts would be similar to those described in Alternative 2 with the following exceptions. During the database search, one underground storage tank was identified adjacent to the South Bridge transmission canal route. Site access to some of the properties along this diversion route was pending as of the date the Phase I ESA was finalized and therefore has not been completed in this area.

Cumulative

The cumulative impacts would be similar to those described in Alternative 2 with the following exceptions. During the database search, one underground storage tank was identified adjacent to the South Bridge transmission canal route. Site access to some of the properties along this diversion route was pending as of the date the Phase I ESA was finalized and therefore has not been completed in this area.

Alternative 6

Direct

The direct impacts would be similar to those described in Alternative 4.

Indirect

The indirect impacts would be similar to those described in Alternative 4.

Cumulative

The cumulative impacts would be similar to those described in Alternative 4.

Alternative 4B

Direct

The direct impacts would be similar to those described in Alternative 4.

Indirect

The indirect impacts would be similar to those described in Alternative 4.

Cumulative

The cumulative impacts would be similar to those described in Alternative 4.

5.19 Unavoidable Adverse Effects

Wetland impacts were avoided and minimized to the extent possible in the preliminary design of the Recommended Plan. With avoidance and minimization of wetland impacts the Recommended Plan would have 53 acres (21 ha) of unavoidable wetland impacts due to construction of the Romeville diversion canal. Construction of the Romeville diversion canal is the best way to divert water from the Mississippi River to southeastern Maurepas Swamp. The wetlands that will be impacted by construction of the Romeville canal are not part of Maurepas Swamp (that will be improved). The improvement of 21,369 acres (8,648 ha) of this baldcypress-tupelo swamp, that are in various stages of deterioration, will mitigate for the wetland impacts resulting from construction of the Romeville diversion canal. There would be no other unavoidable adverse impacts as a result of the implementation of reasonable alternatives for this project.

5.20 Relationship of Short-Term Uses and Long-Term Productivity

NEPA Section 102(2)(c)(iv) and 40 CFR 1502.16 require that an EIS include a discussion of the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. This section describes how the Proposed Action would affect the short-term use and the long-term productivity of the environment.

In reference to the Proposed Action, "short-term" refers to the temporary phase of construction of the proposed project, while "long-term" refers to the operational life of the proposed project and beyond. Section 3 of this document evaluates the direct, indirect and cumulative effects that could result from the Proposed Action.

Construction of the Proposed Action would result in short-term construction-related impacts within parts of the project area and would include to some extent interference with local traffic, minor limited air emissions, increases in ambient noise levels, dust generation, disturbance of wildlife, increased storm runoff, and disturbance of recreational and other public facilities. These impacts would be temporary and would occur only during construction, and are not expected to alter the long-term productivity of the natural environment.

The Proposed Action would assist in the long-term productivity of the Blind River and Maurepas Swamp ecological community by improving the water quantity, water quality, nutrients, and sediments. This in turn will facilitate the growth of the swamp and specifically baldcypress and tupelo trees. The Proposed Action would also result in enhancing the long-term productivity of the natural communities throughout the region. These long-term beneficial effects of the Proposed Action would outweigh the minimal and mitigable short-term impacts to the environment resulting primarily from project construction.

5.21 Irreversible and Irretrievable Commitments of Resources

NEPA requires that environmental analysis include identification of “any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.” Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the use of these resources have on future generations. Irreversible effects primarily result from use or destruction of a specific resource (e.g., energy and minerals) that cannot be replaced within a reasonable time frame. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action (e.g., extinction of a threatened or endangered species or the disturbance of a cultural site). The proposed project would result in few direct and indirect commitments of resources; these would be related mainly to construction components. For the proposed alternatives, most resource commitments are neither irreversible nor irretrievable. Most impacts are short term and temporary. Others that may have a longer effect can be reduced through appropriate measures. There is no irreversible or irretrievable commitment of resources which would preclude formulation or implementation of reasonable alternatives for this project.

5.22 Mitigation

Compensatory mitigation is not needed for this project. Wetland impacts were avoided and minimized to the extent possible in the preliminary design of the Recommended Plan. The Recommended Plan will impact 53 acres (21ha) of wetlands with construction of the Romeville diversion canal. The wetlands that will be impacted are not part of Maurepas Swamp (that will be improved). The improvement of 21,369 acres (8,648 ha) of this baldcypress-tupelo swamp, that are in various stages of deterioration, will mitigate for the wetland impacts resulting from construction of the Romeville diversion canal.

5.23 Environmental Consequences Summary

The environmental analysis evaluates and compares, from a qualitative and quantitative perspective, the alternative plans and the No Action Alternative carried over for detailed analysis. Impact analysis described is based on a combination of scientific and engineering analyses, professional judgment, and previously compiled information.

The impacts of the No Action Alternative, not implementing the diversion, would result in the persistence of existing conditions, including a limited ability to drain and persistent flooding that conflict with historic drying cycles in the swamp, short circuiting of the natural drainage patterns, ponding and stagnant waters in some areas, and minimal contribution and circulation of nutrients and sediments in the swamp. Blind River and Maurepas Swamp would continue to deteriorate. Maurepas Swamp and Blind River have been virtually cut off from periodic overflows from the Mississippi River that brought freshwater, sediment and nutrients to the swamp. Minimal soil building and moderately high subsidence rates that resulted in a net lowering of ground surface elevation would continue and the swamp will continue to be persistently inundated. The limited ability to drain and the persistent flooding that exists in the swamp would continue. Under the existing conditions the frequency of dry out conditions (water levels below 0.5 ft) would occur only 1 percent of the time. This occurrence would limit seedling survival and recruitment. The sediment deficit has and would continue to result in both subsidence and a disruption of natural processes that promote productivity and diversity in the swamp ecosystem. Increases in relative sea level due to continued subsidence and sea level rise would continue to extend flood duration and elevate flood stage within Maurepas Swamp, accompanied by impoundment of hypoxic, nutrient-deficient water.

Additionally under the No Action Alternative there would be a gradual conversion of existing forested wetlands to severely degraded and fragmented swamp forest habitats. Based on the habitat condition classes for the study area (20-30 years to marsh and 30-50 years to marsh), this includes the conversion of 11,228 acres of forested swamp to marsh. As interior forested wetlands convert to marsh and open water, there would be an expected loss of habitat for species dependent on swamp forest habitat.

Under the No Action Alternative, the current water quality conditions would persist; wetlands would still be affected by natural and man-made factors that would have both beneficial and detrimental effects on water quality conditions. Existing wetland communities would continue to diminish. Increased impoundment and limited circulation due to limited freshwater inputs and relative sea level rise would continue to result in anoxic conditions, detrimental to fish and other aquatic organisms. Other diversion projects would work to offset some of the changes in water quality such as decreases in DO and nutrients. Because of the spatial separation between these diversion projects and the Blind River/Maurepas Swamp, the effects of these diversion projects on the study area may be minimal.

Impacts of Alternative 2 on water quality would be the persistence of changes to water quality due to the diversion over time. For Alternative 2, the estimated percent load reduction for nitrate and TN ranged from 82-96% and 50-65%, respectively. The percent load reduction for TP ranged from 19-32%. These values are a little less than removal efficiency estimates provided by Day et al. (2006), that were based on Lane et al. (2003), which were 73% for TN and 43% for TP for removal efficiency as a function of loading rates for data from both Mississippi River diversions and wetland wastewater treatment systems. The loading rates evaluated for nitrate, TN, and TP were 18-34 g-N/m2/yr, 24-45 g-N/m2/yr, and 2-4 g-P/m2/yr, respectively, and were greater than the loading rates presented by Day et al. (2006). The lower removal efficiency estimates reflect the fact that maximum removal efficiency occurs at low loading rates and decreases at higher loading rates. Wetlands also provide assimilation of metals. Increased delivery of freshwater to the swamp will also increase circulation and dissolved oxygen levels in the swamp and in Blind River. Impacts of Alternative 4 would be similar to those described for Alternative 2. However, for Alternative 4 estimates of the percent load reduction for nitrate and TN ranged from 89-98% and 56-70%, respectively. The percent load reduction for TP ranged from 23-40%. The loading rates for nitrate, TN, and TP ranged from 14-27 g-N/m2/yr, 18-35 g-N/m2/yr, and 2-3 g-P/m2/yr, respectively. Impacts of Alternative 6 would be similar to those described for Alternative 2. However, for Alternative 6 estimates of the percent load reduction for nitrate and TN ranged from 85-97% and 52-66%, respectively. The percent load for TP ranged from 20-34%. The loading rates for nitrate, TN, and TP ranged from 17-32 g-N/m2/yr, 22-41 g-N/m2/yr, and 2-4 g-P/m2/yr, respectively. Impacts of Alternative 4B would be similar to those described for Alternative 2. However, for Alternative 4B estimates of the percent load reduction for nitrate and TN ranged from 86-97% and 53-67%, respectively. The percent load reduction for TP ranged from 21-34%. The loading rates for nitrate, TN, and TP ranged from 17-31 g-N/m2/yr, 22-40 g-N/m2/yr, and 2-4 g-P/m2/yr, respectively.

Direct impacts of Alternative 2 include 106.9 acres of permanent impact to prime and unique farmland based on NRCS data. These areas would be loss due to the construction of the Romeville Transmission Pathway. The direct impact of Alternative 2 on sedimentation and erosion would include increases in sediment in the Blind River and Maurepas Swamp. Based on estimates from a 3,000 cfs diversion supplying 16 kg/s of sediment continuously throughout the year, the annual estimate of sediment load to Blind River and Maurepas Swamp would be approximately 505,000,000 kg/yr. Because the diversion would not be operated continuously, this estimate is higher than the sediment load under the likely diversion operation schedule. There would be construction impacts to approximately 53 acres (21 ha) of forested wetland along the transmission canal.

The indirect impacts of Alternative 2 include increased hydrologic connectivity throughout the system. Excavation of berm gaps would increase the flow of water out of the swamp and reduce water levels during low stage periods in Lake Maurepas, at which time diversion inflow would be halted. Under this alternative, the frequency of dry out conditions necessary for tree seedling survival (water levels below 0.5 feet) would occur 23 percent of the time. This would allow for increased recruitment of baldcypress and water tupelo. Additionally, pulsing of the system would enhance productivity and nutrient assimilation in the swamp and thereby improve water quality in Blind River. Increased delivery of freshwater to the swamp will provide nutrients and sediments to the swamp that will enhance productivity and accretion (swamp building). It will also increase circulation of water in the swamp and in Blind River and prevent backflow of saline waters from Lake Maurepas. Swamp building (accretion) would approximately offset subsidence and eustatic sea level rise. Indirectly, this process would minimize the further degradation of wetland vegetation resources in the distribution area due to impoundment and support increased productivity. By maintaining relatively lower water levels in the study area, an increase would be realized in the probability of baldcypress and water tupelo seedling survival, recruitment, and thus forest stability. Forest productivity would also increase substantially due to the greater frequency of periodic drawdown and flow through the system. Drawdown would create opportunities for baldcypress and water tupelo germination and growth. Flow through of diverted water would facilitate seed dispersal. An increase in nutrient availability and productivity would indirectly increase wetland plant resistance to and recovery from herbivore, parasite, disease, and other damage. Importantly, diverted water would also reduce the probability of damage to wetland vegetation resources caused by backflow of saline waters from Lake Maurepas. An increase in forest health would sustain and increase the relatively high basal areas observed throughout most of the study area, which indirectly would reduce the risk of windthrow damage to midstory and understory wetland plants in storms events (Shaffer et al. 2007; personal communication, Dr. Gary Shaffer, 2009).

The Wetland Value Assessment Methodology swamp Model (WVA) was used to contrast the effects of each alternative on wetland vegetation resources within the distribution area over the 50-year project life. Model runs were based on assumptions derived from trends discussed above, field sampling efforts in the study area and Maurepas Swamp, hydrologic modeling, and mapping of habitat conditions in the distribution area. Alternative 2 would provide benefits to approximately 21,369 acres (8,648 ha) of forested wetland. Under the WVA methodology, this alternative would yield a net gain of 6,421 average annual habitat units (AAHUs) over the No Action Alternative.

The direct and indirect impacts of Alternative 4 would be similar to those described for Alternative 2 with the following exceptions. There would be 121.7 acres of impacts to prime and unique farmland and approximately 271 acres (110 ha) of forested wetlands due to the construction of the Sunshine Bridge Transmission Pathway. Under this alternative, the frequency of dry out conditions necessary for tree seedling survival (water levels below 0.5 feet) would occur 20 percent of the time. Additionally, Alternative 4 would provide benefits to approximately 21,206 acres (8,582 ha) of forested wetland. Under the WVA methodology, this alternative would provide a net gain of 6,124 AAHUs over the No Action Alternative.

The direct and indirect impacts of Alternative 6 would be similar to those described for Alternative 2 with the following exceptions. There would be a total of 228.6 acres of impacts to prime and unique farmland and impacts to approximately 287 acres (116 ha) of forested wetland due to the construction of dual transmission pathways. Under this alternative, the frequency of dry out conditions necessary for tree seedling survival (water levels below 0.5 feet) would occur 19 percent of the time. Additionally, Alternative 6 would provide benefits to approximately 21,243 acres (8,597 ha) of forested wetland. Under the WVA methodology, this alternative would provide a net gain of 7,114 AAHUs over the No Action Alternative.

The direct and indirect impacts of Alternative 4B would be similar to those described for Alternative 2 with the following exceptions. There would be construction impacts to approximately 306 acres (124 ha) of forested wetland along the transmission canal. Under this alternative, the frequency of dry out conditions necessary for tree seedling survival (water levels below 0.5 feet) would occur 19 percent of the time. Additionally, Alternative 4B would provide benefits to approximately 21,243 acres (8,597 ha) of forested wetland. Under the WVA methodology, this alternative would provide a net gain of 7,103 AAHUs over the No Action Alternative.

6.0 PUBLIC INVOLVEMENT*

6.1 NEPA Scoping

A Notice of Intent to prepare a SEIS for the Small Diversion at Convent/Blind River, Louisiana, was published on December 22, 2008, in the Federal Register (Volume 73, Number 246, Pages 78339-78340).

A project kick-off meeting was held on December 4, 2008 and a public scoping meeting was organized and hosted in accordance with NEPA on February 12, 2009. Public meeting announcements were published on January 31, 2009 and February 7, 2009 in the Times-Picayune, on January 30, 2009 in the Baton Rouge Advocate, on February 2, 2009 in the Lutcher News-Examiner, and on February 4, 2009 in the Vacherie Enterprise. The public notice was mailed to the stakeholder and NEPA mailing list for New Orleans District on January 7, 2009. Scoping meeting notices were also placed on the website http://www.lca.gov/Convent.aspx.

The scoping comment period began with the filing of the Notice of Intent and continues through release of the DSEIS for public comment. A Public scoping meeting was held on February 12, 2009 in Convent, Louisiana. Approximately 36 stakeholders attended. A total of 83 comments were received during the comment period; 12 multi-part comments were expressed at the scoping meetings and 10 multi-part written (letter, fax and email) and verbal comments were received during the comment period.

Comments were evaluated for recurring themes to gain an understanding of the key issues to address in the DSEIS.

The comments were categorized according to their applicability to the DSEIS. DSEIS categories include: Purpose and Need; Alternatives; Affected Environment; Environmental Consequences; and Consultation, Coordination, and Compliance with Regulations. An individual scoping comment may be categorized under more than one DSEIS subject matter heading, but no one comment was assigned to more than three categories.

Purpose and Need – The most common comment received indicated great support for the project. "Very much in favor of this project, with a number of us on the state level in favor also." Several respondents stressed the urgency of project implementation. "I've watched this area degrade over the years and to me this project can't happen quick enough."

Alternatives – Concerns related to baldcypress regeneration and management of local hydrology dominated the comments received in this category. "To accommodate changing goals and restoration needs for the region, each diversion structure, as well as the outfall management system, should be designed to incorporate operational flexibility to address changing environmental conditions through an adaptive management program." Comments were also received regarding the similarity of this project to the Davis Pond diversion project. Several comments were positive in nature, stating that the project should be a "cookie cutter" version of the successful Davis Pond project; whereas others were concerned about the lack of hydrological management of that project. "Please figure out drainages better than what has happened at diversions like Davis Pond."

Affected Environment – The majority of comments received in this category concerned hydrology and drainage issues. "There are also a number of small canals in this area that are completely choked up. They are no longer helping at all in the natural drainage of the swamp." Some concerns were also raised regarding the effect of existing area structures, such as Interstate 10 and the effect of the logging industry on the study area. It should be noted that very few comments were designated as relating to the affected environment category alone and that most of the comments related to the affect of the no action alternative rather than the affect of the proposed action.

Environmental Consequences – Some concerns were raised regarding the proposed action's impact on area wildlife. Pallid Sturgeons, Gulf sturgeons, the Bald Eagle and Colonial Nesting Waterbirds were mentioned as sensitive receptors in the area. "Regarding the Bald Eagle: Disturbance may lead to nest abandonment, cracked and chilled eggs, and exposure of small young to the elements." Consult National Bald Eagle Management Guidelines to minimize potential impact." Some comments were also related to drainage issues. "My concern is that it would be fighting the natural drainage that wants to come off of high ground. And with that, you would stifle the flushing effect that needs to happen in these canals, bringing off all the pollutants coming off the occupied areas up in here."

Consultation, Coordination, and Compliance with Regulations – Some calls were made for further hydrological studies in the area. "The Louisiana Wildlife Federation urges the LDWF and the Louisiana Department of Transportation to act jointly in leading an effort to restore the natural hydrology of the McElroy Swamp in the Maurepas Basin of Southeast Louisiana and to assume leadership in organizing the other state and Federal agencies, along with private landowners to conduct a drainage study and develop a restoration plan for the McElroy Swamp watershed area." Other comments related to the urgency of project implementation and the funding of the project. "You mentioned the project was authorized under WRDA. Is it fully funded now? If not, can the State put this into the stimulus package to get it built faster?"

Table 6-1 displays the categorization of specific comments by DSEIS subject matter. The most comments were expressed regarding alternatives followed by Affected Environment; Environmental Consequences; and Purpose and Need and Consultation, Coordination and Compliance with Regulations.

Table 6-1: Categorization of Scoping Comments by DSEIS Subject Matter

Source of Scoping Comment	PN	ALT	AE	EC	CC	Totals
Scoping Meeting	14	19	20	5	6	**64**
Scoping Comment Cards	4	9	5	3	2	**23**
Scoping Comment Letters	0	7	3	11	10	**31**
Totals	**18**	**35**	**28**	**19**	**18**	**118**
Legend: **PN** = Purpose and Need, **ALT** = Alternatives, **AE** = Affected Environment, **EC** = Environmental Consequences, & **CC** = Consultation, Coordination, and Compliance with Regulations						

NOTE: A single scoping comment may be categorized under multiple PDSEIS subject matter headings

The scoping comments were documented in a Scoping Report and describe the public's concerns about the restoration effort and strategies for restoration efforts. See Appendix C for the Scoping Report. All registered scoping meeting participants, as well as those providing written or verbal comments, were provided a copy of the Scoping Report. In addition, the Scoping Report will be posted on the study website at http://www.lca.gov/Convent.aspx.

6.2 Other Public Comments, Areas of Controversy, unresolved issues

The following meetings were held to provide opportunities for the public, landowners, NGOs, agencies, the Parishes and other interested parties to see progress on the project and to solicit feedback from the attendees.

- St. James Parish –July 10, 2008
- Ascension Parish – July 30, 2008
- Scoping Meeting – February 12, 2009
- Gulf States Maritime Association – April 28, 2009
- Ascension Parish – June 10, 2009
- U.S. Coast Guard - September 3, 2009
- Pontchartrain Levee District – September 11, 2009
- Public Interest Groups - St. James –September 15, 2009
- Public Interest Groups - Ascension –October 19, 2009
- Focus Group- April 29, 2010

- Public Meeting - June 15, 2010

6.2.1 Land owner involvement

Land/property owners attended the NEPA scoping meeting, and comments received from them are accounted for in the summary presented in Section 6.1.

6.2.2 Non-Governmental Organization (NGO) Involvement

In addition to the formal scoping meeting, two meetings were held in an effort to update recreational user groups on the project for specific input on potential benefits to the project study area. The intent of these meetings was to provide an update on study progress and solicit feedback prior to selection of the final plan. Presentations given to both the Louisiana Wildlife Federation and the East Ascension Sportsman League included representatives from other local groups including but not limited to the following:

- East Ascension Bass Club
- Timberton Hunting Club
- McElroy Hunting Club
- Romeville Hunting Club
- Panama Hunting Club
- Boyce Machinery
- Robert Family property
- St. James Boat Club
- Local Ducks Unlimited (East and West Ascension Chapters)
- Local National Wild Turkey Federation (Blind River Boss Gobblers Chapter)

The first public group meeting was held at the St. James Parish Courthouse on September 15, 2009. Twenty-five attendees were present and represented some of the groups listed above, some were camp owners, and some were other interested local residents.

Comments that were recurring throughout this meeting included the following:

- No action will certainly lead to continued degradation; the diversion is needed without a doubt
- A drainage plan must accompany the diversion project; the swamp needs freshwater but also needs to be able to drain sufficiently
- Generations that have watched the swamp degrade, with decreased duck populations and smaller deer; they want to see improved fishing and hunting conditions; improve the water quality; provide some high-ground areas as refuges for animals during high water

- This entire group was in support of implementing a diversion to improve swamp conditions

The second public group meeting was held at the American Legion Hall in Gonzales on October 19, 2009. A project status update was presented to the East Ascension Sportsman's League as part of their monthly meeting. Over 75 attendees were present, many of which also belong to some of the other public groups that were identified previously. The audience overwhelmingly voiced the need for this diversion as a means to improve water quality and swamp health with many of the same comments received at the first public group meeting.

Based on comments received from both public group attendees, it is very apparent that the main recreational feature(s) associated with the swamp include fishing and hunting.

6.2.3 Parish Involvement

St. James Parish has been involved in the study since its inception. Parish involvement included their active participation on the PDT; weekly updates were provided for their review and input. The Parish also supported the public meeting events by providing meeting facilities, and they provided valuable input from the Parish to the public meeting attendees supportive of PDT decisions. Parish personnel also provided necessary boat access and guided the field teams through swamp areas for environmental and biological assessment and monitoring station placement

6.3 Public Comments on the Draft SEIS

The DSEIS was released to the public on May 21, 2010, followed by a 45-day public review period. Comments from this review period were incorporated into this SEIS. Comments received and the responses to them are included in Appendix G.

7.0 COORDINATION AND COMPLIANCE*

This chapter documents the coordination and compliance efforts regarding statutory authorities including environmental laws, regulation, executive orders, policies, rules, and guidance. Consistency of the Tentatively Selected Plan (TSP)/Recommended Plan with other Louisiana coastal restoration efforts is also described.

7.1 USACE Principles and Guidelines (P&G)

The guidance for conducting Civil Works planning studies (ER 1105-2-100) requires the systematic formulation of alternative plans that contribute to the Federal objective. In order to ensure that sound decisions are made with respect to development of alternatives and ultimately plan selection, the plan formulation process requires a systematic and repeatable approach. The Economic and Environmental Principles and Guidelines for Water and Related Land Implementation Studies (Principles and Guidelines) describe the USACE study process and requirements.

Planning for this feasibility study has been conducted in accordance with the ER 1105-2-100 guidance. This report is a summary of the integrated feasibility study and SEIS conducted for this project. Policy reviews have been conducted to ensure compliance with applicable USACE policies.

7.2 Environmental Coordination and Compliance

Following completion of the final integrated report, the Assistant Secretary of the Army for Civil Works will issue a written Record of Decision (ROD) concerning the proposed action. The ROD will be issued within a framework of laws, regulations, executive orders, policies, rules, and other guidance. These authorities establish regulatory compliance standards for environmental resources pertaining directly to USACE management of water resources development projects, or provide planning guidance for the management of environmental resources. Full compliance with statutory authorities will be accomplished upon review of the integrated feasibility study and environmental impact statement by appropriate agencies and the signing of a ROD.

7.2.1 U.S. Fish and Wildlife Coordination Act

The USACE and the USFWS have formally committed to work together to conserve, protect, and restore fish and wildlife resources while ensuring environmental sustainability of our Nation's water resources under the January 22, 2003, Partnership Agreement for Water Resources and Fish and Wildlife. Accordingly, the USFWS indicated agreement to serve as a Cooperating Agency (per NEPA section 1501.6) in developing the FS/SEIS for the proposed project in accordance with applicable NEPA and CEQ guidance. Participation of the USFWS includes 1) participating in meetings and field trips to obtain baseline information on project-area fish and wildlife resources; 2) evaluating the proposed project's impacts to wetlands and associated fish and wildlife resources, and assisting in the development of measures to avoid, minimize, and/or compensate for those impacts; and 3) providing technical assistance in the development of a Biological Assessment describing the impacts of the proposed activity to Federally listed threatened or endangered species and/or their critical habitat. In the January, 20, 2009, letter, the USFWS also provided specific guidance on avoiding impacts to West Indian manatee (*Trichechus manatus*), the pallid sturgeon (*Scaphirhynchus albus*) Gulf sturgeon (*Acipenser oxyrhynchus desotoi*), bald eagle (*Haliaeetus leucocephalus*), and colonial nesting waterbirds. The U.S. Fish and Wildlife Draft and Final Coordination Letter and Report are provided in **Appendix B**. The coordination act letter report outlines the service's position and recommendations as follows:

> *The TSP will benefit the fish and wildlife resources that depend on the Maurepas Swamp by providing freshwater, nutrients, and sediments to the study area thus facilitating sediment deposition, increase organic production, increase biological productivity, and reduce conversion of swamp habitat to open water. Approximately 21,369 acres would benefit from the proposed project resulting in 6,421 AAHUs of swamp habitat at the end of the project life. The Service supports implementation of Alternative 2, a 3,000 cfs diversion at Romeville, provided the following fish and wildlife recommendations are implemented concurrently with project implementation:*

1. *Because of the expedited schedule, we recommend that the Corps continue to coordinate with the agencies during the remaining Feasibility phase and the Preconstruction, Engineering, and Design (PED) phase to ensure any new project features, development of the operational plan, finalization of the monitoring and adaptive management plan, and/or changes in the design fully incorporate adequate fish and wildlife conservation measures and that those features can be adequately evaluated with regards to impacts to fish and wildlife resources.*

2. *We recommend that hydrologic modeling efforts better identify/quantify influence areas and how water (sediment and nutrients) moves through the system and within each hydrologic unit under the proposed operational plan. Those hydrologic modeling results should be provided to the habitat evaluation team with adequate time to evaluate the results and conduct detailed impacts analysis. Accretion rates need to be determined and incorporated into the hydrologic modeling (e.g., flood durations and depths should decrease).*

3. *To accommodate changing goals and restoration needs for the region, we recommend that the diversion structure, as well as the outfall management system, be designed to incorporate operational flexibility to address changing environmental conditions through an adaptive management program.*

4. *We recommend that water levels and swamp floor elevations be determined on a refined scale and incorporated into the hydrologic modeling.*

5. *We recommend that hydrologic modeling address future with and without project salinity conditions.*

6. *If the proposed project feature is changed significantly, is not implemented within one year of the Endangered Species Act consultation letter, or additional modeling reveals additional potential impacts, we recommend that the Corps reinitiate coordination with our office to ensure that the proposed project would not adversely affect any Federally listed threatened or endangered species or their critical habitat.*

7. *Should additional hydrodynamic modeling determine impacts to Lake Maurepas water quality (e.g., salinity and temperature), we recommend that the Corps reinitiate coordination with the NMFS regarding EFH consultation.*

8. *Avoid adverse impacts to bald eagle nesting locations and wading bird colonies through careful design of project features and timing of construction. A qualified biologist should inspect the proposed work site for the presence of undocumented wading bird nesting colonies and bald eagles during the nesting season (i.e., February 16 through October 31 for wading bird nesting colonies, and October through mid-May for bald eagles).*

9. *To minimize disturbance to colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15, exact dates may vary within this window depending on species present). In addition, we recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and*

their nests, and should avoid affecting them during the breeding season.

10. *Because bald eagles are known to nest within the proposed study area, we recommend that an evaluation be performed to determine whether the project is likely to disturb nesting bald eagles. That evaluation may be conducted on-line at: http://www.fws.gov/southeast/es/baldeagle. Following completion of the evaluation, that website will provide a determination of whether additional consultation is necessary and those results should be forwarded to this office.*

11. *Please coordinate with the LDWF, Region 7 Office (225/765-2360), for further information regarding any additional permits that may be required to perform work on the Maurepas Swamp Wildlife Management Area (WMA).*

12. *Please contact the LDWF, Scenic Rivers Program (318/343-4045) for further information regarding any additional permits that may be required to perform work on the above referenced river.*

13. *Land clearing associated with project features should be conducted during the fall or winter to minimize impacts to nesting migratory birds, when practicable. Land clearing for access to the maintenance canals should be limited to one side of the channel bank to minimize fish and wildlife impacts.*

14. *Project designs for cross culverts proposed under U.S. Highway 61 and the Kansas City Southern Railroad and other bridge openings and water control structures should incorporate fish and wildlife passage. We recommend coordinating with the natural resource agencies during the PED phase to ensure fish and wildlife conservation measures are incorporated into the design of those structures.*

15. *Further detailed planning of project features (e.g., Design Documentation Report, Engineering Documentation Report, Plans and Specifications, or other similar documents) and any adaptive management and monitoring plans should be coordinated with the Service and other State and Federal natural resource agencies, and shall be provided an opportunity to review and submit recommendations on the all work addressed in those reports.*

16. *A report documenting the status of implementation, maintenance and adaptive management measures should be prepared every three years by the managing agency and provided to the Corps, the Service, National Marine Fisheries Service, U.S. Environmental Protection Agency, Louisiana Department of Natural Resources, Office of Coastal Protection and Restoration, and the Louisiana Department of Wildlife and Fisheries. That report should also describe future management activities, and identify any proposed changes to the existing management plan.*

References to the above USFWS recommendations and how each was addressed are as follows: Recommendations 1 and 2 are addressed in Sections 3.8.2.1. Recommendations 3, 4, 9, 10, 11, 12, 13 and 15 are all addressed in Section 3.8.3. Comments 5, 6, 7 & 8 are addressed in Section 3.8.2. Comment 14 is addressed in Section 3.7.3 and Comment 16 in Section 3.7.7.

7.2.2 Clean Water Act – Section 401 Water Quality

Under provisions of the Clean Water Act (33 U.S.C. § 1251), any project that involves placing dredged or fill material in waters of the United States or wetlands, or mechanized clearing of wetlands would require a water quality certification from the Louisiana Department of Environmental Quality (LDEQ), Office of Environmental Services. A public notice for the proposed action was issued. An application for water quality certification was provided to the LDEQ with the draft FS/SEIS, and stated that the proposed placement of fill material into waters of the state will not violate established water quality standards. Issuance of an LDEQ state Water Quality Certification was received September 20, 2010 (**Appendix D**).

7.2.3 Clean Water Act – Section 404(b)(1)

The USACE is responsible for administering regulations under Section 404(b)(1) of the Clean Water Act. Potential project-related impacts subject to these regulations, such as the discharge of dredged material onto spoil banks and the placement of rock for erosion protection, have been evaluated in compliance with Section 404(b)(1) of the Clean Water Act (**Appendix D**). The evaluation of potential impacts to water quality indicated that, on the basis of the guidelines, the proposed disposal sites for the discharge of excavated and previously dredged material and stone comply with the requirement of these guidelines, with the inclusion of appropriate and practicable methods to minimize adverse effects to the aquatic ecosystem.

7.2.4 Coastal Zone Management Act of 1972

Section 307 of the Coastal Zone Management Act (CZM) of 1972 (16 U.S.C. 1456(c)(1)(A)) directs Federal agencies proposing activities or development projects (including civil work activities), whether within or outside the coastal zone, must assure that those activities or projects are consistent, to the maximum extent practicable, with the approved state coastal zone management program. A Consistency Determination is included with this report (**Appendix E**) and was submitted to the LDNR for consistency review. Implementation of the Recommended Plan is considered consistent, to the maximum extent practicable, with the approved Louisiana state coastal management program. A consistency determination was issued August 5, 2010.

7.2.5 Endangered Species Act of 1973

Compliance with the ESA (7 U.S.C. 136; 16 U.S.C. 460 et seq.) has been coordinated with the USFWS and the NMFS for those species under their respective jurisdictions. The use of Chapter 6 Coordination and Compliance with Environmental Requirements FEIS June 2009 6 – 5 recommended primary activity exclusion zones and timing restrictions would be utilized, to the maximum extent practicable, to avoid project construction impacts to any threatened or endangered species or their critical habitat within the proposed action area. The CEMVN will continue to closely coordinate and consult with the USFWS and the NMFS regarding threatened and endangered species under their jurisdiction that may be potentially impacted by the proposed action. Although Gulf sturgeon, pallid sturgeon and West Indian manatee may be found in the proposed action area, the only endangered species with a high potential for adverse impacts from the Recommended Plan is pallid sturgeon. Multi-project research is currently underway to determine the potential for diversion impacts to this species.

Formal consultation on the pallid sturgeon has been conducted and a Biological Opinion (Appendix A) was received on September 23, 2010 from the USFWS. The USFWS determined that the level of expected take is not likely to result in jeopardy to the pallid sturgeon.

7.2.6 Magnuson-Stevens Fishery Conservation and Management Act of 1996; and the Magnuson-Stevens Act Reauthorization of 2006 (EFH)

As directed by the Magnuson-Stevens Fishery Conservation and Management Act (Public Law 104-297), the CEMVN has coordinated with the NMFS and that agency's experts on various marine organisms, as well as EFH. The NMFS provided a letter dated February 20, 2009, to help guide the development of the FS/SEIS for the proposed action (**Appendix C**). The NMFS identified blue crab, striped mullet and Gulf menhaden as estuarine-dependent fisheries species that use freshwater habitats in the project vicinity. The analysis of potential impacts of the Recommended Plan on EFH is described in **Section 4.2.10 EFH**.

7.2.7 Clean Air Act – Air Quality Determination

Compliance with the Clean Air Act (42 U.S.C.A. §§7401) has been fully coordinated with the Air Quality Section of the LDEQ (see also **Section 4.2.4 Air Quality**). As required by Louisiana Administrative Code, Title 33 (LAC 33:III.1405 B), an air quality applicability determination is being made for the Recommended Plan. This includes consideration of the proposed action for the category of general conformity, in accordance with the Louisiana General Conformity, State Implementation Plan (LDEQ, 1994). An air quality determination will be calculated, based upon direct and indirect air emissions. Generally, since no other indirect Federal action, such as licensing or subsequent actions would likely be required or related to the restoration construction actions, it is likely that indirect emissions, if they would occur, would be negligible. Therefore, the air applicability determination analysis will be based upon direct emission for estimated construction hours. Considering that total emissions for each work item separately (or even when all work items are summed) would not exceed the threshold limit applicable to Volatile Organic Compounds (VOC) for parishes where the most stringent requirement (50 tons per year in serious non-attainment parishes) is in effect, (see General Conformity, State Implementation Plan, Section 1405 B.2), the VOC emissions for the proposed construction would be classified as de minimus and no further action would be required.

7.2.8 National Historic Preservation Act of 1966

In compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, and 36CFR 800, Federal agencies are required to identify and consider potential effects that their undertakings might have on significant historic properties, district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. Additionally, a Federal agency shall consult with any tribe that attaches religious and cultural significance to such properties. Agencies shall afford the State Historic Preservation Officer (SHPO) and tribes a reasonable opportunity to comment before decisions are made. Accordingly, the proposed action is being coordinated with the SHPO and tribes, initiation letters are presented in **Appendix F**.

7.2.9 Farmland Protection Policy Act (Prime and Unique Farmlands)

The purpose of the Farmland Protection Policy Act (7 U.S.C. 658) is to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses. Coordination is on-going with NRCS regarding farmlands in the study area so not impact these farmlands when implementing the TSP/Recommended plan.

7.2.10 Executive Order 13186 – Migratory Bird Habitat Protection

Executive Order 13186 proclaims the intent to support the conservation of previous migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions. This Executive Order requires environmental analyses of Federal actions required by the NEPA or other established environmental review processes to evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern. In addition, each Federal agency shall restore and enhance the habitat of migratory birds, as practicable.

7.2.11 Executive Order 12898 – Environmental Justice

Concern with environmental justice issues can be traced to Title VI, Section 601 of the Civil Rights Act of 1964 (Public Law 88-352):

"No person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance."

On February 11, 1994, President Clinton issued Executive Order 12898 regarding Federal actions to address environmental justice issues in minority populations and low-income populations:

"To the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands."

Executive Order 12898 is designed to focus Federal attention on the environmental and human health conditions in minority communities and low-income communities. The order is also intended to promote non discrimination in Federal programs substantially affecting human health and the environment, and to provide minority communities and low income communities access to public information on, and an opportunity for public participation in, matters relating to human health or environmental planning, regulations, and enforcement. Potential environmental justice issues have been considered throughout the entire study process, and will continue to be considered through project implementation. As part of the NEPA process, a scoping input request was provided to the public and interested parties. The scoping comments did not identify any potential environmental justice issues. The CEMVN is committed to ensuring that any potential environmental justice issues are addressed as the study proceeds. The proposed freshwater diversion and wetland restoration measures would equally impact all potential users (e.g., commercial and recreational fishers) in the area. There would be no potential environmental justice issues from implementing the Recommended Plan.

7.2.12 Executive Order 13112 – Invasive Species

On February 3, 1999, President Clinton issued Executive Order 13112 to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause by establishing the National Invasive Species Council. The Recommended Plan is consistent with Executive Order 13112 to the extent practicable and permitted by law and subject to the availability of appropriations, and within Administration budgetary limits. The Recommended Plan will use relevant programs and authorities to prevent the introduction of invasive species and not authorize, fund, or carry out actions likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere, unless the USACE has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species, and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.

7.2.13 Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970

All real estate interests acquired for construction of the TSP/Recommended Plan will be in accordance with the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Uniform Act), as amended in 42 USC 4601-4655, and the Uniform Regulations contained in 49 C.F.R. Part 24. The Uniform Act sets forth procedures for the acquisition of private property for public use and specifically requires that the acquiring agency appraise the real property interests it wishes to acquire and provide the owner a written summary of the basis for the amount established as just compensation.

7.2.14 Louisiana State Rare, Threatened, and Endangered Species, and Natural Communities Coordination

The CEMVN reviewed the database maintained by the LNHP that provides the most recent listing and locations for rare, threatened and endangered species of plants and animals and natural communities within the State of Louisiana. The proposed action would not adversely impact any rare, threatened or endangered species, or unique natural communities. The proposed action would increase the extent of baldcypress-tupelo swamp, which is identified as rare to secure natural communities for St. James and Ascension Parishes (see also Section **4.2.6 Coastal Vegetation Resources**).

7.2.15 Section 122 Rivers and Harbors Act

The U.S. Army Corps of Engineers (USACE) began regulating activities in navigable waters with the Rivers and Harbors Act of 1899. The act includes waters defined as navigable by the U.S. Coast Guard (USCG) but may also include rivers that were historically navigable or those which, with modification, may be available for future use to transport interstate commerce.

- Section 9 empowers USCG to regulate the construction of bridges and causeways within or across navigable waterways as determined by that agency through navigable waterway permits. The General Bridge Act of 1946 has more recent rules and regulations that direct staff through the bridge application process for Section 9 permits.
- Section 10 empowers USACE to regulate all work on structures in or affecting the course, condition, or capacity of navigable waters of the U.S. through navigable waterway permits.

The proposed action does not in any way disrupt or impede navigable waterways or maritime commerce.

7.2.16 Floodplain Management

Floodplain management is the operation of a community program of corrective and preventative measures for reducing flood damage. These measures take a variety of forms and generally include requirements for zoning, subdivision or building, and special-purpose floodplain ordinances.

A community's agreement to adopt and enforce floodplain management ordinances, particularly with respect to new construction, is an important element in making flood insurance available to home and business owners. Currently over 20,100 communities voluntarily adopt and enforce local floodplain management ordinances that provide flood loss reduction building standards for new and existing development.

The proposed action does not in any way influence any existing flood plain management programs.

7.2.17 Protection of Wetlands

An order given by President Carter in 1977 to avoid the adverse impacts associated with the destruction or modification of wetlands. The proposed action would not adversely impact wetlands and would actually improve natural wetlands.

7.2.18 Protection of Children from Environmental Health and Safety Risks

Executive Order (E.O.) 13045 - Protection of Children from Environmental Health Risks and Safety Risks - was issued by President William J. Clinton in 1997. The order applies to economically significant rules under E.O. 12866 that concern an environmental health or safety risk that EPA has reason to believe may disproportionately affect children. Environmental health risks or safety risks refer to risks to health or to safety that are attributable to products or substances that the child is likely to come in contact with or ingest (such as the air we breathe, the food we eat, the water we drink or use for recreation, the soil we live on, and the products we use or are exposed to). When promulgating a rule of this description, EPA must evaluate the effects of the planned regulation on children and explain why the regulation is preferable to potentially effective and reasonably feasible alternatives. The proposed action does not affect children in any way.

8.0 CONCLUSIONS AND DETERMINATIONS*

8.1 Areas of Controversy and Unresolved Issues

The Mississippi River levee system has cut off the Maurepas Swamp (and Blind River) from the natural periodic, near annual flooding by the Mississippi River. Past construction of logging trails, drainage channels, pipelines and other utilities, and roads through the swamp have further disrupted the natural flow and drainage patterns, and impacted the biological productivity of the swamp. Without action, the swamp is predicted to continue to deteriorate at the same or accelerated rates. The overall project objective is to reverse the trend of deterioration of southeastern Maurepas Swamp and Blind River. Meetings and discussions with the public and local, state and federal agencies and the Project Development Team (PDT) indicate support for the project and did not identify any areas of controversy or unresolved issues.

The impacts of the Deepwater Horizon oil spill on coastal Louisiana are uncertain at this time. The impacts of the oil spill as well as the various emergency actions taken to address oil spill impacts (e.g., use of oil dispersants, creation of sand berms, use of Hesco baskets, rip-rap, sheet piling and other actions) could potentially impact USACE water resources projects and studies within the Louisiana Coastal Area. Potential impacts could include factors such as changes to existing, future-without, and future-with-project conditions, as well as increased project costs and implementation delays. The USACE will continue to monitor and closely coordinate with other Federal and state resource agencies and local sponsors in determining how to best address any potential problems associated with the oil spill that may adversely impact project implementation. Supplemental planning and environmental documentation may be required as information becomes available. If at any time petroleum or crude oil is discovered on project lands, all efforts will be taken to seek clean up by the responsible parties, pursuant to the Oil Pollution Act of 1990 (33 U.S.C. 2701 et seq.).

8.2 Conclusions

The Recommended Plan, Alternative 2, best meets the screening criteria; would accomplish the planning objectives and goals; would be consistent with the Environmental Operating Principles; and is within the cost and scope of the Congressional mandate provided in WRDA 2007 (Public Law 110-114) for a small diversion at Convent/Blind River, to reverse the trend of deterioration in the southeast part of the Maurepas Swamp. Alternative 2, a 3,000 cfs diversion at Romeville, has six major components: a diversion structure, a transmission canal, control structures, approximately 30 berm gaps, cross culverts at four locations along U.S. highway 61 and instrumentation to monitor and control the diversion flow rate and the water surface elevations in the diversion, transmission, and distribution system in the swamp. The Recommended Plan would improve a total of

21,369 acres (8,648 ha) of baldcypress-tupelo swamp that are in various stages of deterioration. The Recommended Plan would improve 3,295 acres (1,333 ha) of baldcypress-tupelo swamp that would become marsh in 20 to 30 years without project implementation, 7,934 acres (3,211 ha) of baldcypress-tupelo swamp that would become marsh in 30 to 50 years without project implementation, and 10,140 acres (4,104 ha) of baldcypress-tupelo swamp that would become marsh in greater than 50 years without project implementation.

8.3 Recommendations

LCA Small Diversion at Convent/Blind River recommended and described herein to restore the natural ecology within the Maurepas swamp be constructed as a Federal project, with such modifications thereof as in the discretion of the Commander, USACE may be advisable. The project total first cost, based on October 2010 price levels, is estimated at $116,791,000. The estimated fully funded cost of the Recommended Plan is $123,140,000. The Non-Federal Sponsor shall, prior to implementation, agree to perform the items of local cooperation as were stated in Section 3.9.2.

The recommendation contained herein reflects the information available at this time, price levels as specified in the FS/SEIS, and current departmental policies governing the formulation of the project. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program or the perspective of higher levels of review within the Executive Branch. Consequently, the recommendation may be modified before it is transmitted to the Congress as a proposal for implementation funding.

Edward Fleming

Colonel, U.S. Army

District Engineer

9.0 DISTRIBUTION LIST AND OTHER*

9.1 Distribution List

The LCA Small Diversion at Convent/Blind River Integrated Feasibility Report and Supplemental Environmental Impact Statement (SEIS) will be distributed to Federal, state, parish, and local agencies; tribes; businesses; libraries; museums; universities; environmental organizations, groups and individuals; and scoping participants. The complete distribution list would be available upon request from the U.S. Army Corps of Engineers at the following address.

U.S. Army Corps of Engineers

New Orleans District

P.O. Box 60267

New Orleans, Louisiana 70160-0267

9.2 List of Preparers

Many individuals were involved with the completion of this document. The following selection contains a listing of those people who assisted in writing the LCA Small Diversion at Convent/Blind River Integrated Feasibility Report and SEIS.

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9.3 Literature Cited

Allen, J.A. 1992. Cypress-tupelo swamp restoration in southern Louisiana Restoration Management. Notes. 10: 188-189.

Allen, J.A., J.L. Chambers, and D. McKinney. 1994. Intraspecific variation in the response of *Taxodium distichum* seedlings to salinity. For Ecol Manage 70: 203-214.

Allen, J.A., S.R. Pezeshki, and J.L. Chambers. 1996. Interaction of flooding and salinity stress on baldcypress (*Taxodium distichum*). Tree Physiology 16: 307-313.

Anderson, H.W., M.D. Hoover, and K.G. Reinhart. 1976. Forests and water: effects of forest management on floods, sedimentation and water supply. United

States Department of Agriculture, Forest Service General Technical Report PSW-18.

Applequist, M.B. 1959. Longevity of submerged tupelogum and baldcypress seed. LSU Forestry Notes, Note 27. 2 pp.

Autin, W.J., S.F. Burns, B.J. Miller, R.T. Saucier, and J.I. Snead. 1991. Quaternary geology of the Lower Mississippi valley. Pages 547-582 *in* R.B. Morrison, editor. Geology of North America. Volume K-2. Quaternary nonglacial geology: conterminous U.S. Geological Society of America, Boulder, CO.

Baker, J.A., K.J. Killgore, and R.L. Kasul. 1991. Aquatic habitats and fish communities in the Lower Mississippi River. Reviews in Aquatic Sciences 3: 313-356.

Barras, J.A. 2009. Land area change and overview of major hurricane impacts in coastal Louisiana, 2004-2008. U.S. Geological Survey Scientific Investigations Map 3080, scale 1:250,000, 6 p. pamphlet.

Barras, J.A. 2006. Land area change in coastal Louisiana after the 2005 hurricanes—a series of three maps. U.S. Geological Survey Open-file Report 2006-1274. Available online at http://pubs.usgs.gov/of/2006/1274/>

Barras, J.A., P.E. Bourgeois, and L.R. Handley. 1994. Land loss in coastal Louisiana. Open File Report 94-01. National Biological Survey, National Wetlands Research Center, Lafayette.

Barras, J.A. *et al.* 2003. Historic and predicted coastal Louisiana land changes: 1978-2050. U.S. Geological Survey Open File Report 03-334. U.S. Geological Survey, National Wetlands Research Center.

Barry, J.M. 1997. Rising Tide. The Great Mississippi Flood of 1927 and How it Changed America. Simon and Schuster. New York, NY, USA.

Battelle. 2005. Phase 1 assessment of potential water quality and ecological risk and benefits from a proposed reintroduction of Mississippi River water into the Maurepas swamp. Final report to the U.S. Environmental Protection Agency, Region 6, Dallas, Texas. 66 pp. October 5.

Baumann, R.H. *et al.* 1984. Mississippi deltaic wetland survival—sedimentation versus coastal submergence. Science 224: 1093-1095.

Beck, D.E. 1977. Growth and development of thinned versus unthinned yellow poplar sprout clumps. In: Asheville, N.C.: Southeast. For. Exp. Stn.

Beckett, D.C., and C.H. Pennington. 1986. Water quality, macroinvertebrates, larval fishes, and fishes of the Lower Mississippi River—a synthesis. U.S. Army Corps of Engineers Technical Report E-86-12. Waterways Experiment Station, Vicksburg, MS. 136 pp.

Blair, R.M. and M.J. Langlinais. 1960. Nutria and swamp rabbits damage baldcypress seedlings. Journal of Forestry 58: 388-389.

Boesch, D.F., M.N. Josselyn, A.J. Mehta, J.T. Morris, W.K. Nuttle, C.A. Simenstad, and D. Swift. 1994. Scientific assessment of coastal wetland loss, restoration and management in Louisiana. Journal of Coastal Research SI20: 1-103.

Brady, N.C. and R.R. Weil. 2002. The nature and properties of soils. Prentice Hall, New York, USA.

Brandt, K. and K.C. Ewel. 1989. Ecology and management of cypress swamps: a review. Gainesville, FL: Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. 19 pp.

Brantley, C.G. and S.G. Platt. 1992. Experimental evaluation of nutria herbivory on baldcypress. Proc. La. Acad. Sci. 55: 21-25.

Brinson, M.M. 1990. Riverine forests. Pages 87-134 *in* A.E. Lugo, S. Brown, M.M. Brinson (eds.), Forested Wetlands. Ecosystems of the World, vol. 15. Elsevier, New York, NY.

Brinson, M.M., B.L. Swift, R.C. Plantico, and J.S. Barclay. 1981. Riparian ecosystems: their ecology and status. FWS/OBS-81/17. Washington D.C.: U.S. Fish and Wildlife Service.

Brown, S. 1981. A comparison of the structure, primary productivity, and transpiration of cypress ecosystems in Florida. Ecological Monographs 51: 403-427.

Campo, F.M. 1996. Restoring a repressed swamp: the relative effects of a saltwater influx on an immature stand of baldcypress (*Taxodium distichum* (L.) Richard). M.S. thesis, Southeasten Louisiana University.

Chabreck, R.H. 1970. Marsh zones and vegetative types of the Louisiana coastal marshes. Ph.D. Dissertation, Louisiana State University. Baton Rouge, LA.

Chabreck, R.H. 1972. Vegetation, water, and soil characteristics of the Louisiana coastal region. Louisiana State University, Agricultural Experiment Station Bulletin No. 664, Baton Rouge, LA, USA.

Chabreck, R.H. 1972b. Vegetation, water, and soil characteristics of the Louisiana coastal region. Louisiana State University and Agricultural and Mechanical College Agricultural Experiment Station. 72 pp.

Chabreck, R.H. and R.G. Linscombe. 1978. Vegetative type map of the Louisiana coastal marshes. New Orleans, LA: Louisiana Department of Wildlife and Fisheries.

Chabreck, R.H. and R.G. Linscombe. 1988. Louisiana coastal marsh vegetative type map 1988. Baton Rouge, LA: Louisiana Department of Wildlife and Fisheries.

Chabreck, R.H., T. Joanen, and A. Palmisano. 1968. Vegetative type map of the Louisiana coastal marshes. New Orleans, LA: Louisiana Wildlife and Fisheries Commission.

Chabreck, R.H., R.G. Linscombe, S. Hartley, J.B. Johnston, A. Martucci, C. Saltus, and A. Ballard. 2001. Coastal Louisiana marsh-vegetation types. U.S. Geological Survey National Wetlands Research Center, Lafayette, LA. Report to the Coastal Wetlands Planning, Protection and Restoration Act and Louisiana Department of Wildlife And Fisheries.

Chambers, J. L., W. H. Conner, J. W. D. Jr., S. P. Faulkner, E. S. Gardiner, M. S. Hughes, R. F. Keim, S. L. King, K. W. McLeod, C. A. Miller, J. A. Nyman, and G. P. Shaffer. 2005. Conservation, protection and utilization of Louisiana's coastal wetland forests. Final report to the Governor of Louisiana from the Coastal Wetland Forest Conservation and Use Scientific Working Group. 102 pp.

Coleman, J.M., H.H. Roberts, and G.W. Stone. 1998. Mississippi River delta: An overview. Journal of Coastal Restoration 14: 698-717.

Conner, W.H. 1994. The effect of salinity and waterlogging on growth and survival of baldcypress and Chinese tallow seedlings. Journal of Coastal Research 10(4): 1045-1049.

Conner, W.H. 1998. Impact of hurricanes on forests of the Atlantic and Gulf coasts *in* A.D. Laderman (ed.) Coastally Restricted Forests. New York, NY: Oxford University Press: 271-277.

Conner, W.H. and G.R. Askew. 1992. Response of baldcypress and loblolly pine seedlings to short-term saltwater flooding. Wetlands 12: 230-233.

Conner, W.H. and M. Brody. 1989. Rising water levels and the future of southeastern Louisiana swamp forests. Estuaries 12: 318-323.

Conner, W.H. and M.A. Buford. 1998. Southern deepwater swamps. Pages 261-287 *in* J.C. Brissette (ed.) Proceedings of the Seventh Biennial Southern Silvicultural Research Conference. U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, New Orleans, LA: USA. General Technical Report GTR-SO-93.

Conner, W.H. and J.W. Day, Jr. 1976. Productivity and composition of a baldcypress-water tupelo site and a bottomland hardwood site in a Louisiana swamp. Am J Bot 63: 1354-1364.

Conner, W.H. and J.W. Day, Jr. 1982. The ecology of forested wetlands in the southeastern United States. Pages 69-87 *in* B. Gopal, R.E. Turner, R.G. Wetzel, and D.F. Whigham (eds.) Wetlands: Ecology and Management. Jaipur, India: International Scientific Publishers.

Conner, W.H. and J.W. Day, Jr. 1988. Rising water levels in coastal Louisiana: implications for two coastal forested wetland areas in Louisiana. Journal of Coastal Research 4: 589-596.

Conner, W.H. and J.W. Day, Jr. 1991. Variations in vertical accretion in a Louisiana swamp. Journal of Coastal Research 7(3): 617-622.

Conner, W.H. and J.W. Day, Jr. 1992. Water level variability and litterfall productivity of forested freshwater wetlands in Louisiana. Am Midl Nat 128(2): 237-245.

Conner, W.H. and M. Ozalp. 2002. Baldcypress restoration in a saltwater damaged area of South Carolina. Pages 365-369 *in* K.W. Outcalt (ed). Proceedings of the Eleventh Biennial Southern Silviculture Research Conference. Gen. Tech. Rep. SRS-48. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station.

Conner, W.H. and J.R. Toliver. 1990. Long-term trends in the baldcypress (*Taxodium distichum*) resource in Louisiana (U.S.A.). Forest Ecology and Management 33/34: 543-557

Conner, W.H., J.G. Gosselink, and R.T. Parrondo. 1981. Comparison of the vegetation of three Louisiana swamp sites with different flooding regimes. Am J Bot 68: 320-331.

Conner, W.H., K.W. McLeod, and J.K. McCarron. 1997. Flooding and salinity effects on growth and survival of four common forested wetland species. Wetl Ecol Manage 5: 99-109.

Conner, W.H., J.R. Toliver, and F.H. Sklar. 1986a. Natural regeneration of baldcypress (*Taxodium distichum* (L.) Rich.) in a Louisiana swamp. Forest Ecology and Management 14: 305-317.

Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. O'Neill, J. Paruelo, R. Raskin, P. Sutton, and M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. Nature 387: 253-260.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Office of Biological Services, FWS/OBS-79/31, Washington D.C.

Daigle, J.J., G.E. Griffith, J.M. Omernik, P.L. Faulkner, R.P. McCulloh, L.R. Handley, L.M. Smith, and S.S. Chapman. 2006. Ecoregions of Louisiana (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,000,000).

Davis, D.W. 1975. Logging canals: a distinctive pattern of the swamp landscape in south Louisiana. Forests and People 25: 14-17, 33-35.

Davis, D.W. 2000. Historical perspective on crevasses, levees, and the Mississippi River. Pages 84-106 *in* C.E. Colten (ed.). Transforming New Orleans and Its Environs. Pittsburgh: University of Pittsburgh Press.

Davis, W. E., Jr. 1993. Black-crowned Night-Heron (*Nycticorax nycticorax*). *In* The Birds of North America, No. 74 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.

Day, J.W., Jr., and P. Templet. 1989. Consequences of sea level rise: implications from the Mississippi Delta. Coastal Management 17: 241-257.

Day, J.W., Jr., L.D. Britsch, S.R. Hawes, G.P. Shaffer, D.J. Reed, and D. Cahoon. 2000. Pattern and process of land loss in the Mississippi Delta: a spatial and temporal analysis of wetland habitat change. Estuaries 23: 425-438.

Day, J.W., Jr., G.P. Shaffer, G.P. Britsch, D. Reed, S. Hawes, and D. Cahoon. 2001. Patterns and processes of land loss in coastal Louisiana are complex: a reply to Turner 2001. Estimating the indirect effects of hydrologic change on wetland loss: if the Earth is curved, then how would we know it? Estuaries 24: 647-651.

Day, J.W., Jr., G.P. Kemp, H.S. Mashriqui, D. Dartez, R.R. Lane, and R. Cunningham. 2004. Development plan for a diversion into the Maurepas swamp: water quality and hydrologic modeling components. Final report. U.S. Environmental Protection Agency, Region 6, Dallas, TX.

DeBell, D.S. and A.W. Naylor. 1972. Some factors affecting germination of swamp tupelo seeds. Ecology 53: 504-506.

DeLaune, R.D., J.C. Callaway, W.H. Patrick, Jr., and J.A. Nyman. 2004. An analysis of marsh accretionary processes in Louisiana coastal wetlands. Pages 113-130 *in* D.W. Davis and M. Richardson, (eds). The Coastal Zone: Papers in Honor of H. Jesse Walker. Geoscience Publications, Dept. Geography Anthropology, Louisiana State University, Baton Rouge, LA.

Demaree, D. 1932. Submerging experiments with *Taxodium*. Ecology 13: 258-262.

Dicke, S.G. and J.R. Toliver. 1990. Growth and development of baldcypress/water tupelo stands under continuous versus seasonal flooding. For Ecol Manage 33/34: 523-530.

Dryer, M.P. and A.J. Sandvol. 1993. Recovery plan for the pallid sturgeon (*Scaphirhynchus albus*). Region 6, U. S. Fish and Wildlife Service, Denver, Colorado.

DuBarry, A.P., Jr. 1963. Germination of bottomland tree seed while immersed in water. Journal of Forestry 61: 225-226.

Dundee, H.A. and D.A. Rossman. 1989. The Amphibians and Reptiles of Louisiana. Louisiana State University Press, Baton Rouge.

Effler, R.S., G.P. Shaffer, S.S. Hoeppner, and R.A. Goyer. 2007. Ecology of the Maurepas Swamp: effects of salinity, nutrients, and insect defoliation *in* W.H. Conner, T.W. Doyle, and K.W. Krauss (eds.), Ecology of Tidal Freshwater Forested Wetlands of the Southeastern United States. Chapter 13: 349-384.

Eggler, W.A. and W.G. Moore. 1961. The vegetation of Lake Chicot, Louisiana, after eighteen years of impoundment. Southwestern Naturalist 6: 175-183.

EPA. 2009a. "County Air Quality Report – Criteria Air Pollutants." Air Data. Updated: 10 January 2009. Accessed: 1 November 2009. < http://iaspub.epa.gov/airsdata/adaqs.summary?geotype=co&geocode=22005+22093&geoinfo=co~22005+22093~Ascension+Par%2C+St+James+Par%2C+Louisiana&year=2008+2007+2006+2005+2004+2003+2002+2001+2000+1999+1998&fld=county&fld=stabbr&fld=regn&rpp=25 >

EPA. 2009b. "Air Quality Index Report." Air Data. Updated: 10 January 2009. Accessed: 1 November 2009. < http://www.epa.gov/air/data/monaqi.html?co~22005%2022093~Ascension%20Par%2C%20St%20James%20Par%2C%20Louisiana >

EPA. 2010. "The Green Book Nonattainment Areas for Criteria Pollutants." Updated: 6 January 2010. Accessed: 7 January 2010. < http://www.epa.gov/air/ oaqps/greenbk/ >

Farrell, K.M. 1987. Sedimentology and facies architecture of overbank deposits of the Mississippi River, False River region, Louisiana. Journal of Sedimentary Petrology 57: 111-120.

Faulkner, S.P., J.L. Chambers, W.H. Conner, J.W. Day, E.S. Gardiner, M.S. Hughes, R.F. Keim, S.L. King, K.W. McLeod, C.A. Miller, J.A. Nyman, and G.P. Shaffer. 2007. Conservation and use of coastal wetland forests in Louisiana. Pages 447-460 *in* W.H. Conner, T.W. Doyle, and K.W. Krauss (eds.) Ecology of Tidal Freshwater Forested Wetlands of the Southeastern United States, Spring, Inc., The Netherlands.

Fisk, H.N. 1944. Geological investigation of the alluvial valley of the lower Mississippi River. U.S. Army Corps of Engineers. Mississippi River Commission, Vicksburg, MS. 78 pp.

Fisk, H.N. 1947. Fine-grained alluvial deposits and their effects on Mississippi River activity. U.S. Army Corps of Engineers, Mississippi River Commission, Vicksburg, MS. 82 pp.

Font, W.F. 2007. Parasites of Hawaiian stream fishes: sources and impacts. Pages 157-170 *in* N.L. Evenhuis and J.M. Fitzsimons (eds.). Biology of Hawaiian Streams and Estuaries. Bishop Museum Bulletin in Cultural and Environmental Studies 3.

Frazier, D.E. 1967. Recent deposits of the Mississippi River, their development and chronology. Transactions of the Gulf Coast Association of Geological Societies 17: 287-311.

Gagliano, S.M. and J.L. Van Beek. 1970. Geologic and geomorphic aspects of deltaic processes, Mississippi delta system. Hydrologic and geologic studies of coastal Louisiana. Center for Wetland Resources, Louisiana State University, Baton Rouge, LA.

Galloway, W.E. and D.K. Hobday. 1983. Terrigenous clastic depositional systems: applications to petroleum, coal, and uranium exploration. Springer-Verlag, New York, NY. 423 pp.

Giovannelli, R.F. 1980. Relation between freshwater flow and salinity distribution in the Alafia River, Bull Frog Creek, and Hillsborough Bay, Florida. U.S. Geological Survey Water-Resources Investigations Report 80-102. 62 pp.

González, J.L. and T.E. Törnqvist. 2006. Coastal Louisiana in crisis: subsidence or sea level rise? EOS, Transactions, American Geophysical Union 87(45): 493-498.

Gosselink, J.G. 1984. The ecology of delta marshes of coastal Louisiana: a community profile. U.S. Fish and Wildlife Service. FWS/OBS-84/09. 134 pp.

Goyer, R.A. and J.L. Chambers. 1996. Evolution of insect defoliation in baldcypress and its relationship to flooding. National Biological Service Biological Science Report 8. U.S. Department of Interior, National Biological Service. 36 pp.

Goyer, R.A. and G.J. Lenhard. 1988. A new insect pest threatens baldcypress. LA Agriculture, LA Agricultural Experiment Station 31: 16-17, 21.

Gunter, G. 1952. Historical changes in the Mississippi River and the adjacent marine environment. Publications of the Institute of Marine Science, University of Texas. Vol. 2(2).

Harlow, W.M. and E.S. Harrar. 1969. Textbook of Dendrology. Fifth edition, McGraw Hill, New York, NY. 512 pp.

Harms, W.R., H.T. Schreuder, D.D. Hook, and C.L. Brown. 1980. The effects of flooding on the swamp forest in Lake Ocklawah, Florida. Ecology 61: 1412-1421.

Hastings, R.W., D.A. Turner, and R.G. Thomas. 1987. The fish fauna of Lake Maurepas, an oligohaline part of the Lake Pontchartrain estuary. Northeast Gulf Science 9(2): 89-98.

Hatton, R.S. 1981. Aspects of marsh accretion and geochemistry: Barataria Basin, Louisiana. M.S. thesis, Louisiana State University.

Hodges, J.D. 1997. Development and ecology of bottomland hardwood sites. Forest Ecology and Management 90: 117-125.

Hook, D.D. 1984. Waterlogging tolerance of lowland tree species of the South. Southern Journal of Applied Forestry 8: 36-149.

Jenny, H. 1994. Factors of Soil Formation—A System of Quantitative Pedology. Originally published in 1941, Dover Publ. Inc., New York.

Johnson, R.L. 1990. *Nyssa aquatica* L. water tupelo. Pages 474-478 *in* R.M. Burns and B.H. Honkala (tech. cords.). Silvics of North America, Vol. 2, Hardwoods, Agriculture Handbook, 654, Washington, D.C.

Kadlec, R. and R. Knight. 1996. Treatment Wetlands. CRC Press, Boca Raton, FL.

Keane, R.M. and M.J. Crawley. 2002. Exotic plant invasions and the enemy release hypothesis. Trends Ecol. Evol. 17: 164-170.

Keddy, P.A., D. Campbell, T. McFalls, G.P. Shaffer, R. Moreau, C. Dranguet, R. Heleniak. 2007. The wetlands of Lake Pontchartrain and Maurepas: past, present, and future. Environ. Rev. No. 15: 43-77.

Kelso, W.E., D.A. Rutherford, and R. Bambarger. 2005. Freshwater fishes. Impacts of a freshwater diversion on wildlife and fishes in the Maurepas swamp. Louisiana State University, School of Renewable Natural Resources, Baton Rouge, Louisiana. Prepared for U.S. Environmental Protection Agency, Region 6, Dallas, Texas. 122 pp.

Kennedy, R. S. 1977. Ecological analysis and population estimates of the birds of the Atchafalaya River Basin in Louisiana. Department of Zoology and Physiology. Ph.D. Disertation, Louisiana State University, Baton Rouge.

Kerr, E. 1981. The history of forestry in Louisiana. Special publication of the Louisiana Forestry Association, Alexandria, LA.

Kesel, R.H. 1988. The decline of the suspended load of the lower Mississippi River and its influence on adjacent wetlands. Environmental Geological Water Sciences 11: 271-281.

Kesel, R.H. 1989. The role of the Mississippi River in wetland loss in southeastern Louisiana, U.S.A. Environmental Geology and Water Sciences 13: 183-193.

Kesel, R.H., E. Yodis, and D. McCraw. 1992. An approximation of the sediment budget of the lower Mississippi River prior to major human modification. Earth Surf. Process. Landf. 17: 711-722.

Killgore, K.J., J.J. Hoover, S.G. George, B.R. Lewis, C.E. Murphy, and W.E. Lancaster. 2007. Distribution and abundance of pallid sturgeon and shovelnose sturgeon in the free-flowing Mississippi River. Journal of Applied Ichthyology (In Press).

Kirk, J.P., K.J. Killgore, and J.J. Hoover. 2007. Report to the Environmental Protection Agency (EPA): Evaluation of potential impacts of the Lake Maurepas Diversion Project to Gulf and pallid sturgeon (draft). Environmental Laboratory, Engineer Research and Development Center, Vicksburg, MS. 18 pp. April 17.

Kozlowski, T.T. 1984. Responses of woody plants to flooding. Pages 129-163 *in* T.T. Kozlowski (ed.). Flooding and Plant Growth. New York: Academic Press.

Krauss, K.W., J.L. Chambers, and J.A. Allen. 1998. Salinity effects and differential germination of several half-sib families of baldcypress from different seed sources. New Forests 15: 53-68.

Kravitz A.R. and Campanella R. and Schiavinato L. 2005. State management plan for awquatic invasive species in Louisiana. State of Louisiana, Baton Rouge, LA. Pp. 1-160.

Kryter, K.D. 1994. The Handbook of Hearing and the Effects of Noise. Academic Press, San Diego, CA.

Laiche, G. 1993. The status of oyster leases and leasing practices. Breton Sound, Louisiana. Department of Wildlife and Fisheries. Unpublished.

Lane, R.R., J.W. Day Jr., and B. Thibodeaux. 1999. Water quality analysis of a freshwater diversion at Caernarvon, Louisiana. Estuaries 22: 327-336.

Lane, R.R., J.W. Day, G. Kemp, and B. Marx. 2002. Seasonal and spatial water quality changes in the outflow plume of the Atchafalaya River, Louisiana. Estuaries 25: 30-42.

Lane, R.R., H.S. Mashriqui, G.P. Kemp, J.W. Day Jr., J.N. Day, and A. Hamilton. 2003. Potential nitrate removal from a river diversion into a Mississippi delta forested wetland. Ecol Eng 20: 237-249.

Lantz, K.E. 1970. An ecological survey of factors affecting fish production in a Louisiana natural lake and river. Louisiana Wildlife and Fisheries Commission. D-J Job Compl. Rept. Proj. E-11R.

LDNR. 2009. "Coastwide Reference Monitoring System Sites." Strategic Online Natural Resources Information System. Ver. 15. June 2007. Accessed 2009 December 10. Available from: http://sonris-www.dnr.state.la.us/www_root/sonris_portal_1.htm

Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. 1980 et seq. Atlas of North American Freshwater Fishes. North Carolina State Museum of Natural History, Raleigh. 854 pp.

Lee Wilson & Associates, Inc., G. Shaffer, M. Hester, P. Kemp, J. Day, H. Mashriqui, and R. Lane. 2001. Diversion into the Maurepas Swamp. Final report to U.S. EPA Region 6. Contract No. 68-06-0067, WA #5-02.

Lopez, J.A. 2003. Chronology and analysis of environmental impacts within the Pontchartrain basin of the Mississippi Delta Plain: 1718-2002. Ph.D. Dissertation, Engineering and Applied Sciences Program, University of New Orleans, New Orleans, LA, USA.

Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority. 1999. Coast 2050: Toward a Sustainable Coastal Louisiana. Louisiana Department of Natural Resources. Baton Rouge, La. 161 pp.

Louisiana Forestry Commission (LFC). 1966. 1956-1976 Biennial Progress Reports. Louisiana Department of Conservation, Baton Rouge, LA.

Louisiana Natural Heritage Program, Louisiana Department of Wildlife and Fisheries. 2009. The Natural Communities of Louisiana.

Louisiana Natural Heritage Program, Louisianan Department of Wildlife and Fisheries. 2008. Compilation of data from website on rare, and threatened and endangered species, retrieved 2008 from http://www.wlf.louisiana.gov/wildlife/louisiana-natural-heritage-program

Lowery, G. H. 1974. The mammals of Louisiana and its adjacent waters. Louisiana State University Press, Baton Rouge, LA. 565 pp.

LPBF. 2005. Comprehensive Management Plan for Habitats in the Lake Pontchartrain Basin. Lake Pontchartrain Basin Foundation, New Orleans, LA, USA.

Lugo, A.E., S. Brown, and M.M. Brinson. 1990. Forested Wetlands. Ecosystems of the World, vol. 15. Elsevier, New York, NY.

Mancil, E. 1972. An historical geography of industrial cypress lumbering in Louisiana. Ph.D. thesis, Louisiana State University.

Mancil, E. 1980. Pullboat logging. Journal of Forest History 24: 135-141.

Mashriqui, H.S., G.P. Kemp, J.W. Day, R.R. Lane, and R. Cunningham. 2002. Mississippi River diversion into the Maurepas Swamp—Hydrologic and Ecological Modeling. Coastal Water Resources AWRA Spring Specialty Conference.

Mashriqui, H.S. and G.P Kemp. 1996. Restoring the Capacity of Bayou Lafourche to convey increased discharges form the Mississippi River. Natural Systems Management and Engineering Group, Center for Coastal, Energy and Environmental Resources, Louisiana State University, Baton Rouge, LA.

Mattoon, W.R. 1915. The southern cypress. Agriculture Bulletin 272. U.S. Department of Agriculture, Washington D.C.

McCarron, J.K., K.W. McLeod, and W.H. Conner. 1998. Flood and salinity stress of wetland woody species, buttonbush (*Cephalanthus occidentalis*) and swamp tupelo (*Nyssa sylvatica* var. *biflora*). Wetlands 18(2): 165-175.

McLeod, K.W., J.K. McCarron, and W.H. Conner. 1996. Effects of inundation and salinity on photosynthesis and water relations of four southeastern coastal plain forest species. Wetlands Ecology and Management 4(1): 31-42.

Megonigal, J.P., W.H. Conner, S. Kroeger, and R.R. Sharitz. 1997. Aboveground production in southeastern floodplain forests: a test of the subsidy-stress hypothesis. Ecology 78(2): 370-384.

Middleton, B. 2000. Hydochory, seed banks, and regeneration dynamics along the landscape boundaries of a forested wetland. Plant Ecology 146: 169-184.

Mitsch, W.J. and R.F. Wilson. 1996. Improving the Success of Wetland Creation and Restoration with Know-How, Time, and Self-Design. Ecological Applications 6(1): 77-83.

Mitsch, W.J. and J.G. Gosselink. 1993. Wetlands, Second edition. New York, NY: Van Nostrand Reinhold.

Mitsch, W.J. and J.G. Gosselink. 2000. Wetlands, Third edition. John Wiley & Sons, Inc. New York. 920 pp.

Moore, J.H. 1967. Andrew Brown and Cypress Lumbering in the Old Southwest. Louisiana State University Press, Baton Rouge, LA.

Morton, R.A., N.A. Buster, and M.D. Krohn. 2002. Subsurface controls on historical subsidence rates and associated wetland loss in southcentral Louisiana: Gulf Coast Association of Geological Societies Transactions, Vol. 52: 767-778.

Morton, R.A., J.C. Bernier, J.A. Barras, and N.F. Ferina. 2005. Rapid subsidence and historical wetland loss in the Mississippi delta plain: likely causes and future implications. U.S. Geological Survey Open-file Report 2005-1216.

Murkin, E.J., H.R. Murkin, and R.D. Titman. 1992. Macroinvertebrate abundance and distribution at the emergent vegetation-open water interface in a prairie wetland. Wetlands 12: 45-52.

Myers, R.S., G.P. Shaffer, and D.W. Llwellyn. 1995. Baldcypress (*Taxodium distichum* (L.) Rich.) restoration in southeast Louisiana: relative effects of herbivory, flooding, competition, and macronutrients. Wetlands 15: 141-148.

Nachod, L.H. and D.R. Kucera. 1971. Observations of the forest tent caterpillar in south Louisiana. Insect and disease report. Louisiana Office of Forestry, Woodworth, LA.

National Oceanic and Atmospheric Association (NOAA). 2008. Historic Palmer Drought Indices: Station ID 2534 [Available online at http:www.ncdc.noaa.gov/oa/climate/research/drough/palmer-maps].

National Research Council (NRC). 1987. Responding to Changes in Sea Level: Engineering Implications. National Academy Press: Washington, D.C. http://www.nap.edu/catalog.php?record_id=1006

Odum, E.P. 1980. The status of three ecosystem-level hypotheses regarding salt marsh estuaries. Tidal subsidy, outwelling and detritus based food chains. Pages 485-495 *in* V.S. Kennedy (ed.) Estuarine Perspectives, Academic Press, New York.

O'Neil, T. 1949. The muskrat in the Louisiana coastal marsh. Louisiana Department of Wildlife and Fisheries, New Orleans, LA. 152 pp.

Partners In Flight (PIF). 2009. Partners In Flight Species Assessment Database, Southeastern Coastal Plain. Database accessed November 10-12, 2009. http://www.rmbo.org/pif/jsp/BCRBreed.asp?BCR_NUM=BCR27&BCR_Name=Southeastern%20Coastal%20Plain

Penfound, W.T. 1949. Vegetation of Lake Chicot, Louisiana, in relation to wildlife resources. Proceedings of the Louisiana Academy of Science 12: 47-56.

Penfound, W.T. 1952. Southern swamps and marshes. Botanical Review 18: 413-446.

Penfound, W.T. and E.S. Hathaway. 1938. Plant communities in the marshlands of southeastern Louisiana. Ecol. Monogr. 8: 1-56.

Penland, S., and R. Boyd. 1985. Mississippi delta shoreline development. Pages 53-122 *in* S. Penland and R. Boyd, editors. Transgressive depositional environments of the Mississippi River delta plain: a guide to barrier islands, beaches, and shoals in Louisiana. Louisiana Geological Survey, Baton Rouge.

Penland, S., A. Beall, and J.K. Kindinger. 2002. Environmental atlas of the Lake Pontchartrain basin. U.S. Geological Survey, Open-File Report nr02-206. 185pp.

Perret, W.S., B.B. Barrett, W.R. Latapie, J.F. Pollard, W.R. Mock, G. B. Adkins, W.J. Gaidry, and C.J. White. 1971. Cooperative Gulf of Mexico estuarine inventory and study, Louisiana. Phase I, Area Description. Louisiana Wildlife and Fisheries Commission, New Orleans, LA.

Pezeshki, S.R., R.D. DeLaune, and W.H. Patrick, Jr. 1990. Flooding and saltwater intrusion: potential effects on survival and productivity of wetland forests along the U.S. Gulf Coast. Forest Ecology Management 33/34: 287-301.

Pezeshki, S.R., R.D. DeLaune, and H.S. Choi. 1995. Gas exchange and growth of baldcypress seedlings from selected U.S. Gulf Coast populations: responses to elevated salinities. Canadian Journal Forest Research 25: 1409-1415.

Pickett, S.T.A. and P.S. White. 1985. The Ecology of Natural Disturbance and Patch Dynamics. Academic Press.

Pinckney, J.L., J.L. Wee, A. Hou, and N.D. Walker. 2009. Phytoplankton community structure responses to urban effluent inputs following Hurricanes Katrina and Rita. Marine Ecology Progress Series 387: 137-146.

Putnam, J.A., G.M. Furnival, and J.S. McKnight. 1960. Management and inventory of southern hardwoods. U.S. Department of Agriculture, Agriculture Handbook No. 181, Washington, D.C.

Reed, D.J., N.D. Luca, and A.L. Foote. 1997. Effect of hydraulic management on marsh surface sediment deposition in coastal Louisiana. Estuaries 20: 301-311.

Robbin, C.C. 1966. Voyage to Louisiana 1803-1805 (Originally printed in 1807). Translated by Stuart O. Landry, Jr. Pelican Publishing Co., New Orleans, LA. 272 pp.

Roberts, H.H. 1985. A study of sedimentation and subsidence in the south-central coastal plain of Louisiana. Final report for the U.S. Army Corps of Engineers New Orleans District. New Orleans, LA.

Roberts, H.H. 1997. Dynamic changes of the Holocene Mississippi River delta plain: the delta cycle. J. Coast. Res. 13: 605-627.

Ross, S.T. 2001. The inland fishes of Mississippi. University Press of Mississippi, Jackson, MS.

Saucier, R.T. 1963. Recent geomorphic history of the Pontchartrain Basin. Louisiana State University Press, Baton Rouge, LA.

Saucier, R.T. 1994. Geomorphology and quaternary geologic history of the Lower Mississippi Valley. Volume 1 (Text). U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

Sauer, J. R., J. E. Hines and J. Fallon. 2003. The North American Breeding Bird Survey, results and analysis 1966-2000, version 2003.1. U.S.G.S Patuxent Wildlife Research Center. Laurel, MD.

Sax, D.F., S.D. Gaines, and J.H. Brown. 2002. Species invasions exceed extinctions on islands worldwide: a comparative study of plants and birds. American Naturalist 160: 766-783.

Schexnayder, M. and R.H. Caffey. 2002. Fisheries implications of freshwater reintroductions. *Interpretive Topic Series on Coastal Wetland Restoration in Louisiana.* Coastal Wetland Planning, Protection, and Restoration Act (eds.). National Sea Grant Library No. LSU-G-02-003, 8 pp.

Schlesinger, W.H. 1978. Community structure, dyes, and nutrient ecology in the Okenfenokee cypress swamp-forest. Ecol Monogr 48: 43-65.

Shaffer, G. P., T. E. Perkins, S. Hoeppner, S. Howell, H. Bernard, and A. C. Parsons. 2003. Ecosystem health of the Maurepas Swamp: feasibility and projected benefits of a freshwater diversion. Final Report. Environmental Protection Agency, Region 6, Dallas, Texas. 105 pp.

Sharitz, R.R. and W.J. Mitsch. 1993. Southern floodplain forests. Pages 311-372 *in* W.H. Martin, S.G. Boyce, and A.C. Echternacht (eds.), Biodiversity of the Southeastern United States: Lowland Terrestrial Communities. John Wiley & Sons, Inc., New York, NY.

Sklar, F. 1983. Water budget, benthological characterization, and simulation of aquatic material flows in a Louisiana freshwater swamp. Ph.D. Thesis. Louisiana State University. Baton Rouge, LA.

Sklar, F.H. and F.H. Conner. 1979. Effects of altered hydrology on primary production and aquatic animal populations in a Louisiana swamp forest. Found *in* J.W. Day, Jr., D.D. Culley Jr., R.E. Turner, and A.J. Mumphrey Jr.

(eds.), Proceedings of the third coastal marsh and estuary management symposium. Louisiana State University Diversion of Continuing Education, Baton Rouge, LA.

Souther, R.F. and G.P. Shaffer. 2000. The effects of submergence and light on two age classes of baldcypress (*Taxodium distichum* (L.) Richard) seedlings. Wetlands 20(4): 697-706.

Stouffer, P., D.A. Rutherford, W.E. Kelso, and M. La Peyre. 2005. Impacts of a freshwater diversion on wildlife and fishes in the Maurepas swamp. Louisiana State University, School of Renewable Natural Resources, Baton Rouge, Louisiana. Prepared for U.S. Environmental Protection Agency, Region 6, Dallas, Texas. 122 pp.

Swenson, E.M. and R.E. Turner. 1987. Spoil banks: effects on a coastal marsh water-level regime. Estuarine, Coastal and Shelf Science 24: 599-609.

Tate, J.N., A.R. Carrillo, R.C. Berger, and B.J. Thibodeaux. 2002. Salinity changes in Pontchartrain Basin Estuary, Louisiana, resulting from the Mississippi River Gulf Outlet Partial Closure Plans with Width Reduction. USACE—Coastal Hydraulics Laboratory: ERDC/CHL TR-02-12.

Taylor, J.R. 1985. Community structure and primary productivity of forested wetlands in Western Kentucky. Ph.D. thesis, University of Louisville, Louisville, KY.

Terzaghi, K. 1943. Theoretical Soil Mechanics. 510 pp., John Wiley, Hoboken, N.J.

Theoharides, K.A., Dukes, J.S. 2007. Plant invasion across space and time: factors affecting nonindigenous species success during four stages of invasion. New Phytologist 176: 256-273.

Thomson, D.M., G.P. Shaffer, and J.A. McCorquodale. 2002. A potential interaction between sea level rise and global warming: implications for coastal stability on the Mississippi River deltaic plain. Global Plan 32: 49-59.

Tinkle, D.W. 1955. Observations of reptiles and amphibians in a Louisiana swamp. Texas Tech College, Lubbock, Texas. 17 pp.

Turner, R.E. 2004. Coastal wetland subsidence arising from local hydrologic manipulations. Estuaries 27(2): 265-272.

U.S. Army Corps of Engineers (USACE). 2000. Mississippi River Sediment, Nutrient, and Freshwater Redistribution Study, Draft Report and Environmental Resources Document.

USCOE. 2008. Evaluation of Potential Impacts of the Lake Maurepas Diversion Project to Gulf and Pallid Sturgeon, ERDC/EL TR-08-19

U.S. Geologic Service (USGS). 2000, June. *Nutria, eating Louisiana's coast*. National Wetlands Research Center. Retrieved from: http://www.nwrc.usgs.gov/factshts/020-00.pdf

U.S. Fish and Wildlife Service (USFWS). 2009. In cooperation with Louisiana Sea Grant Program: Louisiana Manatee Sightings from 1929 through 1996.

URS Corporation and Evans-Graves Engineers. 2007. Mississippi River reintroduction into Maurepas Swamp. Project PO-29. Vol. I-VII. Final Report for Louisiana Department of Natural Resources and U.S. EPA.

Visser, J.M. and G.W. Peterson. 1999. Survey of Louisiana seabird colonies to enhance oil spill response. Louisiana Applied and Educational Oil Spill Research and Development Program. OSRADP Technical Report Series 98-012.

Visser, J.M., R.H. Chabreck, and R.G. Linscombe. 2000. Marsh vegetation types of the Chenier Plain, Louisiana, USA. Estuaries 23(3): 318-327.

Visser, J.M., C.E. Sasser, R.H. Chabreck, and R.G. Linscombe. 1998. Marsh vegetation types of the Mississippi River Deltaic Plain. Estuaries 21: 818-828.

Vogel, H.D. 1930. Report on control of floods of the Lower Mississippi River, Annex no. 5, basic data Mississippi River. House Doc. 798, 71st Congress, 3rd session: 61-137.

Wakeley, J. S. and T. H. Roberts. 1996. Bird distribution and forested zonation in a bottomland hardwood wetland. Wetlands 6: 296-308.

Wang, F.C. 1987, 1988. Dynamics of saltwater intrusion in coastal channels. Journal of Geophysical Research 93.C6: 6937-6946.

Watson, M.B., C.J. Killebrew, M.H. Schurtz, and J.L. Landry. 1981. A preliminary survey of Blind River, Louisiana. American Fisheries Society. Warmwater Streams Symposium 1981, pp. 303-319.

Westbrooks, R.G. 1998. Invasive plants: changing the landscape of America. Federal Interagency Committee for the Management of Noxious and Exotic Weeds, Washington D.C., USA.

Wharton, C.H., W.M. Kitchens, E.C. Pendleton, and T.W. Sipe. 1982. The ecology of bottomland hardwood swamps of the southeast: a community profile. U.S. Fish and Wildlife Service FWS/OSB-81/37.

White, W.A. and T.A. Tremblay. 1995. Submergence of wetlands as a result of human-induced subsidence and faulting along the upper Texas Gulf Coast. J. of Coastal Research 11(3): 788-807.

Wicker, K.M., J.B. Johnston, and M.W. Young. 1980. Mississippi deltaic plain region habitat mapping study. Habitat area data tapes. U.S. Fish and Wildlife Service, FWS/OBS-79/07.

Wilhite, L.P. and J.R. Toliver. 1990. *Taxodium distichum* (L.) Rich. Baldcypress. Pages 563-572 *in* R.M. Burns and B.H. Honkala (tech. cords.). Silvics of North America, Vol. 1, Conifers, Agricultural Handbook 654, Washington, D.C.

Wilson, B.C., C.A. Manlove, and C.G. Esslinger. 2002. North American Waterfowl Management Plan, Gulf Coast Joint Venture: Mississippi River Coastal Wetlands Initiative. North American Waterfowl Management Plan, Albuquerque, NM. 28 pp. + appendix.

Young, P.J., B.D. Keeland, and R.R. Sharitz. 1995. Growth response of baldcypress [*Taxodium distichum* (L.) Rich] to an altered hydrologic regime. American Midland Naturalist 133: 206-212.

Zoller, J. A. 2004. Seasonal differences in bird communities of a Louisiana swamp and manipulation of the breeding density of Prothonotary Warblers. M.S. Thesis. Southeastern Louisiana University, Hammond, Louisiana. 136 pp.

9.4 Glossary

Acceptability	Adequate to satisfy a need, requirement, or standard. One of the USACE requirements for a project.
Adaptive Management	An interdisciplinary approach acknowledging our insufficient information base for decision-making; that uncertainty and change in managed resources are inevitable; and that new uncertainties will emerge. An iterative approach that includes monitoring and involves scientists, engineers and others who provide information and recommendations that are incorporated into management actions; results are then followed with further research, recommendations and management actions, and so on.
Air Quality Determination	The Louisiana Department of Environmental Quality ensures that projects do not adversely affect air quality through this determination as a requirement of the Clean Air Act.
Alternative Plan	A set of one of more management measures within a subprovince functioning together to address one or more objectives.
Anthropogenic	Caused by human activity.
Average Annual Habitat Unit (AAHU)	Represent a numerical combination of habitat quality and quantity (acres) existing at any given point in time. The habitat units resulting from the future without- and future with-project scenarios are annualized, averaged over the project life, to determine Average Annual Habitat Units (AAHUs).
Benefits	Valuation of positive performance measures.
Benthic	Living on or in sea, lake, or stream bottoms.

Biomass	The total mass of living matter (plant and animal) within a given unit of environmental area.
Bottomland Hardwood Forest	Low-lying forested wetlands found along streams and rivers.
Brackish Marsh	Intertidal plant community typically found in the area of the estuary where salinity ranges between 4-15 ppt.
Clean Water Act Section 404 (b) (1)	There are several sections of this Act which pertain to regulating impacts to wetlands. The discharge of dredged or fill material into waters of the United States is subject to permitting specified under Title IV (Permits and Licenses) of this Act and specifically under Section 404 (Discharges of Dredge or Fill Material) of the Act.
Coastal Zone Consistency Determination	The U.S. Environmental Protection Agency reviews plans for activities in the coastal zone to ensure they are consistent with Federally approved State Coastal Management Programs under Section 307(c)(3)(B) of the Coastal Zone Management Act.
Coastwide Plan	Combination of alternative plans assembled to address an objective or set of objectives across the entire Louisiana Coast.
Comprehensive Plan	Same as coast-wide Plan.
Conditional Authorization	Authorization for implementation of a project subject to approval of the project feasibility-level decision document by the Assistant Secretary of the Army for Civil Works.
Congressional Authorization	Authorization for investigation to prepare necessary feasibility-level report to be recommended for authorization of potential future project construction by

	Congress.
Connectivity	Property of ecosystems that allows for exchange of resources and organisms throughout the broader ecosystem.
Control Structure	A gate, lock, or weir that controls the flow of water.
Cumulative Impacts	The combined effect of all direct and indirect impacts to a resource over time.
Datum	A point, line, or surface used as a reference, as in surveying, mapping, or geology.
Decomposition	Breakdown or decay of organic materials.
Degradation Phase	The phase of the deltaic cycle when sediments are no longer delivered to a delta, and it experiences erosion, dieback, or breakup of marshes.
Deltaic Cycle	The repeating pattern of delta development, progression, and abandonment. As sediments are deposited at the mouth of the distributary channels, the delta progresses seaward. The main channel then switches to a new course with a shorter reach to the depositional basin. Abandoned delta lobes decrease in elevation due to continued subsidence and sediment compaction, resulting in retreat of the shoreline. Abandoned lobes may be partially or wholly covered by new lobes during later deltaic cycles.
Deltaic Deposits	Mud and sand deposited at the mouth of a river.
Deltaic Plain	The land formed and reworked as the Mississippi River switched channels in the eastern part of the Louisiana coastal area.

Detritus	The remains of plant material that has been destroyed or broken up.
Dewatering	The process of dredged sediments compacting while losing water after being deposited.
Discharge	The volume of fluid passing a point per unit of time, commonly expressed in cubic feet per second, millions of gallons per day, or gallons per minute.
Dissolved Oxygen	Oxygen dissolved in water, available for respiration by aquatic organisms. One of the most important indicators of the condition of a water body.
Direct Impacts	Those effects that result from the initial construction of a measure (e.g., marsh destroyed during the dredging of a canal). Contrast with "Indirect Impacts."
Diversion	A turning aside or alteration of the natural course or flow of water. In coastal restoration this usually consists of such actions as channeling water through a canal, pipe, or conduit to introduce water and water-borne resources into a receiving area.
Dredged material embankments (Dredged material berms, Side-cast Banks, Excavated Material Banks)	Dredged material removed from canals and piled in a linear mound along the edge of canals.
Dynamic	Characterized by continuous change and activity.
Ecological	Refers to the relationship between living things and their

	environment.
Economic	Of or relating to the production, development, and management of material wealth, as of a country, household, or business enterprise.
Ecosystem	An organic community of plants and animals viewed within its physical environment (habitat); the ecosystem results from the interaction between soil, climate, vegetation, and animal life.
Ecosystem Restoration	Activities that seek to return an organic community of plants and animals and their habitat to a previously existing or improved natural condition or function.
Effectiveness	Having an intended or expected effect. One of the USACE requirements for a project.
Efficiency	The quality of exhibiting a high ratio of output to input. One of the USACE requirements for a project.
Egress	A path or opening for going out; an exit.
Embankment	A linear mound of earth or stone existing or built to hold back water or to support a roadway.
Encroachment	Entering gradually into an area not previously occupied, such as a plant species distribution changing in response to environmental factors such as salinity.
Endangered Species	Animals and plants that are threatened with extinction.
Enhance	To augment or increase/heighten the existing state of an area.

Environmental Impact Statement (EIS)	A document that describes the positive and negative environmental effects of a proposed action and the possible alternatives to that action. The EIS is used by the Federal government and addresses social issues as well as environmental ones.
Estuary	A semi-enclosed body of water with freshwater input and a connection to the sea where fresh water and salt water mix.
Estuarine	Related to an estuary.
Evaporation	The process by which any substance is converted from a liquid state into, and carried off in, vapor; as, the evaporation of water.
Exotic Species	Animal and plant species not native to the area; usually undesirable (e.g., hyacinth, nutria, tallow tree, giant salvinia).
Feasibility Report	A description of a proposed action, previously outlined in a general fashion in a Reconnaissance Report, that will satisfy the Federal interest and address the problems and needs identified for an area. It must include an assessment of impacts to the environment (either in an Environmental Assessment, or the more robust Environmental Impact Statement), an analysis of alternative methods of completion, and the selection of a Recommended Plan through the use of a cost-effectiveness analysis.
Feature	A constructible increment of an alternative plan.

Final Array	The final grouping of the most effective coast wide plans from which a final recommendation can be made.
Fresh Marsh	Intertidal herbaceous plant community typically found in that area of the estuary with salinity ranging from 0-3 ppt.
Geomorphic	Related to the geological surface configuration.
Goals	Statements on what to accomplish and/or what is needed to address a problem without specific detail.
Gradient	A slope; a series of progressively increasing or decreasing differences in a system or organism.
Habitat	The place where an organism lives; part of physical environment in which a plant or animal lives.
Habitat Loss	The disappearance of places where target groups of organisms live. In coastal restoration, usually refers to the conversion of marsh or swamp to open water.
Habitat Units (HUs)	Represent a numerical combination of quality (HSI) and quantity (acres) existing at any given point in time. The HUs resulting from the future without- and future with-project scenarios are annualized, averaged over the project life, to determine Average Annual Habitat Units (AAHUs). The “benefit” of a project can be quantified by comparing AAHUs between the future without- and future with-project scenarios. The difference in AAHUs between the two scenarios represents the net benefit attributable to the project in terms of habitat quantity and quality.
Hazardous, Toxic, and Radioactive Wastes (HTRW)	Wastes that contain toxic constituents, or that may cause hazardous chemical reactions, including explosive or flammable materials, or radioactive wastes, which,

	improperly managed may present a hazard to human health or the environment.
Headland	A point of land projecting into the sea or other expanse of water, still connected with the mainland.
Herbaceous	A plant with no persistent woody stem above ground.
Hydrodynamic	The continuous change or movement of water.
Hydrology	The pattern of water movement on the earth's surface, in the soil and underlying rocks, and in the atmosphere.
Hypoxia	The condition of low dissolved oxygen concentrations.
Indirect Impacts	Those effects that are not as a direct result of project construction, but occur as secondary impacts due to changes in the environment brought about by the construction. Contrast with "Direct Impacts."
Infrastructure	The basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communications systems, water and power lines, and public institutions including schools, post offices, and prisons.
Inorganic	Not derived from living organisms; mineral; matter other than plant or animal.
Intermediate Marsh	Intertidal herbaceous plant community typically found in that area of the estuary with salinity ranging from 2-5 ppt.
Intertidal	Alternately flooded and exposed by tides.

Invertebrates	Animals without backbones, including shrimp, crabs, oysters, and worms.
Larvae	The stage in some animal's life cycles between egg and adult (most invertebrates).
Levee	A linear mound of earth or stone built to prevent a river from overflowing; a long, broad, low ridge built by a stream on its flood plain along one or both banks of its channel in time of flood.
Maintain	To keep in existing state.
Methodology	A set of practices, procedures, and rules.
Mineral Substrate	Soil composed predominately of mineral rather than organic materials; less than 20 percent organic material.
Mudflats	Flat, unvegetated wetlands subject to periodic flooding and minor wave action.
National Ecosystem Restoration (NER)	USACE standard for cost-effectiveness based on ecosystem, not economic, benefits.
National Environmental Policy Act (NEPA)	Ensures that Federal agencies consider the environmental impacts of their actions and decisions. NEPA requires all Federal agencies to consider the values of environmental preservation for all significant actions and prescribes procedural measures to ensure that those values are fully respected.
Net Gain	The amount of cumulative land gain less land loss, when gain is greater than loss.
Net Loss	The amount of cumulative land gain less land loss, when

	gain is less than loss.
No Action Alternative	The alternative in the NEPA document which describes the ecosystem of the coastal area if no restoration efforts/projects were done.
Nursery	A place for larval or juvenile animals to live, eat, and grow.
Objectives	More specific statements than "Goals," describing how to achieve the desired targets.
Organic	Composed of or derived from living things.
Oxidation of Organic Matter	The decomposition (rotting, breaking down) of plant material through exposure to oxygen.
Oxygen-depleted	Situation of low oxygen concentrations where living organisms are stressed.
Potable Water	Water that is fit to drink.
ppt	Parts per thousand. The salinity of ocean water is approximately 35 ppt.
Prime Farmland	Land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion. One of the categories of concern in the NEPA document.
Principles	Framing statements that can be used to evaluate alternatives while considering issues that affect them. Used along with targets and assessments of ecosystem needs to provide guidance in formulation of alternative

	plans.
Productivity	Growth of plants and animals.
Progradation	The phase during the deltaic cycle where land is being actively accreted through deposition of river sediments near the mouth.
Programmatic Environmental Impact Statement (PEIS)	And Environmental Impact Statement that supports a broad authorization for action, contingent on more specific detailing of impacts from specific measures.
Province	A major division of the coastal area of Louisiana. (e.g., Deltaic Plain and Chenier Plain).
Quantitative	Able to assign a specific number; susceptible to measurement.
Reduce	To diminish the rate or speed of a process.
Rehabilitate	To focus on historical or pre-existing ecosystems as models or references while emphasizing the reparation of ecosystem processes, productivity and service.
Relative Sea Level Rise	The sum of the sinking of the land (subsidence) and eustatic sea level rise; the change in average water level with respect to the surface.
Restore	Return a wetland to an approximation of its condition or function prior to disturbance by modifying conditions responsible for the loss or change; re-establish the function and structure of that ecosystem.
Salinity	The concentration of dissolved salts in a body of water,

	commonly expressed as parts per thousand.
Salt Marshes	See Saline Marsh.
Scoping	Soliciting and receiving public input to determine issues, resources, impacts, and alternatives to be addressed in the draft EIS.
Sea level	Long-term average position of the sea surface.
Sheet Flow	Flow of water, sediment, and nutrients across a flooded wetland surface, as opposed to through channels.
SEIS	Typically prepared after either a Final EIS or Record of Decision has been issued and new environmental impacts that were not considered in the original EIS are discovered, requiring the lead agency to re-evaluate its initial decision and consider new alternatives to avoid or mitigate the new impacts. Supplemental EISs are also prepared when the size and scope of a Federal action changes, or when all of the proposed alternatives in an EIS are deemed to have unacceptable environmental impacts and new alternatives are proposed.
Social	Relating to human society and its modes of organization.
Socioeconomic	Involving both social and economic factors.
Stabilize	To fix the level or fluctuation of; to make stable.
State Historic Preservation Office (SHPO)	The part of the Louisiana Department of Culture, Recreation, and Tourism that oversees consultation and compliance with Section 106 of the National Historic Preservation Act for Federally funded, permitted, or approved projects.
Storm Surge	An abnormal and sudden rise of the sea along a shore as a

	result of the winds of a storm.
Strategy	Ecosystem restoration concept from the Coast 2050 Plan.
Stream Gaging Data	Records of water levels in streams and rivers.
Submergence	Going under water.
Subprovince	The divisions of the two Provinces (see "Province") into smaller groupings: 1) east of the Mississippi River; 2) west of the Mississippi River to Bayou Lafourche; 3) Bayou Lafourche to Freshwater Bayou; 4) Freshwater Bayou to Sabine River.
Subsidence	The gradual downward settling or sinking of the Earth's surface with little or no horizontal motion.
Sustain	To support and provide with nourishment to keep in existence; maintain.
Target	A desired ecosystem state that meets an objective or set of objectives.
Terrestrial Habitat	The land area or environment where an organism lives; as distinct from water or air habitats.
Toxicity	The measure of how poisonous something is.
Transpiration	The process by which water passes through living plants into the atmosphere.
Turbidity	The level of suspended sediments in water; opposite of clarity or clearness.
Upland	A general term for non-wetland elevated land above low

areas along streams or between hills.

Water Resources Development Act (WRDA) — A bill passed by Congress that provides authorization and/or appropriation for projects related to the conservation and development of water and related resources.

Weir — A low head dam placed across a canal or river to raise, divert, regulate or measure the flow of water.

9.5 Acronyms

AAHU	Average Annual Habitat Unit
Ac	acres
ACM	Articulate concrete mattress
ADCIRC	Advanced circulation model
ADCM	Acoustic Doppler current meter
AM	Adaptive Management
ARE	Area of Potential Effect
APHIS	Animal and Plant Health Inspection Service
AQD	Air Quality Division
AQI	Air Quality Index
ARDC	Amite River Diversion Canal
ASA, CW	Assistant Secretary of Army, Civil Works
ASTM	American Society for Testing and Materials
BAI	Basal area increment
BMP	Best Management Practice
BOD	Biological Oxygen Demand
CECW-PB	Corps of Engineers Civil Works Policy Branch
CEMVN	Civil Engineering Mississippi Valley New Orleans
CE	Categorical Exclusions
CEQ	Council of Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIAP	Coastal Impact Assistance Program
CITES	Convention on International Trade in

	Endangered Species Of wild Fauna and Flora
CMD	Coastal Management Division
CN RR	Canadian National Railroad
COL	Colonies
CO-OPS	Center for Operational Oceanographic Products and Services
CPRA	Coastal Protection and Restoration Authority
CRMS	Coast-wide Reference Monitoring System
Cfs	Cubic feet per second
CWPPRA	Coastal Wetlands Planning, Protection, and Restoration Act
CW	Civil Works
CZM	Coastal Zone Management Act
DA	Diversion Alignment
DBH	Diameter at breast height
DEQ	Department of Environmental Quality
DNR	Department of Natural Resources
DO	Dissolved Oxygen
DOTD	Department of Transportation and Development
DS	Distribution System
DSEIS	Draft Supplemental Environmental Impact Statement
DV	Diversion System
EA	Environmental Assessment
EASL	East Ascension Sportsman League
E&D	Engineering and Design
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ELEV.	Elevation
EO	Executive Order
EPA	Environmental Protection Agency
ER	Engineering Regulation
ESA	Endangered Species Act
ESA	Environmental Site Assessment
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FMC	Fishery management council
FMP	Fishery management plan
FPEIS	Final Programmatic Environmental Impact Statement
FS	Feasibility Study
FWP	Fish and Wildlife Propagation

FY	Fiscal Year
GIWW	Gulf Intracoastal Waterway
GCLV	Gulf Coast Joint Venture
GOM	Gulf of Mexico
Ha	Hectares
HEP	Habitat Evaluation Procedures
HES	Habitat Evaluation System
HHS	U.S. Department of Health and Human Services
HQUSACE	Headquarters, US Army Corps of Engineers
HIS	Habitat Suitability Index
HTRW	Hazardous, Toxic and Radioactive Waste
HU	Habitat Unit
HWY	Highway
I	Interstate
IWR	Institute for Water Resources
KCS RR	Kansas City Southern Railroad
Km	Kilometers
Kg	Kilograms
L	Liter
LA	Louisiana
LAC	Louisiana Administrative Code
LACPR	Louisiana Coastal Protection and Restoration
LADAF	Louisiana Department of Agriculture and Forestry
LAGIC	Louisiana Geographic Information Center
LAMP	Louisiana Amphibian Monitoring Program
LCA	Louisiana Coastal Area
LCWCRTF	Louisiana Coastal Wetlands Conservation and Restoration Task Force
LDEQ	Louisiana Department of Environmental Quality
LDNR or LADNR	Louisiana Department of Natural Resources
LDWF or LADWF	Louisiana Department of Wildlife and Fisheries
LERRD	Lands, Easements, Rights of Way and Disposal Sites
LFC	Louisiana Forestry Commission
LIDAR	Light detection and ranging
LNHP	The Natural Heritage Program
LPBF	Lake Pontchartrain Basin Foundation

LPP	Locally Preferred Plan
LNG	Liquefied natural gas
LSU	Louisiana State University
M	Monitoring
MCACES	Micro-Computer Aided Cost Estimating System
MCL	Maximum Contaminant Level
MCY	Million Cubic Yards
Mg	Milligrams
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MRC	Mississippi River Commission
MRGO	Mississippi River Gulf Outlet
MR&T	Mississippi River and Tributaries Project
MSA	Metropolitan statistical areas
MTBE	Methyl-t-butyl ether
MVD	US Army Corps of Engineers, Mississippi Valley Division
MVN	US Army Corps of Engineers, Mississippi Valley Division, New Orleans
NA	No Action
NA	Not Available
NAAQS	National Ambient Air Quality Standards
NASS	National Agricultural Statistics Service
NAVD	North American Vertical Datum
NAVD88	North American Vertical Datum of 1988
NAWFMP	North American Waterfowl Management Plan
NED	National Economic Development
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NGO	Non-governmental Organization
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Agency
NPMS	National Pipeline Mapping System
NRCS	National Resources Conservation Service
NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Units
NWRC	National Wetland Research Center
O&M	Operation and Maintenance
OMRR&R	Operation, maintenance, repair, rehabilitation, and replacement
OCPR	Office of Coastal Protection and

	Restoration
ONR	Outstanding Natural Resource
ORCS	Old River Control Structure
PCR	Primary Contact Recreation
PCU	Pollution Control Unit
PEIS	Programmatic Environmental Impact Statement
PDDFS	Pre-Decisional Draft Feasibility Study
PDT	Project Development Team
PED	Preconstruction, engineering, and design
P&G	Principles and Guidelines
PHMSA	Pipeline and Hazardous Material Safety Administration
PL	Public Law
PLD	Pontchartrain Levee District
PM	Project Manager
PMP	Project Management Plan
PPA	Project Partnership Agreement
PPPMD	Planning, Programs & Project Management Division
Psu	Practical salinity units
QCP	Quality Control Plan
RA	Recreational Access
RE	Real Estate
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RR	Railroad
RSET	Rod-surface elevation table
RSLR	Relative Sea Level Rise
SA	Study Area
SCORP	Statewide Comprehensive Outdoor Recreation Plan
SCR	Secondary Contact Recreation
SD	Standard Deviation
SET	Surface elevation table
SHPO	State Historic Preservation Officer
SM	Sediment Management
SONRIS	Strategic Online Natural Resources Information System
S&A	Supervision & Administration
S&T	Science and Technology
SU	Standard Units
THPO	Tribal Historic Preservation Officer
TMDL	Total Daily Mass Load
TN	Total Nitrogen

TP	Total Phosphorous
TS	Transmission System
TSP	Tentatively Selected Plan
TSS	Total Suspended Solids
TY	Target Year
UDV	Unit Daily Value
US	United States
USACE	U.S. Army Corps of Engineers
USACE-MVN	U.S. Army Corps of Engineers – Mississippi Valley New Orleans District
USAED	U.S. Army Engineer District
U.S.C.	United States Code
U.S.C.A.	United States Code Annotated
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDOT	United States Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VM	Vegetation Management
VOC	Volatile Organic Compounds
WCRA	Wetlands Conservation and Restoration Authority
WQ	Water Quality
WM	Water Management
WMA	Wildlife Management Area
WRDA	Water Resources Development Act
WVA	Wetland Value Assessment

MAIN REPORT

ATTACHMENT 1

Non-Federal Sponsor's Letter of Intent

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CPRA
Coastal Protection and
Restoration Authority of Louisiana

Colonel Edward R. Fleming
New Orleans District
U.S. Army Corps of Engineers
P.O. Box 60267
New Orleans, LA 70160-0267

August 9. 2010

Dear Col. Fleming:

The State of Louisiana is pleased to offer its continuing support of the Louisiana Coastal Area (LCA) Multi-purpose Operation of the Houma Canal Lock, Terrebonne Basin Barrier Shoreline Restoration, Small Diversion at Convent/Blind River, Amite River Diversion Canal Modification, Medium Diversion at White's Ditch, and Convey Atchafalaya River Water to Northern Terrebonne Marshes projects as authorized in the Water Resources Development Act of 2007 (WRDA 2007). These projects are a critical part of the overall LCA Program and a vital component in rehabilitating the natural system of coastal Louisiana that serves to protect the economic and energy security of both the state and nation, the safety of more than 2 million Louisiana residents, the ecological balance of the Gulf region, and the survival of a unique culture.

This letter, while not legally binding on the State as an obligation of future funds appropriated by the State Legislature, declares our full support for the LCA Multi-purpose Operation of the Houma Canal Lock, Terrebonne Basin Barrier Shoreline Restoration, Small Diversion at Convent/Blind River, Amite River Diversion Canal Modification, Medium Diversion at White's Ditch, and Convey Atchafalaya River Water to Northern Terrebonne Marshes projects as described in the draft reports dated August 2010, with cost sharing as required in WRDA 2007. Accordingly, the State acknowledges that the projects require the non-Federal sponsor to contribute 35% of the total project costs, including all lands, easements, rights-of-way, relocations, and any improvements on lands, easements, and rights-of-way required for disposal of dredged material. The State also acknowledges that it will be required to perform all activities necessary to operate, maintain, rehabilitate, repair and replace the projects at the State's expense, including the performance of renourishment for the Terrebonne Basin Barrier Shoreline Restoration Project features as described in the feasibility report for that project. The State of Louisiana fully supports these projects, and the Coastal Protection and Restoration Authority will make diligent efforts to secure all necessary funding, including asking the State legislature for additional appropriations if necessary. Nevertheless, the Coastal Protection and Restoration Authority and the State of Louisiana reserve the right to seek the enactment of Federal law to reduce the non-Federal cost share.

1051 North 3rd Street Capitol Annex Bldg. Suite 138 | Baton Rouge, LA 70802 | Phone: 225.342.3968 Fax: 225.342.5214

The State of Louisiana and the Coastal Protection and Restoration Authority whole-heartedly endorse this and other Corps' efforts to restore Louisiana's coastal ecosystem, and we look forward to working with the Corps on the implantation of these important projects.

Respectfully,

Garret Graves
Chair
Coastal Protection and Restoration Authority