LOUISIANA COASTAL AREA (LCA) ECOSYSTEM RESTORATION STUDY

Volume II of VI

Final Integrated Feasibility Study and Supplemental Environmental Impact Statement

for the

Amite River Diversion Canal Modification Ascension and Livingston Parishes, 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

This report contains six volumes.

You are at **Volume II** which is the element-specific analysis for the
The Louisiana Coastal Area-Amite River Diversion Canal Modification Element.

Volume I:	Summary
Volume II:	**Amite River Diversion Canal Modification**
Volume III:	Atchafalaya Conveyance to N. Terrebonne Marshes
Volume IV:	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 Amite River Diversion Canal (ARDC) Modification Project

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

ABSTRACT: The USACE proposes to dredge openings in the existing ARDC dredged material berm, construct bifurcated conveyance channels, and establish vegetative plantings in the study area. The natural hydrology in the study area has been modified by the ARDC and a railroad grade. Sea level changes and geological subsidence have compounded these effects, leading to poor swamp health and ecosystem degradation. This project would establish hydrologic connectivity between the ARDC and the western Maurepas Swamp, allowing the swamp to drain during seasonal low-flow conditions in the Amite River and promoting the germination and survival of the seedlings of bald cypress and other trees. This connectivity would allow nutrients and sediments to be introduced into the swamp during flood events and localized rainfall events and improve biological productivity.

Without action, the swamp habitat surrounding the ARDC would continue the conversion from a freshwater swamp to freshwater marsh and open water. Direct impacts would be the continued impoundment of swamp water within the study area, decreased hydrologic connectivity, and a transition toward marsh and salinity tolerant vegetation. Indirect effects would be the decline of wildlife, fishery, and vegetative resources. Flora and fauna may change as salt-tolerant species replace fresh water species. Existing habitat would convert to waterbottoms and alter the benthic community, decreasing available nutrients and detritus. Cumulative impacts would be the projected conversion of 18,204 acres of swamp to fresh marsh and open water. The water and air treatment functions of wetlands would subside, and the integrity of existing resources within the study area would be endangered.

Excluding the No-Action Alternative, the final array of alternatives included seven options. Alternative 33 was chosen as the recommended plan. It would restore 1,602 acres of swamp habitat, create 679 Average Annual Habitat Units (AAHUs), 5.0 acres of bottomland hardwood habitat, establish hydrologic connectivity, promote the germination and survival of the seedlings of bald cypress and other trees, and improve biological productivity. According to the Micro-Computer Aided Cost Estimating System (MCACES), the total fully funded estimated cost for construction of this alternative would be $8,540,000.

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 Final SEIS appeared in the Federal Register.

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EXECUTIVE SUMMARY

ES.1 SUMMARY INTRODUCTION AND STUDY INFORMATION

Title VII of the Water Resources Development Act (WRDA) 2007 authorizes the Louisiana Coastal Area (LCA) program. This authorization was recommended by the Chief of Engineer's Report, dated January 31, 2005. This report recommended projects and features that reintroduce historical flows of river water, nutrients, and sediment to coastal wetlands; restore coastal hydrology to minimize saltwater intrusion; and maintain the structural integrity of the coastal ecosystem. One project feature of this recommendation was modifications to the Amite River Diversion Canal (ARDC).

This report concerns the LCA ARDC Modification project, located along the ARDC in Ascension and Livingston parishes, in the vicinity of Head of Island, Louisiana. Prior studies and reports have documented degradation in the swamp adjacent to the ARDC and have demonstrated a need for ecosystem restoration that simulates historical hydrologic conditions. This project would establish hydrologic connectivity between the ARDC and the western Maurepas Swamp, allowing the swamp to drain during seasonal low-flow conditions in the Amite River and promoting the germination and survival of the seedlings of bald cypress and other trees. This connectivity would also allow nutrients and sediments to be introduced from the ARDC into the swamp during flood events and from runoff during localized rainfall events. Nutrients and sediment delivered to the swamp would improve biological productivity and reduce the chances of further habitat deterioration. Finally, the establishment of hydrologic connectivity would reduce the likelihood of the swamp being converted to marsh or open water.

Louisiana contains one of the largest expanses of coastal wetlands in the contiguous United States and accounts for 90 percent of the total coastal wetland loss occurring in the Nation. The Maurepas Swamp complex is the second largest continuous coastal forest in Louisiana, comprising over 190,000 acres of freshwater swamp habitat. The LCA ARDC study area is an essential ecosystem since it includes wetland habitats and provides high fish and wildlife value as well as habitat for migratory birds and other aquatic organisms including threatened or endangered species.

ES.2 NEED FOR AND OBJECTIVES OF ACTION*[1]

The natural processes of subsidence, habitat switching, and erosion of wetlands, combined with a widespread human alteration, have increased rates of wetland loss

[1] An asterisk denotes paragraphs that are required for National Environmental Policy Act (NEPA) compliance.

and ecosystem degradation. Without action, Louisiana's coastal ecosystem is not sustainable. This loss of sustainability has manifested itself as accelerated land loss. Coastal Louisiana is projected to lose an additional 328,000 acres of coastal marshes, swamps, and barrier islands by the year 2050. The following ecosystem functions are at risk:

- Vegetative habitat suitability and community diversity;
- Elevational maintenance and soil contribution from decomposing organic material;
- Protection against substrate erosion;
- Water quality improvement;
- Nutrient uptake and carbon sequestration;
- Important nursery habitat;
- North American Central Flyway and North American Mississippi Flyway waterfowl;
- wintering habitat; and
- Resting and feeding areas for neotropical migrants.

The natural hydrology within the study area has been modified by the construction of the ARDC and a railroad grade. Sea-level rise and geological subsidence have compounded the effects of these modifications. This has led to poor swamp health and ecosystem degradation including surge-related saltwater intrusion; impoundment of water; and lack of freshwater, sediment and nutrient input. Functions of the freshwater swamp lost include habitat for wildlife and aquatic species, recreational opportunities, aesthetics, and storm surge protection. Upon severe degradation; the swamp will convert to freshwater marsh, then to open water.

Investigation led to the establishment of the following planning objectives to be implemented within the study area over the 50-year period of analysis:

- Increase hydrologic connectivity between the degraded swamp and bottomland hardwood habitats within the study area and the ARDC by increasing the exchange of freshwater, sediments, and nutrients over the 50-year period of analysis.
- Reduce habitat conversion of swamp to open water within the study area over the 50-year period of analysis.
- Facilitate natural hydrologic cycle within the study area over the 50-year period of analysis by reducing impoundment in degraded swamp and bottomland hardwood habitats adjacent to the ARDC to improve tree productivity and seedling germination.
- Improve fish and wildlife habitat within the study area over the 50- year period of analysis.

The LCA ARDC Modification project is designed to be within the scope of the LCA 2004 report. The goal of the LCA Plan is to reverse the current trend of degradation of the coastal ecosystem using restoration strategies that: reintroduce historical flows of river water, nutrients, and sediment to coastal wetlands: restore coastal hydrology to minimize saltwater intrusion; and maintain the structural integrity of the coastal ecosystem (LCA, 2004).

ES.3 ALTERNATIVES*

PLANNING CONSTRAINTS

Specific Planning Constraints identified for the LCA ARDC Modification project include the following:

Flood Control: The ARDC is a component of the AR&T (1956) flood control channel. Project plans must not significantly decrease the performance and original intent of the ARDC and the Amite River and Tributaries (AR&T) project.

Designated Scenic Rivers: Blind River, located within the study area, is a designated Scenic River. Designated Scenic Rivers are protected by a set of use restrictions including channelization, clearing and snagging, channel realignment, reservoir construction, and commercial cutting or harvesting of trees or timber in violation of the Louisiana Scenic Rivers Act.

Hydroperiod: Water levels within the ARDC exhibit seasonal high channel flow and low channel flow intervals. The natural variability of the hydroperiod necessitates a project design that allows the project to function as intended under a variety of flow regimes.

Other items that were taken into consideration during plan development and plan selections include:

Drainage Infrastructure: Formulating a project design that does not impair the capacity of the existing drainage system with additional waters would help to ensure that residential flooding is minimized in the area.

Recreation: Minimize disruption of existing recreational use of the area and ARDC vessel traffic to the extent practicable.

Existing Development: Existing residential structures and recreational facilities along portions of the ARDC dredged material berms may pose design challenges.

Water Quality: Planning objectives of the proposed project include the periodic draining of the swamp during low-flow intervals in the channel and flushing the adjacent habitat during high-flow intervals. Swamps may release phosphorus sequestered within their substrates as well as other constituents when subjected to a freshwater reintroduction. Project design should minimize potential negative impacts to downstream water quality.

U.S. ARMY CORPS OF ENGINEERS (USACE) ENVIRONMENTAL OPERATING PRINCIPLES

In 2002, the USACE formalized a set of Environmental Operating Principles applicable to decision-making in all programs. The principles are consistent with National Environmental Policy Act (NEPA); the Army Strategy for the Environment; other environmental statutes, and the WRDAs that govern USACE activities. The Environmental Operating Principles inform the plan formulation process and are integrated into all project management processes. A further discussion of how the alternatives were formulated for this project consistent with the Environmental Operating Principles can be found in the main report.

WETLAND VALUE ASSESSMENT (WVA) MODEL

Wetland Value Assessment (WVA) models are ecological benefit models designed to evaluate the existing, Future Without Project (FWOP), and Future With Project (FWP) condition. The WVA produced Average Annual Habitat Units (AAHUs), a measure of change, for the 50-year period of evaluation when comparing the FWP to the FWOP. The Habitat Suitability Index (HSI) is a unitless number bounded by 0 and 1 where 0 represents no habitat and 1 represents optimum habitat.

The WVA calculates the benefits (FWP as compared to the FWOP) for years 0, 1, 10, 25, and 50. The habitat units for each from year 1 to year 50 are calculated. The cumulative habitat units generated for the 50 year period of analysis (2012 - 2062) divided by 50 will determine the AAHU. Thus the WVA accounts for tree growth and the timing for ecological restoration.

ES.4 ALTERNATIVES*

A total of 105 structural and non structural measures and 45 alternatives were considered and evaluated as part of the USACE planning process. All measures and alternatives were evaluated for ecosystem benefits, cost-effectiveness, and environmental impacts. Excluding the No-Action Alternative, the final array of alternatives included seven options, each including openings in the north and/or south banks of the ARDC, bifurcated conveyance channels, sidecasting of dredged material in alternating berms along the proposed conveyance channels, cuts in an existing railroad grade, and both dredged material berm and swamp floor vegetative plantings.

Recommended Plan

Alternative 33, which addresses the most-highly degraded portion of the study area, has been chosen as the Recommended Plan. Alternative 33 is an implementable element of the National Ecosystem Restoration (NER) plan, is within the cost and scope of the authorization, has stand-alone utility, and can be justified based on ecosystem restoration benefits.

Alternative 33 includes:

- Three dredged material bank openings and three bifurcated conveyance channels in the north bank of the ARDC in NE-2 with the westernmost channel in the north bank of the ARDC also extending through the railroad grade into NE-1 to add connectivity between NE-1, NE-2, and the ARDC.
- Dredged material (5.0 acres) from the bank openings and the conveyance channel would be sidecast in alternating berms so sheet flow is not reduced.
- One cut would be created in the railroad grade approximately 0.9 of a mile north of the ARDC to improve sheet flow.
- Vegetative plantings of bottomland hardwood/freshwater swamp tree species on 5.0 acres of dredged material berms.
- Vegetative plantings of freshwater swamp tree species within 438 acres of the swamp floor.
- Installation of nutria guards on all newly planted trees to protect against tree loss.

Alternative 33 would meet the established objectives by:

- Restoring and benefitting 1,602 acres of freshwater swamp habitat;
- Creating a net of 679 AAHUs;
- Creating 5.0 acres of bottomland hardwood habitat;
- Establishing hydrologic connectivity between the ARDC and the western Maurepas Swamp;
- Reducing the likelihood of the swamp being converted to marsh or open water;
- Promoting the germination and survival of the seedlings of bald cypress and other trees;
- Improving biological productivity and reducing further habitat deterioration.

NATIONAL ECOSYSTEM RESTORATION (NER) PLAN

Alternative 39 was chosen to be the NER plan. This plan includes all the areas in the final array including the areas with the critical need of restoration (have already begun converting to marsh) and an additional area that is expected to need restoration in the next 20 years. This proposed action provides 1,602 average annual habitat units for the impact areas and represents the long term restoration need for the area. This plan exceeds the WRDA 2007 cost authorization. Features of Alternative 39 include:

- Three dredged material bank openings and three bifurcated conveyance channels in the north bank of the ARDC in NE-2 with the westernmost cut in the north bank of the ARDC also extending through the railroad grade into NE-1 to add connectivity between NE-1 and NE-2.
- One dredged material bank opening and one bifurcated conveyance channel in the south bank of the ARDC in SE-1 with the conveyance channel extending through the railroad grade into SE-1 to add connectivity between SE-1 and SE-2, and the ARDC.
- One opening and one conveyance channel in the south bank of the ARDC in SE-1. Dredged material (9.9 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps will be left in the disposal berms so sheet flow is not reduced.
- Three cuts would be created in the railroad grade to improve sheet flow. One cut would be approximately 0.9 miles north of the ARDC. The second cut would be approximately 0.9 miles south of the ARDC. The third cut would be approximately two miles south of the ARDC.
- Initial and secondary vegetative plantings of bottomland hardwood/ freshwater swamp tree species on 9.9 acres of dredged material berms.
- Initial and secondary vegetative plantings of freshwater swamp tree species within 925 acres of the swamp floor.
- Installation of nutria guards on all newly planted trees to protect against tree loss.

SEA LEVEL RISE

Within the LCA ARDC study area, sea-level rise is predicted to occur from 1.5 ft (0.46 m) to 3.2 ft (0.97 m) over the 50-year period of analysis. In order to gauge the effects of Relative Sea Level Rise (RSLR) on the selected plans, the WVA model was run for Alternative 33 (Recommended Plan) and Alternative 39 (NER) over the 50-year period of analysis. Section 3.8 of the report discusses the impacts of various RSLR estimates on the benefits obtained for the Recommended Plan and NER plans.

ES.5 AFFECTED ENVIRONMENT*

Climate, Geomorphic and Physiographic Setting: The study area is located in the southeastern portion of Louisiana, approximately 30 miles southeast of Baton Rouge, Louisiana. The climate is subtropical marine with long humid summers and short moderate winters. The study area is susceptible to tropical waves, tropical depressions, tropical storms, and hurricanes. These cause considerable property and environmental damage and loss of human life.

Hurricanes Katrina, Rita, Gustav, and Ike did not have a significant direct impact on the study area; there was little wind and wave damage. These did have an indirect effect due to the introduction of higher-salinity storm surge waters into the impounded swamps within the LCA ARDC study area. This salt intrusion reduces biomass production and impairs health, which increases tree mortality, decreases soil production and integrity, and increases relative subsidence (Coastal Wetlands Planning, Protection, and Restoration Act [CWPPRA] Task Force, 2002). These higher-salinity storm surge waters become impounded by the dredged material berms along the ARDC and are not drained from the swamps. Consequently, salinity is increased in impounded waters and soils in the study area. Increased connectivity through the ARDC dredged material berms would allow the large headwater event that normally follows a tropical storm to flush the higher salinity waters out of the swamp before it has an opportunity to infiltrate into the substrate.

Soils and Waterbottoms: The study area is located in the Maurepas Basin, a component of the Lake Pontchartrain Basin, located near the southern terminus of the Mississippi Alluvial Plain physical province. Construction of the AR&T (1956) flood control project, which includes the ARDC, has impacted the geomorphology of the St. Bernard Delta complex.

Hydraulics and Hydrology: Hydrologic analyses within the study area indicate that the ARDC and its dredged material berms have prevented the adjacent bald cypress-tupelo swamp habitat from receiving nutrient and sediment during high channel flow events and have prevented draining during low channel flow events in the lower Amite River system.

Water Quality and Salinity: Human developments result in wastewater and polluted runoff. The continued conversion of swamp habitat to marsh and open water reduces natural filtration of water. Elevated salinities caused by impoundment of storm-driven higher-salinity waters and the subsequent absorption of salt into the substrate contribute to the degradation of the forested swamp and its conversion to marsh and open water.

Air Quality: The study area was in nonattainment for the interval 2004-2007 for ozone.

Noise: The noise from distant urban areas has little impact on the area. As the population in the study area continues to grow, some noise pollution would occur. The ambient noise caused by boat traffic and human activity in the ARDC, Amite and Blind rivers may cause disturbances.

Vegetation and Wildlife Resources: The study area is considered "coastal wetland," which forms in sheltered coastal environments in conjunction with river deltas, barrier islands, and estuaries. They are rich in wildlife resources and provide nesting grounds and stopovers for waterfowl and migratory birds, as well as spawning areas and valuable habitats for fish. Intertidal and subtidal bottoms are populated by communities of macrofauna whose structure is dependent upon substrate, salinity, temperature, depth, and ecological relationships.

Benthic, Plankton, Fishery Resources and Essential Fish Habitat (EFH): Construction of the ARDC and dredged material berms has prevented exchange of organisms and water between the swamp and the ARDC.

The benthic community is seasonally abundant, typically during winter months. Phyto-plankton, microscopic plants, and zooplankton can be found in the vicinity of the ARDC and are important for their role in nutrient cycling and are a major source of primary food-energy for most estuarine systems.

The fish species assemblage in the vicinity of the ARDC is primarily composed of freshwater species, with occasional transient marine and diadromous species.

The area provides some habitat for a few euryhaline species, but is not classified as EFH.

Threatened and Endangered Species: The U.S. Fish and Wildlife Service (USFWS), in a letter dated January 20, 2009, identified two threatened and endangered species (Gulf sturgeon and West Indian manatee) and one delisted species (bald eagle) that are known to occur within the area.

Cultural Resources: Five archaeological sites were identified within or immediately adjacent to the study area, including a mound site on the Bayou Chene Blanc bankside, shell middens on Bayou Chene Blanc (two sites) and ARDC (one site north of the study area) banksides, and a shell midden and prehistoric scatter on the lower Amite River bankside. The mound site on Bayou Chene Blanc could not be located and is presumed to be destroyed. Two cultural resources were identified: the railroad grade of the Garyville Northern Railroad (I6LVI 02) and the Amite River Diversion Canal (16LV I03/I6AN84*)* (ARDC). Neither the ARDC nor the railroad grade are eligible for the National Register of Historic Places.

Aesthetics: Aesthetic resources in the study area were negatively impacted by hurricanes Katrina, Rita, Gustav, and Ike. Blind River is a designated Scenic River. The study area encompasses approximately 24,000 acres of undeveloped bald cypress-tupelo swamp habitat in the western Maurepas Swamp. The visual complexity surrounding the study area's waterfront properties, bayous, and coastal swamp habitat provides a pleasing aesthetic to the public eye.

Recreation: Recreational activities such as hunting, trapping, and fishing exist within the study area.

Socioeconomic Resources – Employment: Total employment in Ascension and Livingston parishes is increasing. Employment and income resources are primarily retail, and restaurants.

Socioeconomic Resources – Community Cohesion: The three communities within the study area are Berthelot's Campground, Waterfront East, and Three Rivers Island. The three communities are internally homogeneous and not related to each other.

Socioeconomic Resources – Environmental Justice and Population: Population in the vicinity of Head of Island has 30-40 percent minority composition. The entire study area is characterized by poverty levels of less than 20 percent.

Socioeconomic Resources – Infrastructure: State and local roads, railroad grade, overhead distribution lines, and underground telephone lines traverse the study area.

Socioeconomic Resources – Business and Industry: Six businesses are in the study area. Two unnamed local cypress lumber mills process logs extracted from the region. A Recreational Vehicle (RV) park contains six covered spaces. The Blind River Bar is located south of the ARDC at its confluence with the Blind River and is accessible only by water.

Socioeconomic Resources – Traffic and Transportation: State and local roads traverse the study area. Louisiana Highways 22 and 16 are the major roads in the study area.

Socioeconomic Resources – Public Facilities and Services: The study area is not serviced by a municipal sewer system. Wastewater Treatment of Louisiana, Inc. provides sewer service to the two Blind River Properties developments along the left descending bank of the ARDC. Properties within the study area not served by private companies use septic systems.

Socioeconomic Resources – Local Government Finances, Community and Regional Growth, Tax Revenue and Property Values: Increasing population growth is resulting in increased local government finances, tax revenue and property values. It is also increasing the community and regional growth.

Socioeconomic Resources – Agriculture and Forestry: Approximately 373 acres of agricultural lands, primarily livestock pastures are present. Little timber harvesting occurs within the study area. However, submerged cypress logs are extracted and processed by local timber mills. Recreational activities in the study area include hunting for white-tailed deer, squirrels, rabbit and raccoons; fishing for largemouth bass, bream, and crappie; and trapping alligators and nutria. Some waterfowl hunting occurs in the WMA near the study area.

Merchantable size timber was found only on the ridges in the study area; however, marketability was considered doubtful due to inaccessibility.

Socioeconomic Resources – Public Lands: A portion of the Maurepas Swamp WMA is located within the southwestern study area. Recreational activities in the WMA include hunting, fishing and trapping.

Socioeconomic Resources – Water Use and Supply: The study area for this project lies on the Chicot Equivalent aquifer system, identified by the Environmental Protection Agency (EPA) as a sole-source aquifer. The study area also lies on the southern edge of both the Evangeline Equivalent aquifer system and the Jasper Equivalent aquifer system

Socioeconomic Resources – Navigation: No Federal navigation channels exist within the study area. The Amite River and Bayou Manchac Federal navigation channel is present along the northwestern boundary of the study area.

Navigable waterbodies within the study area include the ARDC, the Petite Amite River, Blind River, and portions of Bayous Pierre and Chene Blanc.

Socioeconomic Resources – Oil, Gas, and Utilities: The western Maurepas Swamp has undergone significant oil and gas exploration activity. However, most oil and gas exploration and production activities in the region have occurred southwest of the study area.

Socioeconomic Resources – Flood Control and Hurricane Protection Levees: The AR&T flood control project was completed in 1964. Municipal and parish flood control measures, including drainage canals and control structures are present.

Socioeconomic Resources – Commercial Fisheries and Oyster Leases: The fishes of the LCA ARDC study area primarily consist of freshwater species, with occasional transient marine and diadromous species. There are no oyster leases located within the study area.

Environmental and Hazardous Toxic and Radiological Waste (HTRW): A limited HTRW survey and Phase I Environmental Site Assessment were conducted for the study area to identify recognized environmental condition (REC) sites or potential REC sites in connection with the study area. None of the potential REC sites would be likely to expose the public or construction workers to HTRW or to adversely affect the project.

ES.6 ENVIRONMENTAL CONSEQUENCES*

A comparison of the direct, indirect, and cumulative impacts for alternatives to reverse the trend of degradation in the western portion of the Maurepas Swamp was conducted. The No-Action Alternative is compared to the alternatives retained for detailed analysis. The No-Action Alternative is considered to be the same as the FWOP condition and analyzes the future conditions of the resource over a 50-year period of analysis (2012-2062).

No-Action Alternative: Without Federal action, the swamp habitat surrounding the ARDC would continue the eventual conversion from a freshwater swamp to a freshwater marsh and open water. The direct impacts would be the continued impoundment of swamp water within the study area, decreased hydrologic connectivity, and a transition towards marsh and salinity-tolerant vegetation. The demographics and economic conditions within the study area would remain stable. Storm surges from tropical cyclone events would increase salinity levels, and the frequency of saltwater inundation is expected to increase with RSLR.

Indirect impacts would be the decline of wildlife, fishery, and vegetative resources. Flora and fauna species could experience stress due to saline waters not being flushed from the system, and may change as salt-tolerant species replace fresh water species. Existing swamp habitat would convert to water bottoms and alter the benthic community, decreasing available nutrients and detritus. The habitat quality would degrade, creating a stressful environment for species present.

Diminished viewscapes for the study area would result. Existing and future infrastructure present within the study area would be affected due to land loss. A portion of the Maurepas WMA is the only public lands in the study area and would be affected. There would be increased exposure of existing oil, gas, and utility pipelines to coastal land loss which would increase operations, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs, as well as increase the required investment in facilities and pipelines. Coastal forest habitat provides protection from tropical cyclone events, consequently, there could be an increase in storm surge and risk of flooding. Wetland loss would impact commercially important species, including black drum, brown and white shrimp, and blue crab, leading to declining abundances.

Cumulative impacts would be shoreline erosion and land loss resulting in a projected conversion of 18,204 acres of swamp to fresh marsh and open water. There would be decreased flows into and out of the swamp, increased water levels due to coastal wetland loss and increased runoff due to increased urbanization of the Pontchartrain Basin. The water and air treatment functions of wetlands would subside. The integrity of existing recreational resources and aesthetics within the study area would be endangered. Property values may fall as wetlands continue to degrade. Public lands would be adversely affected. Localized storm surge and storm wave damages are likely to increase. A loss of commercial fishery habitat is likely. Impacts on all forms of vegetation include continued deterioration and loss of vegetation and wetland habitat acreage. Continued nationwide wetland loss would lead to increased acreage of shallow water bottoms. Benthic populations and plankton would respond to perturbations with a shift towards saline-oriented species. Land loss within the study area threatens the existence and integrity of cultural and historic resources. Loss of vegetation would degrade the visually complex environment and reduce opportunities for viewing wildlife. The degradation and loss of wetlands would contribute to increased maintenance costs of infrastructure. Current subdivisions within the study area may expand, creating additional roads, bridges and utilities. As populations migrate to coastal communities, investment in hurricane and flood control levees, pump stations, and other flood control facilities are likely to increase.

Alternative 33 (Recommended Plan): Implementation of Alternative 33 (Recommended Plan) would reverse the conversion of swamp habitat to open water and would improve 1,602 acres of swamp habitat and create 5.0 acres of upland habitat within the study area.

Direct impacts would result from construction activities associated with the removal of the existing dredged material berm, dredging of new conveyance channels, and placement of dredged material to create bottomland hardwood islands along conveyance channels. The appropriate Best Management Practices (BMPs) would be implemented to limit introduction of sediments. Cutting through the berms and stockpiling dredged sediments would directly impact water quality by introducing sediments. Sediment introduction would temporarily increase total suspended and dissolved solids, turbidity, as well as increase total metals and nutrients. There would be an increase in water flow into and out of the swamp depending on ARDC stages, tidal activity and flow. Water level fluctuations would occur in swamp habitats adjacent to ARDC. Restoring hydraulic connectivity would temporarily and periodically allow impounded swamp waters that are low in dissolved oxygen and high in biochemical oxygen demand (BOD), chlorides and nutrients to enter the waterways. Vegetative plantings would necessarily involve human access into areas that have rarely been disturbed. Fresh water would be introduced into the forested swamp, reducing salinity, chloride, and total dissolved solids concentrations. Initial and future periodic releases of waters of potentially higher salinities from the impounded areas may impact the flowing water bodies by temporarily increasing these parameters in the areas surrounding the cuts. Ambient air quality impacts would be temporary and localized, resulting from emissions of construction equipment, but would be negligible. Noise impacts may impact fish and wildlife species, but these would generally avoid the construction area. Construction activities would directly affect vegetation in the areas of the new conveyance channels and cuts in the existing ARDC dredged material berm. Riparian habitat would be created along the conveyance channels, and wetland vegetation would be planted. Direct impacts to benthic resources and plankton would be associated with construction activities including dredging and placement of borrow material. Precautions have to be taken with regard to the Gulf sturgeon, West Indian manatee and bald eagle. Viewscapes would temporarily be disturbed by construction activities.

Indirect impacts would include improved hydrological connectivity between the ARDC and the adjacent swamp. This would allow nutrients and sediments to be introduced from the ARDC into the swamp during flood events and would improve biological productivity and reduce the chances of further habitat deterioration or conversion to marsh or open water. Dissolved organic compounds and detritus would increase. The ARDC's Fish and Wildlife Propagation use is currently listed as impaired due to mercury, chloride and total suspended solids. The release of swamp waters into the system may cause continued impairments. Implementation is expected to improve water quality, thereby improving growth and health of the cypress-tupelo forest. The cycle of inundation and drying of the swamp would be partially restored, helping to prevent salt water intrusion and degradation of the forested wetland. Particulates and gaseous air pollutants would be reduced, increasing air quality. Smothering of benthic organisms may also occur from dredge plume resettlement, but these impacts would be minimized through the use of silt curtains or other measures. Increased nutrients and detritus would provide increased benefits to plankton. Algal blooms may occur if phosphorus sequestered in swamp sediments is released into surface waters. Land loss and erosion prevented would benefit threatened cultural and historic resources in the area. High quality emergent wetland viewscapes would increase visual complexity. An increase in substrate quality would result in the preservation and retention of existing infrastructure. Environmental easements would be placed within the areas of impact. A restoration of coastal forest habitat would occur.

Cumulative impacts would be the effects of this alternative with the additive combination of impacts and benefits for overall net acres nourished and protected by other Federal, state, local and private restoration efforts. A net total of 1,602 acres of wetland soils would be hydrologically restored and nourished; 2.6 acres of soils along ARDC berms and 28.6 acres of existing swamp soils would be impacted by the construction of conveyance channels; however these sediments would be used to construct 5.0 acres of bottomland hardwood islands. The amount of deepwater waterbottoms created from the construction of the conveyance channels would be 18.6 acres. Dissolved organic compounds and detritus from the swamp would increase. The water purification function of a swamp would increase. Water quality and the overall health of the forested swamp would improve. Noise levels would return to preconstruction conditions. Upland habitat would be created and would simulate existing upland and riparian habitat. Wetland creation and nourishment would alter the plankton and benthic community and would result in greater resources for these organisms. Appealing viewscapes supporting eco-tourism as one travels Louisiana's remote areas would be maintained. There would be a reduced level of infrastructure damages and relocation compared to the No-Action Alternative. Environmental easements would be implemented within the areas of impact. The restoration of the forest would result in localized storm surge protection and a decrease in wave heights. Overall, the fishing industry would be more stable near the study area due to a long-term increase in the quality of fisheries habitat.

Alternative 34: Impacts resulting from the implementation of Alternative 34 would be similar to those of Alternative 33 (Recommended Plan), except 1,459 acres of swamp habitat would be improved and 2.7 acres of upland habitat would be created.

Alternative 35: Impacts resulting from the implementation of Alternative 35 would be similar to those of Alternative 33 (Recommended Plan), except 820 acres of swamp habitat would be improved and 2.2 acres of upland habitat would be created.

Alternative 36: Impacts resulting from the implementation of Alternative 36 would be similar to those of Alternative 33 (Recommended Plan), except 3,061 acres of swamp habitat would be improved and 7.8 acres of upland habitat would be created.

Alternative 37: Impacts resulting from the implementation of Alternative 37 would be similar to those of Alternative 33 (Recommended Plan), except 2,279 acres of swamp habitat would be improved and 4.9 acres of upland habitat would be created.

Alternative 38: Impacts resulting from the implementation of Alternative 38 would be similar to those of Alternative 33 (Recommended Plan), except 2,422 acres of swamp habitat would be improved and 7.2 acres of upland habitat would be created.

Alternative 39: Impacts resulting from the implementation of Alternative 39 would be similar to those of Alternative 33 (Recommended Plan), except 3,881 acres of swamp habitat would be improved and 9.9 acres of upland habitat would be created.

ES.7 PUBLIC INVOLVEMENT*

The following public involvement has occurred during the study phase of this project.

- A Notice of Intent (NOI) to prepare a Supplemental EIS (SEIS) for the LCA ARDC Modification Feasibility Study was published on December 22, 2008.
- A public scoping meeting was held in accordance with NEPA on February 12, 2009.
- A meeting was held with Mr. Glen Martin, part owner of Blind River Properties Inc. and majority land owner within the LCA-ADRC study area, on August 31, 2009, in which preliminary project alternatives were presented to gain his input.
- A second public meeting was held on June 24, 2010 in French Settlement Louisiana.
- Both the Lake Pontchartrain Basin Foundation and the Coalition to Restore Coastal Louisiana expressed support for the LCA ARDC Modification project in a joint letter to the commander of the New Orleans office of the USACE, February 20th, 2009.
- On November 2, 2009 a meeting was held with the Louisiana Conservation Fund (LCF) and the Audubon Society at their request to discuss LCA ARDC efforts.
- Separate meetings were held between representatives of Ascension and Livingston Parish and members of the LCA ARDC PDT on August 6, 2009 and February 4, 2010 in order to solicit feedback on the project objectives and to report on the progress to date. Continual coordination between the LCA ARDC Project Delivery Team (PDT) and Parish representatives has occurred. Additional meetings have been held with Livingston Parish to prepare for the potential coordination between the Hydrologic Restoration in Swamps West of Lake Maurepas CIAP and the LCA ARDC projects.

The Integrated Feasibility Report and Supplemental Environmental Impact Statement was released to the public in May 2010, followed by a 45-day public review period.

ES.8 COORDINATION AND COMPLIANCE*

Following completion of the Final Integrated Report, the Assistant Secretary of the Army for Civil Works will most likely issue a ROD concerning the proposed action. Full compliance with statutory authorities will be accomplished upon review of the Final Integrated Feasibility Report and SEIS by appropriate agencies and the public and the signing of the ROD, in compliance with NEPA. The USACE has coordinated with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and the Louisiana Department of Wildlife and Fisheries as per the Fish and Wildlife Coordination Act. A final Coordination Act Letter Report has been received.

ES.9 AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

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 implementation of the recommended plan (Alternative 33) would result in long-term, sustainable ecosystem restoration. Fish and wildlife habitat would be restored and maintained. The project outputs are cost-effective and consistent with the Recommended Plan. This plan is acceptable to the public and the State of Louisiana.

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.).

ES.10 CONCLUSIONS AND RECOMMENDATIONS*

The recommended plan (Alternative 33) includes the creation of three conveyance channels through the dredged material berm of the ARDC to improve connectivity that would increase the movement of freshwater, sediments, and nutrients to and from the cypress-tupelo swamp. This plan is both cost-effective and environmentally beneficial and addresses the most critical habitats in the study area. The recommended plan would create 679 AAHU, restore 1,602 acres of cypress-tupelo swamp habitat and create 5.0 acres of bottomland hardwood habitat. The MCACES fully funded cost is estimated at $8,540,000 and the average annualized cost per AAHUs is estimated to be $660. This restoration would benefit fish and wildlife resources, freshwater swamp habitat, and improve water quality.

The overall benefits of the recommended plan justify the estimated costs for project implementation. This project would be cost shared by the non-Federal sponsor, the Coastal Protection and Restoration Authority (CPRA) at 35 percent non-Federal and 65 percent Federal. The total Federal share would be $5,610,000 and the non-Federal share would be $2,930,000. Additionally, the non-Federal sponsor will be 100 percent responsible for the OMRR&R costs of the project which is estimated to be $10,000 annually. Monitoring costs, which are estimated to be $2,970,000 over 10 years would be cost shared at 35 percent non-Federal and 65 percent Federal.

1.0 STUDY INFORMATION

1.1 STUDY AUTHORITY

The Amite River Diversion Canal (ARDC) Modification project was identified in the *Louisiana Coastal Area* (LCA), *Louisiana Ecosystem Restoration Study* (USACE 2004; 2004 LCA Plan). The 2004 LCA Plan was recommended to Congress by a Chief of Engineers report dated January 31, 2005, which called for a coordinated, feasible solution to the identified critical water resource problems and opportunities in coastal Louisiana.

The 2004 LCA Plan and the January 2005 Chief of Engineers report included the following recommendations:

1. Specific Congressional authorization for five near-term critical restoration features,

2. Programmatic authorization of various programs, demonstration projects and investigations.

3. Approval of investigations and preparation of necessary feasibility-level reports for 10 additional near-term critical restoration features, for future potential Congressional authorization. The ARDC Modification project was included in this list of 10 additional projects.

Title VII of the Water Resources Development Act (WRDA) 2007: (Public Law 110-114, 121 STAT. 1270) authorizes the LCA program. In total, the LCA program has authority for 25 projects falling into various components including investigations, research, demonstrations, and construction. 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. The 10 projects recommended in the 2004 LCA Plan for further analysis and conditionally authorized for construction by WRDA 2007. Furthermore, the six projects listed under Sec 7006(e)(3) were provided with the conditional construction authorization pending a favorable Chief's Report by December 31, 2010.

According to WRDA 2007 the study authority is the following:

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.

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.

WRDA Implementation guidance for the 7006(e)(3) studies was issued in July of 2009 and directs the 7006(e)(3) studies to have a favorable Chief's Report by December 2010. The guidance did not discuss the 2008 report requirement. Nevertheless in 2008, U.S. Army Corps of Engineers, Mississippi Valley Division, New Orleans MVN provided ASA with a letter report for Congress informing them MVN would not be submitting a report in 2008, but would be complying with the 2010 deadline set forth in WRDA 2007.

WRDA Section 7003 directs that the projects would be carried out substantially in accordance with the 2005 Chief of Engineers report. The 2004 LCA Ecosystem Restoration report recommended the following action for the Louisiana Coastal Area Amite River Diversion Canal (LCA ARDC) Modification project:

Increase Amite River Diversion Canal influence by gapping banks

This restoration feature involves the construction of gaps in the existing dredged material banks of the Amite River Diversion Canal. The objective of this feature 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 feature would provide nutrients and sediment to facilitate organic deposition in the swamp, improve biological productivity, and prevent further swamp deterioration.

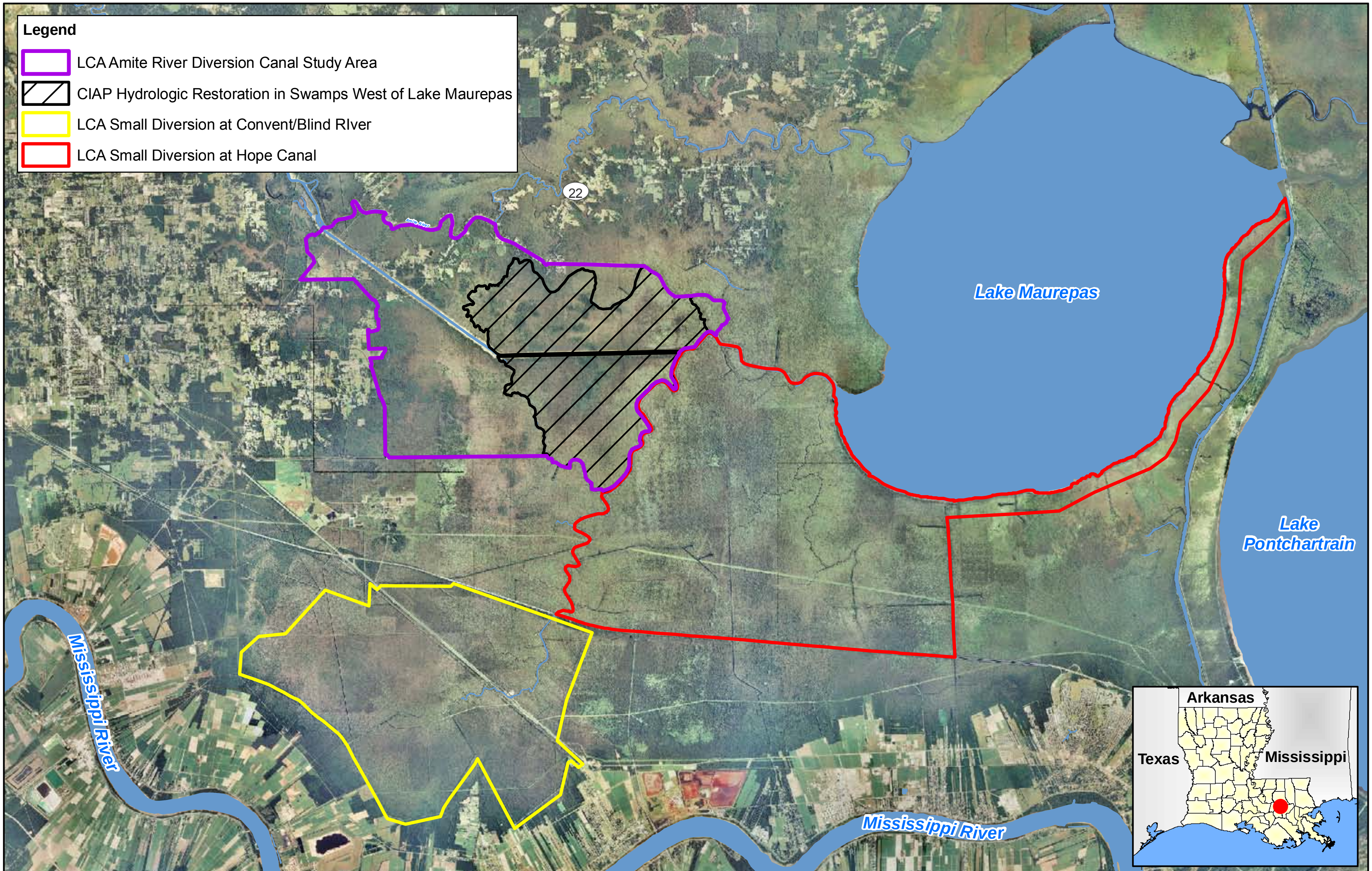
Prior studies and reports have documented degradation in the swamp adjacent to the ARDC and have demonstrated a need for ecosystem restoration that simulates historical hydrologic conditions. This project would evaluate different methods for establishing hydrologic connectivity between the ARDC and the western Maurepas Swamp, allowing the swamp to drain during seasonal low-flow conditions in the Amite River and promoting the germination and survival of the seedlings of bald cypress and other trees. This connectivity would also allow nutrients and sediments to be introduced from the ARDC into the swamp during flood events and from runoff during localized rainfall events. Nutrients and sediment delivered to the swamp would improve biological productivity and reduce the chances of further habitat deterioration. Finally, the establishment of hydrologic connectivity would reduce the likelihood of the swamp converting to marsh or open water.

In keeping with the LCA goals, the LCA ARDC Modification project is an ecosystem restoration project which focuses on near-term solutions. Delaying any proposed restoration action could result in a loss of restoration opportunities and could limit the benefits available for this project.

This project would complement but is independent of two other proposed LCA projects (LCA Small Diversion at Hope Canal and LCA Small Diversion at Convent/Blind River) and two proposed Coastal Impact Assistance Program (CIAP) projects (Hydrologic Restoration in Swamps West of Lake Maurepas and Bald Cypress/Tupelo Coastal Forest Protection (Not illustrated in Figure)) (Figure 1.1). The LCA ARDC Project Delivery Team (PDT) coordinated with the staff of these other projects to identify all known interactions between projects.

1.2 PURPOSE AND SCOPE

This document serves as the Integrated Feasibility Report and National Environmental Policy Act (NEPA) documentations for the Louisiana Coastal Area Amite River Diversion Canal (LCA ARDC) Modification project. Section 7006(e)(3) of the WRDA 2007, Ecosystem Restoration Projects Study (hereafter referred to as the LCA ARDC Supplement Environmental Impact Statement [SEIS]) outlines the study elements requiring Congressional reporting that will be undertaken in



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RELATED PROJECTS IN VICINITY OF AMITE RIVER DIVERSION CANAL MODIFICATION

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2007 Ascension, Livingston, St. James, St. John, and Tangipahoa Parishes USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 1.1
Date: April 2010
Scale:1:220,000
Source: NAIP/GEC
Map ID: 27850108-1381

partnership between the United States Army Corps of Engineers (USACE) and the State of Louisiana.

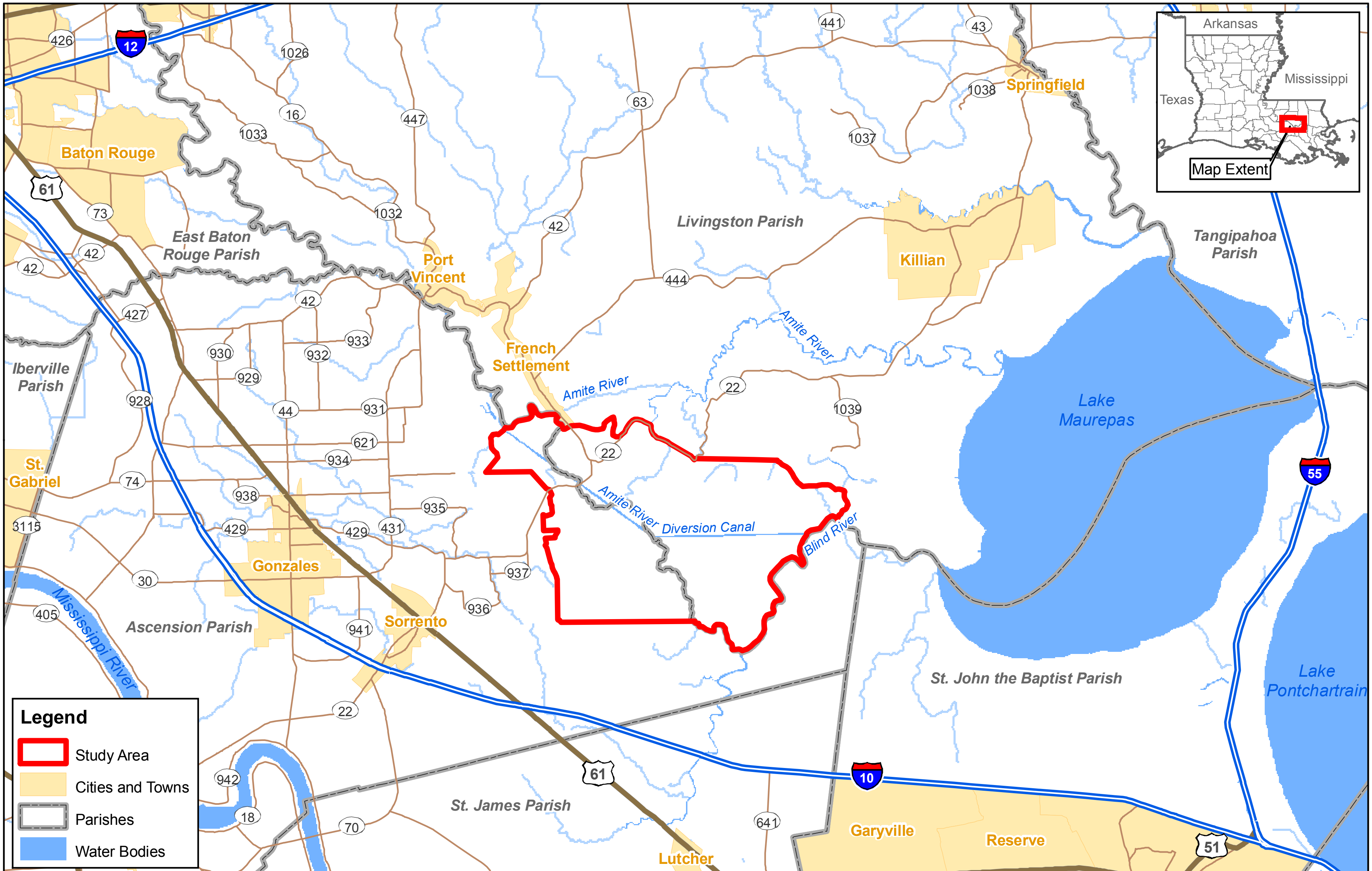
The LCA ARDC Feasibility Study is being developed as a supplement to the *LCA Louisiana - Ecosystem Restoration: Comprehensive Coast-wide Ecosystem Restoration Study* (LCA Near-term Restoration Plan) and is intended to meet the requirements of the Section 7006(e) of the WRDA 2007. This feasibility study is anticipated to result in a Chief of Engineers Report containing a recommended plan (Plan). The Plan addresses systematic restoration of bald cypress-tupelo swamp in areas affected by the Amite River Diversion Canal (ARDC), and considers measures to reduce future bald cypress-tupelo swamp degradation and conversion, restore sheet flow impaired by dredged material bank construction, and protect vital socioeconomic and public resources. The Plan addresses ecosystem restoration exclusively, and does not impair or alter the flood control capabilities of the ARDC. The Plan is independent of, but synergistic with, other LCA near-term critical features, as well as coastal restoration projects proposed under other authorities to provide a holistic approach to restore impaired swamp habitat in the western Maurepas Swamp (see section 1.5).

The environmental consequences of the proposed project are evaluated in Section 5 of this report. The integrated NEPA documentation/SEIS presented here is a supplement to the Final Programmatic Environmental Impact Statement, LCA Ecosystem Restoration Study (FPEIS). The Record of Decision (ROD) for the FPEIS was signed on November 18, 2005. The FPEIS is hereby incorporated by reference.

1.3 STUDY AREA

In the 1950s, the USACE, in an effort to relieve flooding along the upper Amite River, authorized the construction of the ARDC to enhance the flow of water from the meandering Amite River to Lake Maurepas. The 10 mile long canal is 300 feet wide and was dug to a depth of 25 feet. The LCA ARDC study area (Figures 1.2 and 1.3) is located in LCA Subprovince 1 (USACE 2004) and is situated along the ARDC in Ascension and Livingston Parishes, in the vicinity of Head of Island, Louisiana. The study area is bounded to the north by the old channel of the Amite River, Old River, Chinquapin Canal and Bayou Chene Blanc; to the east by the Blind River; to the south by the Petite Amite River and the New River Canal; and to the west by the Sevario Canal, Ascension Parish flood protection levees, and the Laurel Ridge Canal; and is located in the following sections:

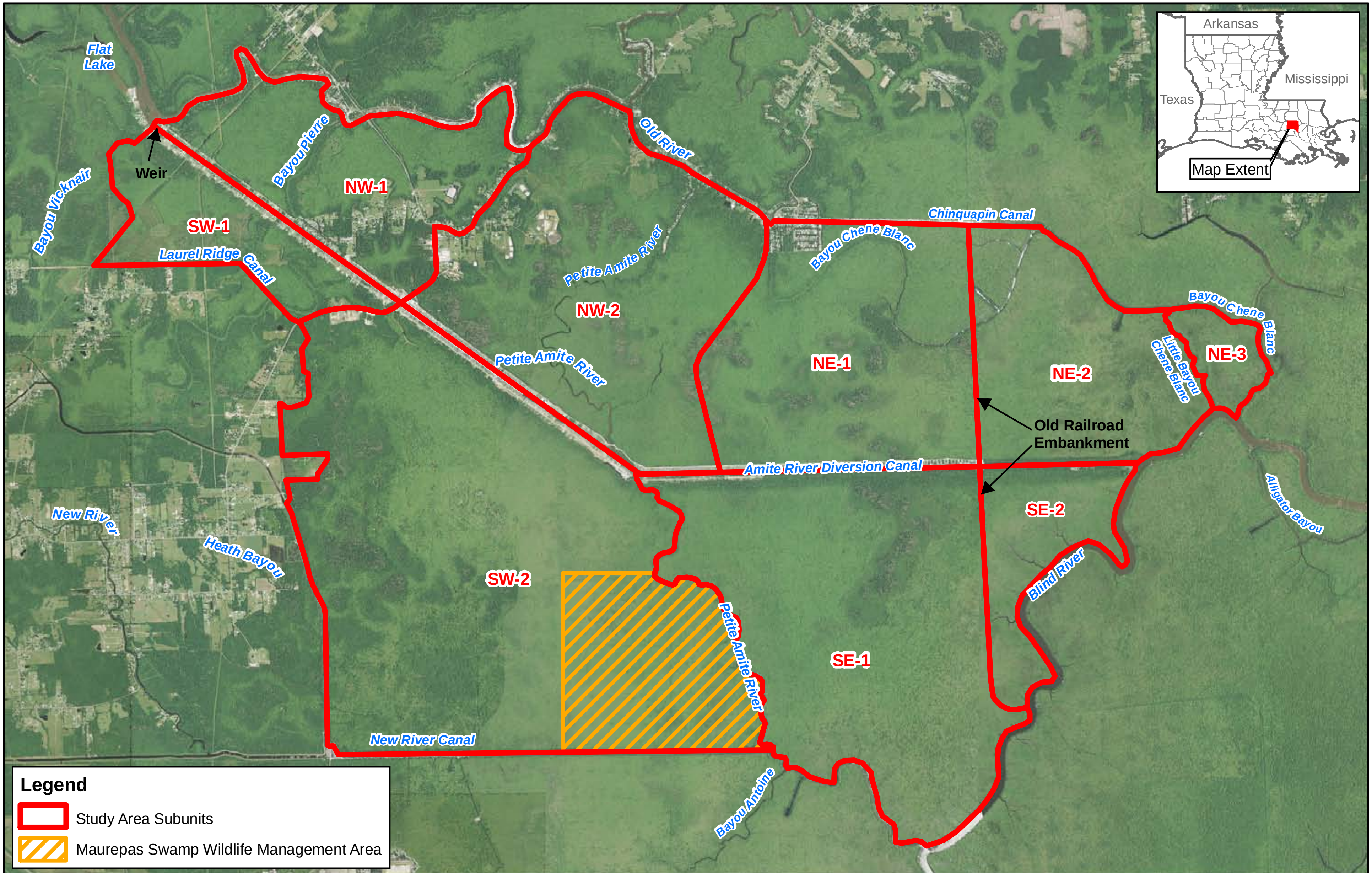
- Township 9 South, Range 4 East, Sections 9-16, 22-27, and 34-36;
- Township 9 South, Range 5 East, Sections 7, 14-36;
- Township 9 South, Range 6 East, Section 30;
- Township 10 South, Range 4 East, Sections 1-3 and 10-12; and
- Township 10 South, Range 5 East, Sections 2-11.



STUDY AREA REGION

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Figure: 1.2
Date: October 2009
Scale: 1:260,000
Source: USDA/GEC
Map ID: 27850108-1781



STUDY AREA AND SUBUNITS

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Ascension and Livingston Parishes USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 1.3
Date: July 2010
Scale: 1:80,000
Source: USDA/GEC
Map ID: 27850108-1780

For planning purposes, the LCA ARDC study area has been divided into nine separate hydrologic subunits. Each subunit was developed based on hydrologic differences (Appendix L) that exist throughout the study area due to natural and manmade hydrologic boundaries (Table 1.1). These boundaries include natural topography such as natural ridges and waterways, as well as manmade features such as dredged material berms and waterways.

1.4 HISTORY OF INVESTIGATION

In 1999, the State of Louisiana and the Federal agencies charged with restoring and protecting Louisiana's coastal wetlands released a plan to restore coastal Louisiana entitled "Coast 2050: Toward a Sustainable Coastal Louisiana" plan. In response to the Coast 2050 Plan USACE developed the May 1999 report, entitled Section 905(b) ([Water Resource Development Act] (WRDA) 1986) Analysis Louisiana Coastal Area, Louisiana -- Ecosystem Restoration. This reconnaissance-level effort evaluated the Coast 2050 Plan as a whole and expressed a Federal interest in proceeding to the feasibility phase. In 2000, it was envisioned that a series of feasibility reports would be prepared over a 10-year period. As a result, the USACE and the State of Louisiana initiated the Louisiana Coastal Area (LCA) Comprehensive Coastwide Ecosystem Restoration Study to coordinate the separate studies. In FY 2004, recognition of Federal and state funding constraints and scientific and engineering uncertainties pertaining to some of the restoration features under consideration led to the determination that the coastal area ecosystem restoration effort should begin with the development and implementation of a restoration plan that identifies highly cost effective restoration features that address the most critical needs of coastal Louisiana, as well as large-scale and long-term restoration concepts. The resulting near term restoration plan was released in 2004 as the LCA, Louisiana Ecosystem Restoration Study. This study was identified in the 2004 LCA report and authorized by WRDA 2007. The previous reports and plans are further described in Section 1.5.

In November 2008, the USACE and the State of Louisiana represented through the Coastal Protection and Restoration Authority (CPRA) executed a single Feasibility Cost-Share Agreement (FCSA) covering the six LCA near-term plan projects listed in Section 7006(e) of the WRDA 2007. The six features each underwent a separate feasibility analysis and environmental compliance review.

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 1.2 lists these efforts and denotes how each is relevant to the ARDC, Louisiana study followed by a discussion of each report or project.

Table 1.1. Hydrologic Subunits

Hydrologic Subunit	Acres	Description
NW-1	2,332	This subunit is one of the healthier portions of the western Maurepas Swamp and is connected hydrologically by Bayou Pierre and the Amite River. This area also contains an extensive housing development. It is surrounded by Old River to the north, the ARDC to the south, and a developed natural ridge to the east.
NW-2	4,289	This subunit contains the healthiest portion of the western Maurepas Swamp. It is surrounded by Old River to the north, the ARDC to the south, a developed natural ridge to the west, and a natural ridge to the east. It is connected hydrologically by Old River and the Petite Amite River.
NE-1	3,351	This subunit exhibits some degradation and has little to no hydrologic connectivity with the ARDC, but is hydrologically connected by Bayou Chene Blanc and the Chinquapin Canal. The subunit is surrounded by the Chinquapin Canal to the north, the ARDC to the south, an abandoned railroad embankment to the east, and an undeveloped natural ridge to the west
NE-2	2,309	This subunit has a high degree of habitat degradation and has little to no hydrologic connectivity with the ARDC. The subunit is surrounded by the Chinquapin Canal to the north, an abandoned railroad embankment to the west, the ARDC to the south, and Little Bayou Chene Blanc and Blind River to the east. This subunit is highly degraded and is one of the areas in most need of restoration.
NE-3	358	This subunit has some degree of habitat degradation and is hydrologically connected by Bayou Chene Blanc, Little Bayou Chene Blanc. A portion of Blind River, which is hydrologically connected to this subunit as well, borders to the south.
SW-1	1,300	This subunit contains a series of culverts that provide hydrologic connectivity between the swamp and the ARDC and is one of the healthier portions of the western Maurepas Swamp. The subunit is bordered by the ARDC to the north and natural ridges to the south and west.
SW-2	8,106	This subunit appears to have some areas of degradation along with some areas of healthy swamp. The subunit is hydrologically connected by the Petite Amite River to the east and New River Canal to the south. It is also bordered by the ARDC to the north, and a developed natural ridge to the west.
SE-1	4,875	This subunit exhibits some degradation, mainly due to the lack of freshwater, sediment, and nutrient input caused by the ARDC dredged material berms. This subunit is hydrologically connected by Blind River on the south and the Petite Amite River to the west side. This subunit is bordered by the ARDC to the north and an abandoned railroad embankment to the east.
SE-2	1,062	This subunit exhibits some degradation, mainly due to the lack of freshwater, sediment, and nutrient input caused by the ARDC dredged material berms. The subunit is surrounded by the ARDC to the north, an abandoned railroad embankment to the west, and Blind River to the east. This subunit is highly degraded and is one the areas in most need of restoration.

Table 1.2. Relevance of Prior Studies, Reports, Programs, and Water Projects to the LCA ARDC Integrated Feasibility Report and EA

Prior Studies, Reports, Programs, and Water Projects	Relevance to LCA ARDC				
	Data Source	Consistency	Structural Measures	Non-Structural Measures	Future Without Project Condition
Comprehensive Planning Studies					
Coast 2050, 1999	X		X	X	
LCA Near-term Restoration Plan, 2004	X	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		
Prior Studies, Reports and Water Projects					
Amite River and Bayou Manchac, 1928	X	X			X
Mississippi River and Tributaries (MR&T), 1928	X	X			X
Amite River and Tributaries (AR&T), 1956	X	X			X
Comite River Diversion	X	X			X
LCA Near Term Critical Restoration Features					
• LCA Small Diversion at Hope Canal (1,500 – 2,000 cfs)	X	X	X	X	X
• LCA Small Diversion at Convent/Blind River (1,000 – 5,000 cfs)	X	X	X	X	X
Coastal Impact Assistance Program (CIAP) Projects					
• Hydrologic Restoration in Swamps West of Lake Maurepas	X	X	X	X	X
• Bald cypress/Tupelo Coastal Forest, Pontchartrain Basin	X	X	X	X	X
CWPPRA Projects Authorized for Design	X	X	X	X	X
Related Laws and Programs					
Louisiana Coastal Management Program, 2008	X	X			
Louisiana Coastal Wetlands Conservation, Restoration and Management Act, 1989	X	X			
The Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), 1990	X	X	X	X	X
The Coastal Impact Assistance Program (CIAP), 2001 and 2005	X	X	X	X	X
Act 8 of the First Extraordinary Session of 2005	X	X			
Various Plans and Programs of Non-Government Organizations	X		X	X	X

1.5.1 Federal

Amite River and Tributaries (AR&T), 1956: The ARDC was authorized by Congress in 1956 as a component of the AR&T Federal flood control project. The

ARDC was constructed from mile 25.3 of the Amite River to mile 4.8 of the Blind River. The ARDC is 10.6 miles long, 300 feet wide, and was originally dredged to 25 feet deep. The ARDC is connected to the Amite River by a control weir at French Settlement that was designed to retain low flows in the Amite River. A small navigation channel through the control weir allows small boats to pass to and from the river and the ARDC. Maintenance of portions of the AR&T within their respective boundaries is the responsibility of the Ascension and Livingston Parish Councils and the East Baton Rouge Parish Council. Construction of this project was initiated in 1957 and completed in 1964. No dredging activities have occurred in the ARDC since its construction. The dredged material berms created alongside the ARDC as a result of this project provide interference with natural hydrologic exchange within the LCA ARDC study area.

CWPPRA Project Priority Lists: Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), often referred to as simply "The Breaux Act," was the first Federally mandated restoration effort to take place along Louisiana's coast and the first program to provide a stable source of Federal funds dedicated specifically to coastal restoration.

Various ARDC modification projects have been proposed to the CWPPRA including:

- **CWPPRA's PPL 12 Proposal, 2002:** This initial proposal involved cutting five to 10 gaps in the dredged material berms on both sides of the diversion canal and installing 36-inch or 48-inch culverts at the gap locations for the purpose of facilitating water exchange to increase productivity, regeneration, and sediment accretion within the adjacent cypress and tupelo swamps, and to increase dissolved oxygen in water flowing through the adjacent swamp habitat.
- **CWPPRA PPL 16 Proposal, 2006:** A proposal for gapping the dredged material berms of the ARDC was again submitted to the CWPPRA Task Force for consideration for the PPL 16 on 5 January 2006. The proposal involved the construction of 5 to 10 gaps in the dredged material berms on both sides of the ARDC to facilitate water exchange, while also presenting the option of placing two of the proposed gaps on the banks of the Petite Amite River north of the existing bridge, to avoid existing development along the western portion of the ARDC.
- **CWPPRA PPL 17 Proposal, 2007:** A proposal for gapping the dredged material berms of the ARDC was submitted to the CWPPRA Task Force for consideration for the 17th Priority Project List (PPL 17) on 11 January 2007. The proposal features differed markedly from those of the PPL 12 proposal. The PPL 17 proposal involved the construction of numerous gaps in the dredged material berms of the ARDC, the old railroad grade that traverses the areas of impact to the north and south, and the levees of the Blind River and the Petite Amite River along the study area border to facilitate water

exchange. The proposal indicates that the gaps would be located to maximize water exchange.

Coast 2050 Plan, 1998: In 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 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.

LCA Ecosystem Restoration Study, 2004: In 2000, the Nation and State of Louisiana initiated the LCA Ecosystem Restoration Study to address Louisiana's severe coastal land loss problem. The goal of LCA study was to achieve and sustain a coastal ecosystem that can support and protect the environment, economy, and culture of coastal Louisiana and thus contribute to the economy and well-being of the Nation. The LCA study focused on "lessons learned" from previous Louisiana coastal restoration efforts, the Coast 2050 restoration strategies, and the best available science and technology to develop a plan addressing the most critical coastal ecological needs. The *Final Programmatic Environmental Impact Statement, LCA, Louisiana, Ecosystem Restoration Study* was prepared for this study. The LCA ARDC project was identified as a near-term critical restoration feature of the LCA Ecosystem Restoration Plan.

- **LCA Small Diversion at Hope Canal:** The LCA Small Diversion at Hope Canal is located east of the project. The LCA Small Diversion at Hope Canal consists of diverting approximately 1,500 to 2,000 cfs from the Mississippi River into the Hope Canal at Garyville. The Hope Canal will be improved and water management features will be included to distribute the flow into the Maurepas Swamp. The project service area is approximately 36,000 acres (56.25 square miles). The project is currently being investigated under the CWPPRA program as PO-29 River Reintroduction to Maurepas Swamp. The work for this project has not yet begun under the LCA program.

  This project will benefit a different portion of the Maurepas swamp than the LCA ARDC Modification project. Both of the projects are independent but their effects will be additive in restoring the swamp. Figure 1.1 displays the current project still under CWPPRA.

- **LCA Small Diversion at Convent/Blind River:** The LCA Small Diversion at Convent/Blind River project is located south of the project area. The LCA Small Diversion at Convent/Blind River project consists of diverting approximately 1,000-5,000 cfs from the Mississippi River into the Blind River and the Maurepas Swamp. The objective of this feature is to introduce sediment and nutrients into the swamp to reverse swamp decline in that area.

The LCA ARDC modification project will restore a different portion of the Maurepas swamp than the Small Diversion at Convent/Blind River project (Figure 1.1). The study areas for both projects are hydrologically independent; therefore any proposed actions would not result in ecosystem benefits or impacts between the two projects. The ARDC will add 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.

USACE Amite River Diversion Channel Spoil Bank Gapping Preliminary Restoration Plan, 2004: This project was a USACE restoration project under Section 1135. A Preliminary Restoration Plan was developed and completed, but the project went unfunded. This project was to gap the northern dredged material berms in an effort to reintroduce ARDC water into the adjacent swamps.

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.

Coastal Impact Assistance Program (CIAP) Projects, 2008: The Energy Policy Act of 2005 was signed into law on August 8, 2005. Section 384 of the Act establishes the 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. CIAP projects located within or near the LCA ARDC study area include:

- **Hydrologic Restoration in Swamps West of Lake Maurepas (CIAP):** This proposed project would be located within portions of the LCA ARDC Modification project study area. The CIAP project received study funding in September 2010 to begin design but has not yet been awarded construction funding. The CIAP project proposes to facilitate water exchange between the ARDC and portions of the adjacent Maurepas Swamp. Additionally, the project proposes to facilitate better hydraulic conductivity between portions of the interior Maurepas Swamp and the ARDC. The LCA ARDC Modification project PDT, the CIAP project team, and representatives of Livingston Parish have coordinated these separate efforts to ensure that implementation of the proposed CIAP project and the LCA ARDC Modification project would result in the maximum benefits for the Maurepas Swamp area. Based on the aforementioned coordination, once the CIAP project is authorized for construction funding, the actions proposed by this project will represent a separate effort from the actions recommended by the LCA ARDC Modification project. To date no formal request for the use of CIAP funds as a cost share for this project has been made.

- **Bald cypress/Tupelo Coastal Forest, Pontchartrain Basin (CIAP):** This proposed CIAP project would be located nearby the LCA ARDC study area. The project proposes to purchase a portion of the existing bald cypress-tupelo swamp in the western Maurepas Swamp northeast of the study area to protect the habitat from future logging. This CIAP project was awarded funding for initial work including land appraisal and legal documents however has not yet been awarded final funding to acquire land.

1.5.2 State

Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast, 2007: Act 8 of the First Extraordinary Session of the 2005 Louisiana Legislature established the CPRA to develop, implement, make reports on, and provide oversight for a comprehensive coastal protection master plan and annual coastal protection plans. The report Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast (Master Plan) was developed to fulfill the mandates of Act 8, which was signed into law in November 2005. The Master Plan presents a series of recommended hurricane protection and coastal restoration measures that, taken together, present a conceptual vision of a sustainable coast based on the best available science and engineering. Measures presented in the plan are divided into three groups: restoring sustainability to the Mississippi River Delta; restoring sustainability to the Atchafalaya River Delta and Chenier Plain; and hurricane protection (structural and non-structural measures). The LCA ARDC project is consistent with restoring sustainability to the Mississippi River Delta.

1.6 PLANNING PROCESS AND REPORT ORGANIZATION

The LCA ARDC Modification project follows the United States Army Corps of Engineers (USACE) six-step planning process specified in Engineering Regulation (ER) 1105-2-100. The planning process identifies and responds to problems and opportunities associated with the Federal objective and specified State and local concerns. This integrated report (FS/SEIS) includes elements of both the planning process and sections specific to the NEPA review of the project.

The chapter headings and order in this report generally follow the outline of the required NEPA documentation for an EIS. Chapters of the report relate to the six steps of the planning process in ER 1105-2-100 as follows:

- **Chapter 2: Need For and Objectives of Action**
  This chapter addresses the first step in the planning process. In the first step of the planning process, the study area problems and opportunities are defined in addition to the constraints, goals, and objectives. An initial statement of problems and opportunities was developed for the 2004 LCA report which reflected the priorities and preferences of the Federal government, non-Federal sponsor, and other stakeholders. This report presents an updated problem identification that includes enhanced understanding of the process and problems of the study area.

- **Chapter 3: Alternatives**
  The third chapter of this report addresses the third, fifth, and sixth steps in the planning process. Step three of the planning process is the formulation of alternative plans. During this step, the plans developed in the 2004 LCA report were reevaluated. The fifth step in the planning process addresses comparisons of the alternative plans with emphasis on the outputs and effects of each alternative. During the sixth step of the planning process, the selection of the recommended plan is made based upon the comparison of the alternative plans.

- **Chapter 4: Affected Environment**
  The fourth chapter of this report addresses the second step of the planning process which requires an inventory and forecast of resources within the study area. The inventory and forecast of the study area provides the without project condition and is the basis of comparison for the alternatives.

- **Chapter 5: Environmental Consequences**
  The fifth chapter of this report covers the fourth step of the planning process which evaluates the effects of the proposed alternative plans in terms of ecosystem benefits. The evaluation criteria are based on the overall goals and objectives of the LCA program and specific planning objectives and purposes of the near-term critical restoration projects recommended in the 2005 Chief of Engineers Report.

1.7 USACE CAMPAIGN PLAN

The USACE has developed a Campaign Plan with a mission to "provide vital public engineering services in peace and war to strengthen our Nation's security, energize the economy, and reduce risk from disasters." This Campaign plan is shaping

USACE command priorities, focusing transformation initiatives, measuring and guiding progress, and helping the USACE adapt to the needs of the future.
USACE Campaign Plan Goals and Objectives Summary:

- **Goal 1: Deliver USACE support to combat, stability and disaster operations through forward deployed and reach back capabilities.**
  - Objective 1a: USACE is ready, responsive and reliable in delivering high performance, all hazard, contingency mission execution in a world-wide theater of operations.
  - Objective 1b: Prepare Theater Engineer Commands (TEC) to support Combatant Commanders throughout the spectrum of operations.
  - Objective 1c: Establish human resources and family support programs that promote readiness and quality of life.
  - Objective 1d: Institutionalize USACE capabilities in interagency policy and doctrine.

- **Goal 2: Deliver enduring and essential water resource solutions through collaboration with partners and stakeholders.**
  - Objective 2a: Deliver integrated, sustainable, water resources solutions.
  - Objective 2b: Implement collaborative approaches to effectively solve water resource problems.
  - Objective 2c: Implement Streamlined and Transparent Regulatory Processes to Sustain Aquatic Resources.
  - Objective 2d: Enable Gulf Coast recovery.

- **Goal 3: Deliver innovative, resilient, sustainable solutions to the Armed Forces and the Nation.**
  - Objective 3a: Deliver sustainable infrastructure via consistent and effective military construction and real estate support to customers.
  - Objective 3b: Improve resilience and lifecycle investment in critical infrastructure.
  - Objective 3c: Deliver reliable infrastructure using a risk-informed asset management strategy.
  - Objective 3d: Develop and apply innovative approaches to delivering quality infrastructure.

- **Goal 4: Build and cultivate a competent, disciplined, and resilient team equipped to deliver high quality solutions.**
  - Objective 4a: Identify, develop, maintain, and strengthen technical competencies in selected Communities of Practice (CoP).
  - Objective 4b: Communicate strategically and transparently.
  - Objective 4c: Standardize business processes.

- Objective 4d: Establish tools and systems to get the right people in the right jobs, then develop and retain this highly skilled workforce.

This project addresses two points of the USACE Campaign Plan. The second goal of the USACE Campaign Plan is addressed by this project since it is an element of the LCA ecosystem restoration plan on the Gulf Coast and is part of a collaborative effort with the non-Federal sponsor. This project also addresses the third goal through the application of the planning process to formulate, analyze, and evaluate alternative designs in pursuit of a sustainable, environmentally beneficial, and cost-effective ecosystem restoration design.

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2.0 NEED FOR AND OBJECTIVES OF ACTION

This section presents the results of the first step of the planning process, the specification of problems and opportunities and the establishment of planning objectives and planning constraints, which is the basis for the formulation of alternative plans. The 2004 LCA problems, needs, opportunities and objectives are presented along with the specific problems, needs, opportunities and constraints identified for the LCA ARDC study area project.

2.1 NATIONAL OBJECTIVES

The U.S. Army Corps of Engineers (USACE) planning process is based on the economic and environmental Principals and Guidelines (P&G) promulgated in 1983. The P&G provide for development of reasonable plans that are responsive to National, State, and local concerns. Planning project benefits are quantified in this process as national economic development (NED) output, national ecosystem restoration (NER) output, or a combination of NED/NER output.

For water and land resources planning, the Federal objective is to contribute to NED while protecting the Nation's environment and adhering to national environmental statutes, executive orders, and Federal planning requirements. NED contributions are increases in the net value of the national output of goods and services, expressed in monetary units. These NED outputs are the direct net benefits that accrue in the planning area and the rest of the Nation. Contributions to NED may include increases in the net value of marketed and non-marketed goods and services.

Ecosystem restoration is one of the primary goals of the USACE Civil Works Program. The USACE objective in ecosystem restoration planning is to contribute to NER. NER contributions include increases in the net quantity and/or quality of desired ecosystem resources. NER measurements are changes in ecological resource quality as a function of improvement in habitat quality and/or quantity. The units are expressed quantitatively in physical units or indexes that are not based on monetary units. Net changes are measured in the study 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 NER output. Multipurpose plans that include ecosystem restoration shall contribute to both NED outputs and NER outputs. For multipurpose projects, a plan that trades off NED and NER benefits to maximize the sum of net contributions to NED and NER is usually recommended.

NER contributions were considered in the alternatives analysis for this project. As specified, under Title VII of Water Resource Development Act (WRDA) 2007, any project or separable project element under the Louisiana Coastal Area (LCA) may be justified by the environmental benefits alone and economic justification is not required if the Secretary determines that the project or activity is cost-effective. This exemption does not apply for any project that is not predominately related to the protection, preservation, and restoration of the coastal Louisiana ecosystem.

2.2 PUBLIC CONCERNS

Public input was received through coordination with the sponsor, coordination with other agencies, public review of draft and interim products, and through workshops, and public meetings. A National Environmental Policy Act (NEPA) scoping meeting was held on Thursday, February 12, 2009 in French Settlement, Louisiana in which LCA plan, the NEPA process and milestones, an overview of the study goals and objectives, and maps of the study area were presented. Overall, the public has expressed its general approval and support for the LCA ARDC Modification project. A discussion of public involvement is included in Section 6, Public Involvement, Review and Consultation. The public concerns were considered and incorporated into the establishment of planning objectives, planning constraints and management measures listed below:

- Weir at French Settlement does not function properly and diverts excessive flow to ARDC, impairing lower Amite River.
- Project should incorporate weir construction at downstream end of ARDC.
- ARDC construction has disrupted natural hydrologic regime and damaged properties.
- Endangered/protected species are present in the study area and vicinity.
- Scope of project should address wildlife and fisheries habitat.
- Hydraulics and Hydrology (H&H) modeling should be expansive, incorporate conditions from other projects, and/or involve stage data collection.
- Project should incorporate rehabilitation of weir at French Settlement.
- Southwestern boundary of study area should be expanded.
- Boat trips to reconnaissance study area are needed.
- Diversion canal stages are primarily influenced by Lake Maurepas.
- Gap placement is an issue because of development on dredge material berms.
- Swamps south of Bayou Pierre are impaired from acidity caused by lack of hydrologic exchange.
- Project is greatly needed and should be completed on an expedited schedule.
- Project should include vegetative planting and nutria control.
- Create hydrologic exchange between Bayou Pierre and ARDC on south canal bank.
- Colonial nesting waterbird rookeries are present in the study area.
- Draining swamp waters may impair water quality in ARDC and downstream.
- Project should operate under flood events, not merely normal flow or high flow conditions.

- Dredge material berm gapping has been implemented as part of waterfront development projects in study area.
- Avoidance or minimization of forest habitat impacts should be considered during gap location.
- Project scope should include restoration of lower Amite River.

The Integrated Feasibility Report and Supplemental Environmental Impact Study (FS/SEIS) was released to the public on May 21, 2010, and was followed by a 45-day public review period ending on July 6, 2010. A public meeting was held on June 24, 2010 in French Settlement Louisiana. Comments received and the responses to them are included in Appendix G.

2.3 PROBLEMS, NEEDS, AND OPPORTUNITIES

This study is designed to address ecosystem restoration problems and opportunities in the LCA ARDC 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 LCA:

- Coast 2050
- Louisiana Coastal Area (LCA) Report
- Louisiana Coastal Protection and Restoration (LACPR) Technical Report
- Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast

Planning for this project uses data from these reports and additional public scoping. Alternative plans will be formulated to build upon these previous plans.

2.3.1 2004 LCA Ecosystem Restoration Report

The 2004 LCA Ecosystem Restoration report summarizes the problems, needs, and opportunities facing coastal Louisiana.

The problems, needs, and opportunities, specific to the LCA ARDC study area, were determined based upon the 2004 LCA report, as well as prior comprehensive planning studies, 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 LCA ARDC study area (Table 2.1) (see Section 1.5). 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. A Conceptual Ecological Model (CEM) was also developed to further identify specific study area

Table 2.1. Problems and Opportunities by LCA ARDC Study Area Subunits

Problem	Degree of Problem by Subunit								
	NW-1	NW-2	NE-1	NE-2	NE-3	SW-1	SW-2	SE-1	SE-2
Subsidence	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Sea level Rise	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Tropical Cyclone Events	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Modification of Natural Hydrology:									
Impoundment	Minimal	Minimal	Severe	Severe	Minimal	Minimal	Minimal	Moderate	Moderate
Decreased Freshwater, Sediment, and Nutrient Inputs	Minimal	Minimal	Moderate	Severe	Minimal	Minimal	Moderate	Severe	Severe
Habitat Changes and Land Loss:									
Decreased Productivity	Minimal	Minimal	Moderate	Severe	Severe	Minimal	Moderate	Severe	Severe
Increased Seedling Mortality	Minimal	Minimal	Minimal	Severe	Severe	Minimal	Moderate	Severe	Severe
Increased Habitat Conversion	Minimal	Minimal	Moderate	Severe	Severe	Minimal	Moderate	Severe	Severe
Invasive Species	Minimal	Minimal	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Opportunity	**Subunit**								
	NW-1	**NW-2**	**NE-1**	**NE-2**	**NE-3**	**SW-1**	**SW-2**	**SE-1**	**SE-2**
Improve hydrologic processes impaired by dredged material bank construction, including connectivity, sheet flow, and freshwater nutrient inflow and outflow.			X	X				X	X
Prevent future cypress swamp degradation and transition currently predicted to occur.			X	X				X	X
Improve areas that have been degraded and transitioned to fresh or open water.			X	X				X	X
Protect vital socioeconomic and public resources.			X	X				X	X

problems. The project-specific problems and opportunities are located in Sections 2.3.3 and 2.3.6, respectively, of the report.

2.3.2 Conceptual Ecological Model

The CEM developed for the LCA ARDC Modification project, identifies specific study area problems via diagrammatic relationships between major anthropogenic and natural stressors, biological indicators, and target ecosystem conditions (Appendix I). The LCA ARDC CEM:

(1) Identifies drivers of ecological processes, anthropogenic stressors, and their ecological effects and attributes useful in monitoring and forecasting ecosystem response;
(2) Diagrams qualitative explanations of how human activities alter ecology;
(3) Develops and communicates working hypotheses;
(4) Identifies performance measures; and
(5) Develops monitoring and modeling activities to support restoration and management.

This CEM does not explain all possible relationships or include all possible factors influencing the performance measure targets within natural systems in the study area. Rather, the CEM model displays ecosystem functioning relationships within the study area by presenting only the information deemed most relevant to ecosystem monitoring goals.

The CEM developed for the LCA ARDC Modification project is presented in Figure 2.1. Model components are identified as the following:

- Drivers
  - Canal Construction
  - Hurricanes

- Ecological Stressors
  - Impoundment
  - Lack of Riverine Input and Connectivity
  - Storm Surge

- Ecological Effects
  - Trees Stressed and Die
  - Increased Seedling Mortality
  - Loss of Nutrients and Sediments
  - Decreased Water Quality and Increased Salinity
  - Decreased Productivity
  - Increased Habitat Conversion

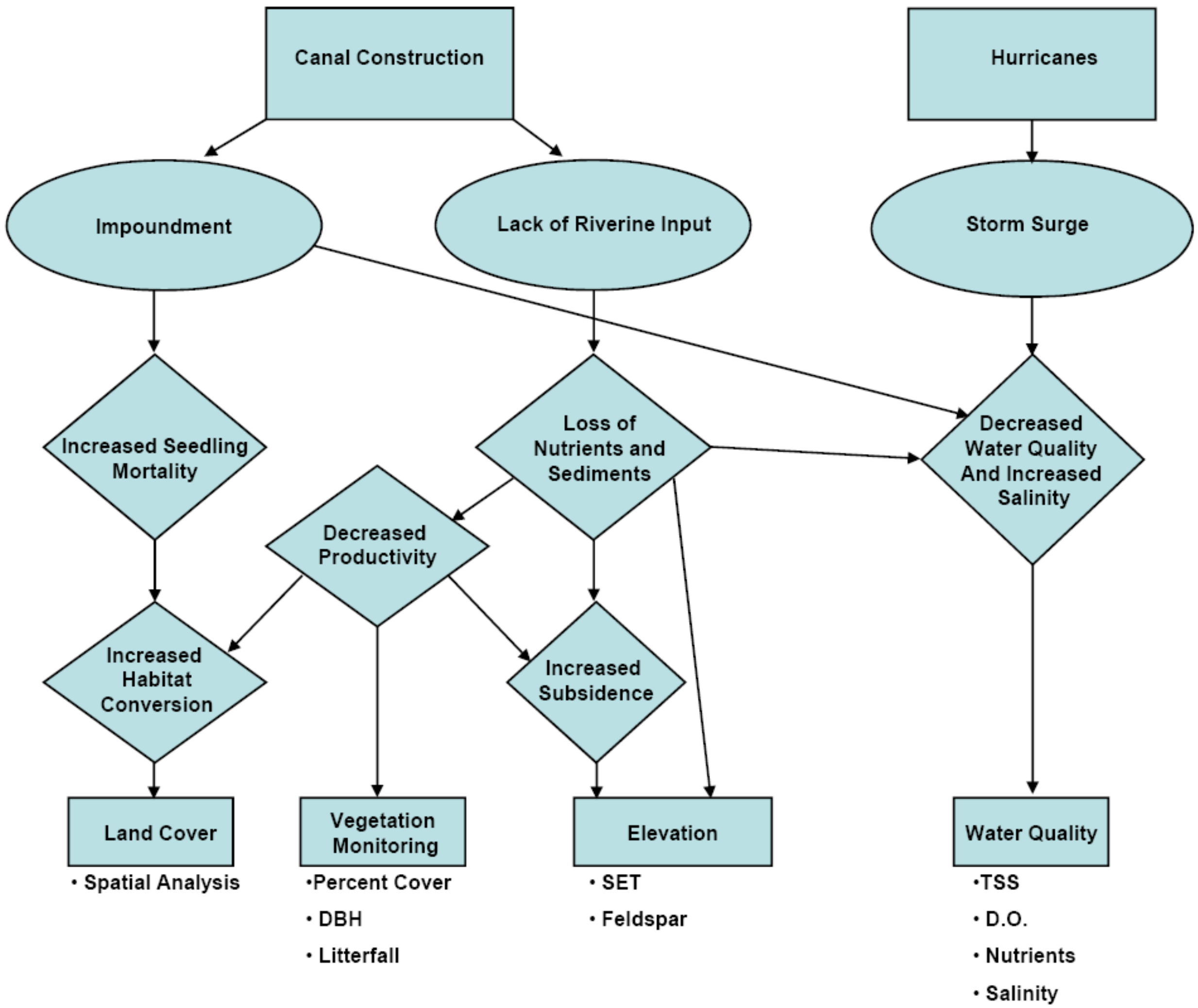


Figure 2.1. Conceptual Ecological Model, Amite River Diversion Canal Modification Project

  - Increased Subsidence

- Attributes and Performance Measures
  - Land Cover
  - Vegetation Monitoring
  - Elevation
  - Water Quality

The Wetland Value Assessment (WVA) model was used to evaluate the environmental benefits of the final array in Section 3. The WVA measures functional benefits for the Future With Project (FWP) as compared to Future Without Project (FWOP) (see Section 3.5.2). While the CEM does not directly provide quantitative data for the WVA, the CEM provides the ecological principles that are quantitatively captured by the WVA.

2.3.3 Problems

According to the 2004 LCA Ecosystem Restoration Study, the measurable increase in coastal land loss in the mid- to late- 20th century can be linked to human activities that have fundamentally altered the deltaic processes of the coast and limited their ability to rebuild and sustain it. In the Chenier Plain, human activities have fundamentally altered the hydrology of the area, which has impacted the long-term sustainability of the coastal ecosystems. Because of the magnitude and variety of these human-induced changes, and their interaction with natural landscape processes, all of the factors contributing to coastal land loss and ecosystem degradation must be viewed together to fully understand how Louisiana's coastal ecosystem shifted from the historical condition of net land gain to the current condition of accelerated net land loss.

According to the 2004 LCA report, the natural processes of subsidence, habitat switching, and erosion of wetlands, combined with a widespread human alteration, have caused significant adverse impacts to the Louisiana coastal area, including increased rates of wetland loss and ecosystem degradation. Without action, Louisiana’s healthy and highly productive coastal ecosystem, composed of diverse habitats and wildlife, is not sustainable. Man-made alterations have impacted the natural sustainability and quality of the Louisiana coastal ecosystem. This loss of sustainability has manifested itself as accelerated land loss. If recent loss rates continue into the future, even taking into account current restoration efforts, coastal Louisiana is projected to lose an additional 328,000 acres of coastal marshes, swamps, and barrier islands by the year 2050. The loss of wetlands could result in ecosystem conversion to open water by placing the following ecosystem functions at risk:

- Vegetative habitat suitability and community diversity;

- Elevational maintenance and soil contribution from decomposing organic material;
- Protection against substrate erosion;
- Water quality improvement;
- Nutrient uptake and carbon sequestration;
- Important nursery habitat;
- North American Central Flyway and North American Mississippi Flyway waterfowl;
- Wintering habitat; and
- Resting and feeding areas for neotropical migrants.

LCA ARDC Study Area. The primary problem within the LCA ARDC study area is ecosystem degradation of the freshwater swamps adjacent to the ARDC. The natural hydrology within the study area has been modified by construction of the ARDC (1964) and construction of the railroad grade utilized during the 1800s through the early 1900s to aid with lumber extraction activities (see Figure 1.3 with location of railroad grade). These features have resulted in impoundment of the swamp. Sea level rise (Gornitz *et al.,* 1982) and geological subsidence have compounded the effects of these modifications. The modification of the hydrology within the study area has led to hydrologic isolation; impoundment of water, including storm surge-related, higher salinity waters; and lack of freshwater, sediment and nutrient inputs, all of which have contributed to the degradation and conversion of the freshwater swamps to marsh and open water habitats. Impoundment leads to a reduction in freshwater, sediment and nutrient input within the study area.

2.3.3.1 Modification of Natural Hydrology

The construction of flood control projects within the LCA ARDC study area, primarily the ARDC component of the Amite River and Tributaries (AR&T) project, together with other land use practices, such as land development and logging, have significantly altered the hydrology of the study area. These projects and practices have altered patterns of water and sediment flow through the bald cypress-tupelo swamp, directly converting swamps to marsh and open water and indirectly altering the natural processes instrumental in the development and sustenance of a healthy coastal swamp ecosystem.

2.3.3.2 Subsidence

Land elevations decrease from subsidence, which may be produced by compaction, oxidation, and consolidation of sediments, faulting, groundwater depletion, or decreased organic deposition as a result of decreased vegetation biomass production. Within a healthy freshwater swamp, land elevations have the potential to increase as a result of sediment accretion, from direct sediment input from riverine sources or from organic vegetation deposition. The soil characteristics of the western Maurepas Swamp indicate a lack of riverine influence as evidenced by high soil organic matter content and low bulk density values (DeLaune *et al.*, 1979; Hatton, 1981; Messina and Conner, 1998). Consequently, soil building within the Maurepas Swamp is almost exclusively a result of organic productivity (Shaffer *et al.,* 2001, 2003, 2006 and 2009). In the swamps adjacent to the ARDC, productivity is substantially depressed compared to normal conditions (Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Task Force, 2002). Subsidence in the LCA ARDC study area and vicinity is classified as intermediate, at about 1.1-2.0 feet per century (LCA, 2004). With minimal soil building and intermediate subsidence, there has been a net lowering of ground surface elevation, doubling flood frequency over the last four decades (Thompson, 2000), so that the swamps are now persistently flooded.

2.3.3.3 Sea Level Rise

2.3.3.3.1 Eustatic Sea Level Rise. Eustatic sea level rise is the global change in the oceanic water level. Eustatic sea level rise has been attributed to the global increase in ocean volume and has been estimated as 1.0-2.4 millimeters per year (mm/yr) (Church *et al.*, 2001). Long-term sea level rises are projected to increase due to global climate change (Titus and Richman, 2001).

2.3.3.3.2 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 USACE 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). Sediment and organic accretion will not likely mitigate RSLR, especially with no action. Under the FWOP condition little to no biomass accretion would occur due to the continued degradation within the study area and the lack of hydrologic connectivity. It has been estimated that biomass accretion levels for a healthy freshwater swamp within the study area would be approximately 8 mm/yr (Bernard Wood, unpublished data, 2005 through 2009).

2.3.3.4 Tropical Cyclone Events

Tropical cyclone events exert a stochastic but severe influence on the LCA ARDC study area. Tropical cyclone events can directly and indirectly contribute to coastal land loss through a variety of processes, including erosion from increased wave energies, removal and/or scouring of vegetation from storm surges, and saltwater intrusion into estuaries and interior wetlands carried by storm surges. These destructive processes can result in the loss and degradation of large areas of coastal habitats in a relatively short period of time (e.g., days and weeks versus years). These saltwater surges become impounded for long periods of time in the areas of impact along the ARDC, causing additional damage to the soils and vegetation.

The storm centers of at least 15 tropical cyclones with a Saffir-Simpson Hurricane Scale of Category 2 or higher have passed within 50 miles of the LCA ARDC study area during the interval 1851-2008, and at least 52 such tropical cyclones have passed within 100 miles of the study area during the same interval (National Oceanic and Atmospheric Association (NOAA) Coastal Services Center, 2009). The most recent tropical cyclones affecting the study area were hurricanes Katrina (August 2005), Rita (September 2005) and Gustav and Ike (September 2008).

Hurricanes Katrina, Rita, Gustav, and Ike – These tropical storms did not have a significant direct impact on the study area; there was very little wind and wave damage as noted by subsequent field investigations. These, and other storms, did have an indirect effect due to the introduction of higher-salinity storm surge waters into the impounded swamps within the LCA ARDC study area. This salt intrusion, particularly in the impounded areas, reduces biomass production and impairs health, which in turn increases tree mortality, decreases soil production and integrity, and consequently increases relative subsidence (CWPPRA Task Force, 2002). These higher-salinity storm surge waters become impounded in the swamp by the dredged material berms along the ARDC and are not drained from the swamps during seasonal low flow events or flushed by seasonal river bank overflow events. Consequently, these periodic influxes of saline storm surge waters cumulatively increase salinity in impounded waters and soils in the study area. Even though salinity spikes are inevitable, increased connectivity through the ARDC dredged material berms would allow the large headwater event that normally follows a tropical storm to flush the higher salinity waters out of the swamp before it has an opportunity to infiltrate into the substrate. This flushing action could greatly reduce the impact of salinity spike generated by tropical storm events.

2.3.4 Effects

A direct result of the problems impacting the study area include the impoundment of water within the swamp areas, reduced amounts of natural hydrologic connectivity which leads to limited amounts of sediment and nutrient transport to the swamp habitat, and the eventual degradation of existing habitat. The following section describes each of these effects.

2.3.4.1 Impoundment

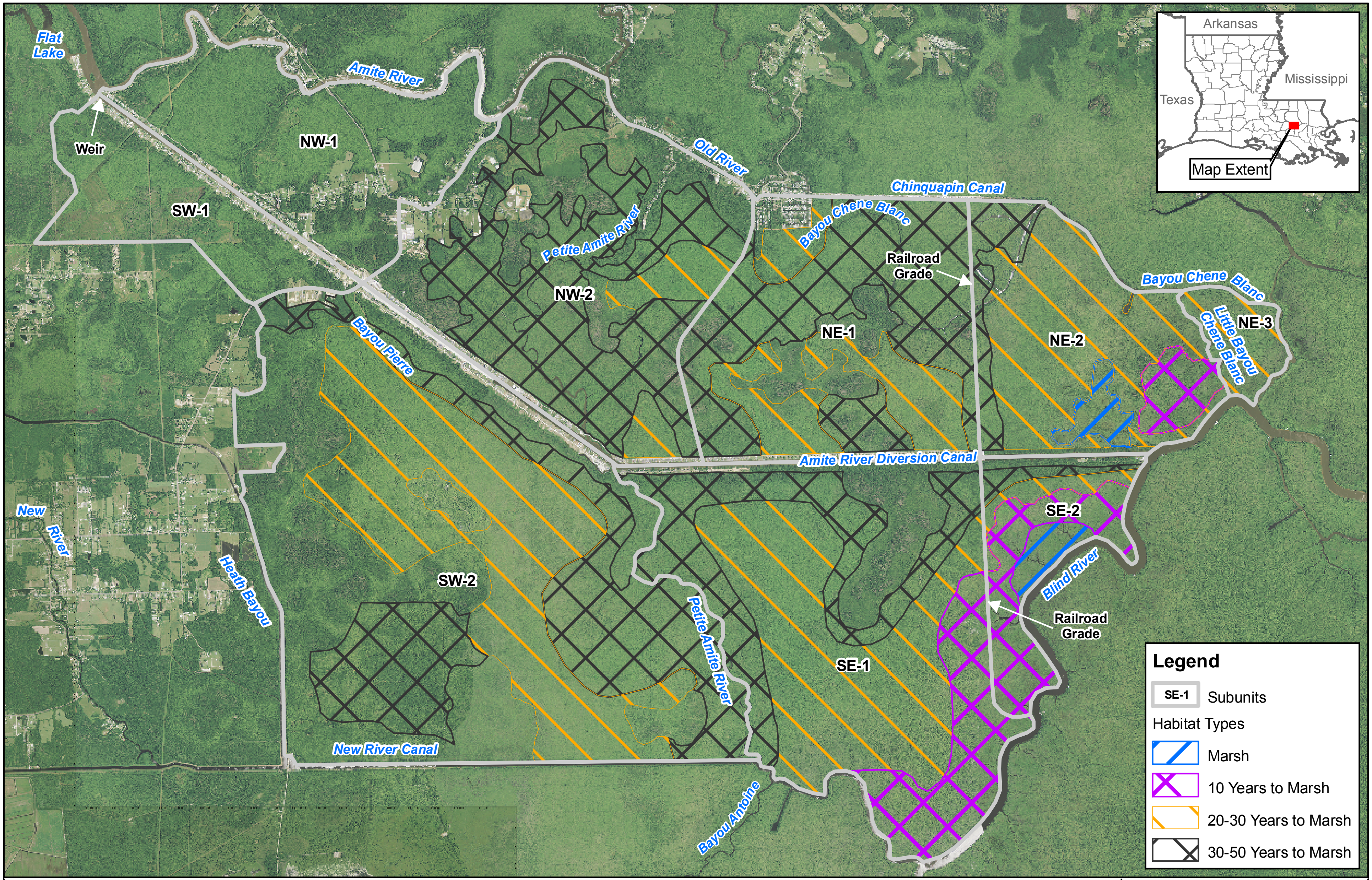
The placement of dredged material as berms along either side of the ARDC disrupted sheet flow within the LCA ARDC study area and formed topographic high points (ridges) that prevented the drainage of bald cypress-tupelo swamps into the ARDC during low surface flow intervals (USACE, 2004). This activity, in conjunction with other activities, such as the construction of a railroad grade utilized for logging that traverses the eastern study area from north to south, permanently impounded bald cypress-tupelo swamp habitat within the study area.

Impoundment within the study area has also contributed to decreased water quality and increased cypress and tupelo seedling mortality, which in turn have contributed to increased habitat conversion to marsh and open water. Additional damages to vegetative resources and soils have occurred when saltwater storm surges are impounded within the system over long periods; vegetation becomes stressed and additional salt leaches into the soil substrate. Increased connectivity through the ARDC dredged material berms would decrease impoundment and allow a large headwater event to flush the higher salinity waters out of the swamp before it has an opportunity to infiltrate into the substrate. This flushing action could greatly reduce the impact of salinity spike generated by tropical storm events.

Swamp impoundment is particularly pronounced in the eastern portion of the LCA ARDC study area (subunits NE-1 and NE-2), as demonstrated by 2005 hydrograph data from the CWPPRA Priority Project List (PPL) 16 proposal *Hydrologic Restoration in the Swamps West of Lake Maurepas,* Figure 2.2, and Table 2.2.

Table 2.2. Conversion of Habitat Types (Years to Marsh)

Years to Marsh	Acres
Existing Marsh	300
10 Years to Marsh	1,723
20 – 30 Years to Marsh	7,979
30 – 50 Years to Marsh	8,202
Total	**18,204**



HABITAT TYPES

Amite River Diversion Canal Modification

Ascension and Livingston Parishes, Louisiana

Source: Bernard Wood, personal communication, October 2009

Image: 2009 Livingston Parish and Ascension Parish USDA-FSA-APFO NAIP MrSID Mosaics

Figure: 2.2

Date: February 2010

Scale: 1:75,000

Source: USGS/GEC

Map ID: 27850108-1890

The habitat types shown in Figure 2.2 represent areas of degradation expected to occur within the study area over the 50-year period of analysis, based on field observations and professional judgment provided by Dr. Gary Shaffer. More specifically, Table 2.2 quantifies acreages associated with each habitat type found in Figure 2.2. The figure includes four habitat types, consisting of existing marsh, 10-years to convert to marsh, 20-30 years to convert to marsh, and 30-50 years to convert to marsh.

Marsh. This represents areas within the study area that have converted to freshwater marsh habitat and are in transition to open water. These areas are characterized by non-existent canopy and scrub-shrub and herbaceous type vegetation. These areas are considered the most degraded within the study area.

10-years to Marsh. This represents areas within the study area likely to transition into marsh with the next ten years. These areas are characterized by little-to-no canopy cover, which is indicative of areas in which degradation is taking place and the habitat is nearing conversion to freshwater marsh. This habitat type is located in areas with hydrologic connectivity, but lack freshwater flushing and is subsequently subject to increased saltwater intrusion.

20-30 years to Marsh. This represents areas within the study area likely to transition into marsh with the next 20-30 years. These areas are characterized by reduced canopy cover, which is indicative of areas in which freshwater swamp tree species are present, but exhibit reduced stand productivity. This habitat type exhibits reduced hydrologic connectivity, is found in impounded areas that lack freshwater flushing, and is subject to saltwater intrusion during high-water events.

30-50 years to Marsh. This represents areas within the study area likely to transition into marsh with the next 30-50 years. These areas are characterized by the beginning stages of canopy cover reduction, and are indicative of areas in which freshwater swamp tree species are abundant, but exhibit reduced stand productivity. This habitat type has little-to-no hydrologic connectivity, is found within impounded areas that lack freshwater flushing, and is often not influenced by saltwater intrusion.

Approximately 11 months of water gage data were recorded in the eastern portion of the study area from three water gages within the ARDC and inundated swamp habitat on the left descending bank. These data indicate the swamp habitat along the left descending bank of the ARDC in the eastern portion of the study area is impounded; water levels within this area never receded below 2.2 feet above mean sea level (msl), although canal water levels receded below that level (Shaffer *et al.,* 2006). Areas within Figure 2.2, which do not display a time frame for degradation, indicate that no degradation will occur for these areas within the 50-year period of analysis.

2.3.4.2 Decreased Connectivity Resulting In Decreased Freshwater, Sediment, and Nutrient Inputs into the Swamps

Historically, hydrologic conditions within the LCA ARDC study area were influenced by the Amite River in the north and west, by overbank flow from the Mississippi River in the south, and by tidal influence from Lake Maurepas in the east (Hamilton and Shaffer, 2001; CWPPRA Task Force, 2002). Periodic flooding of the Amite and/or Mississippi Rivers inundated bald cypress-tupelo swamps within the study area. Flooding occurred in and near the study area, with peak water elevations in the late spring or early summer. As floodwaters receded, surface waters in the study area were conveyed eastward via sheet flow to Bayou Chene Blanc or Blind River and, then to Lake Maurepas. Flood control implementation such as construction of the ARDC, disrupted the natural hydrologic regime within the LCA ARDC study area. River channelization and levee construction greatly reduced overbank flooding in the study area, nutrients and sediments in the ecosystem were lost, and water quality was decreased (CWPPRA Task Force, 2002).

The swamp within the LCA ARDC study area is severely nutrient-limited (Shaffer *et al.,* 2001). However, biomass production of herbaceous vegetation has been significantly enhanced (approximately 33 percent) by nutrient augmentation based on data from monitoring stations located within the western Maurepas Swamp outside of the study area.

Decreased water quality and increased salinity have also contributed to swamp ecosystem degradation in the LCA ARDC study area. A water quality analysis of surface waters in the western Maurepas Swamp was conducted in support of CWPPRA Project PO-29 *Mississippi River Reintroduction into Maurepas Swamp* (Day *et al.,* 2001). Nitrate, ammonium, and nitrogen concentrations at surface water stations in the western Maurepas Swamp were lower than Mississippi River concentrations. As a result, the bald cypress-tupelo swamp in the study area and vicinity is severely nutrient-limited. The trees are also highly stressed from elevated salinities, which decrease productivity and increase mortality and susceptibility to herbivory and parasites (CWPPRA Task Force, 2002).

Saltwater intrusion has increased in this general area, partly due to net subsidence and the lack of riverine freshwater inputs. Salinities as low as three parts per thousand (ppt) can reduce growth of both bald cypress and water tupelo saplings (Pezeshki, 1990). Salinity, combined with flooding stress, can substantially reduce bald cypress growth. Consequently, salinity significantly contributes to swamp deterioration, particularly combined with stressors such as flooding and herbivory.

Storm surges from Lake Maurepas caused by tropical cyclones also exert a stochastic but severe stress on the swamp habitat through salinity spikes in swamp surface waters. Dredged material berms prevent higher salinity water from being flushed out of the system (CWPPRA Task Force, 2002). Storm surge waters remain in the impounded swamps of the LCA ARDC study area cumulatively increasing salinities in impounded waters and soils.

2.3.4.3 Habitat Changes and Land Loss

Decreased Productivity. Vegetative communities in the LCA ARDC study area have decreased productivity according to previous reports and studies (Hoeppner *et al.,* 2007). The existing levels of productivity in the western Maurepas Swamp are as low as 25 to 50 percent of average values found within swamps that are managed or have more favorable hydrology, and/or receive nutrient enrichment (Hamilton and Shaffer, 2001).

From 2000-2007, diameter growth measurements for more than 1,800 trees in the western Maurepas Swamp were significantly less than established growth levels for trees in healthy freshwater swamp systems (Shaffer *et al.*, 2008). In interior swamp locations, such as the LCA ARDC study area, the primary factors inhibiting diameter growth were nutrient-poor stagnant standing water and the lack of nutrient-rich freshwater exchange caused by the loss of hydrologic connectivity with riverine systems.

Increased Seedling Mortality. Seedling germination and establishment are essential to ensure sustainability of bald cypress-tupelo swamp by replacing trees lost to disease and other causes. However, the establishment of bald cypress and tupelo seedlings is impaired in the LCA ARDC study area due to persistent flooding from impoundment (CWPPRA Task Force, 2002). Bald cypress and tupelo seeds cannot germinate when flooded (Hamilton and Shaffer, 2001). Seeds of both species remain viable when submerged in water and can germinate readily when floodwaters recede (Kozlowski, 1984). However, the seedlings require seasonal drying periods, and the substrate compaction associated with these drying periods, for root systems to become properly established in the swamp substrate. With minimal ability to drain and persistent flooding, the typical seasonal drying of the LCA ARDC swamp does not usually occur and seedlings fail to establish themselves and replace older trees lost to other natural processes (CWPPRA Task Force, 2002).

Nutria, which are common to the study area, pose a threat to seedling establishment, and could result in increased mortality of planted and regenerated freshwater swamp vegetation.

Increased Habitat Conversion. As shown in Section 5.6.2 most of the Maurepas Swamp is stressed and appears to be on a trajectory of slow degradation leading to a gradual conversion to marsh and open water (Hoeppner *et al.,* 2007). Stagnant flooding and nutrient deprivation appear to be the largest stressors in the swamp interior, whereas increased salinity, flooding stress, and nutrient deprivation are killing many trees along the navigable waterways, such as the ARDC and Blind River.

Under the continued influence of these conditions, tree mortality would continue to increase and tree density would continue to decline. Based on the low tree density, degraded condition, and expectation for mortality, the USACE estimated that most swamp habitat within the LCA ARDC study area would degrade to less than 33 percent canopy cover within 20 years (USACE, 2004). Approximately 46 percent of the canopy within the study area would remain within 20 to 30 years; this is comparable to USACE data (Figure 2.3) (Shaffer *et al.,* 2009). Because of this degradation and decreased productivity, soil accretion is insufficient to offset regional subsidence, and the degraded swamp habitat is consequently susceptible to conversion to fresh marsh (Hamilton and Shaffer, 2001). Land area trends in the study area for the interval 1985-2006 were calculated by the U.S. Geological Survey (USGS) using Landsat Thematic Mapper (TM) analysis (Barras *et al.*, 2008). Land area trends within the study area were relatively stable with an average land loss of less than two acres per year. However, Landsat TM imagery does not distinguish between forested canopy and marsh vegetation. Other studies indicate that land area trends for bald cypress-tupelo swamp in the study area are unstable and habitat conversion is occurring at an accelerated rate in portions of the study area (USGS, 2008).

Bald cypress-tupelo swamp is already converting to freshwater marsh in the LCA ARDC study area particularly north of the ARDC in the eastern study area in subunits NE-2 and SE-2 (CWPPRA Task Force, 2002). Many fresh marsh areas in the greater southern Maurepas Swamp have converted to fragile spikerush flotant. Approximately 9,702 acres of swamp habitat would fully convert to marsh habitat within 20 to 30 years (Figure 2.2 and Table 2.2). Throughout this report the habitat surrounding the ARDC is referred to as freshwater or bald cypress-tupelo swamp. While it is recognized that portions of the study area have converted to freshwater marsh, it is generally referred to as a freshwater swamp habitat.

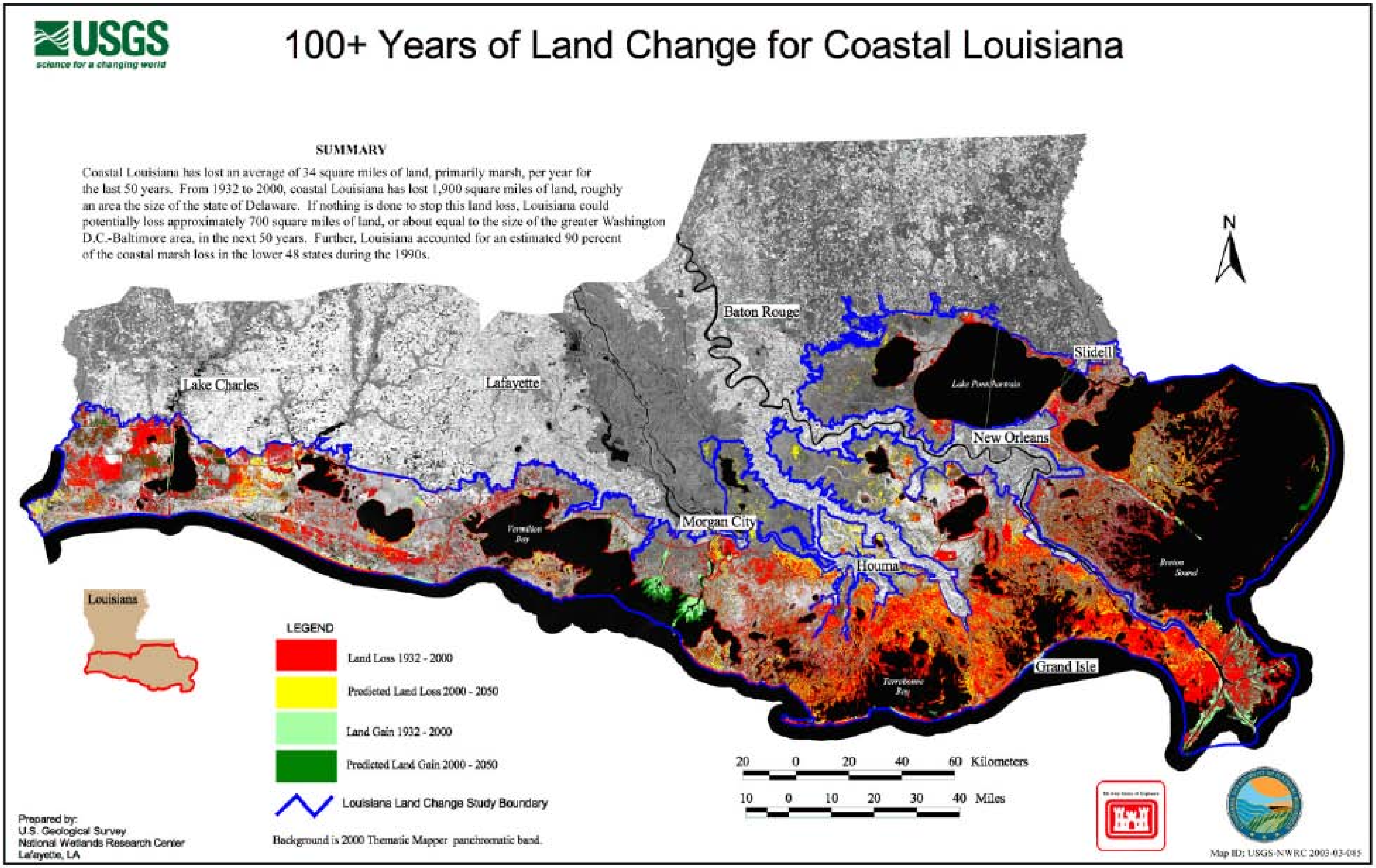


Figure 2.3. Predicted Land Change for Coastal Louisiana (USACE, 2004)

Without restoration, factors and processes contributing to stress and deterioration of swamps near the ARDC would continue and result in swamp habitat loss with succession to open water. The wetland loss rates developed by Coast 2050 for the Amite/Blind Rivers mapping unit (which contains the LCA ARDC study area) for 1974-1990 were estimated to be 0.83 percent per year for swamp habitat, and 0.02 percent per year for fresh marsh (CWPPRA Task Force, 2002). Based on these rates, approximately 35 percent (18,204 acres) of the bald cypress-tupelo swamp within the study area would be converted to fresh marsh or open water for the interval 2012-2062.

2.3.4.4 Increased Invasive Species

The spread of invasive species decreases native plant communities, altering ecosystem function. Within the LCA ARDC study area, water hyacinth, alligator weed, hydrilla, common salvinia, giant salvinia, and variable-leaf milfoil are invasive aquatic vegetative species, which displace native aquatics and degrading water and habitat quality [Louisiana Coastal Protection and Restoration (LACPR), 2009]. Additionally, the study area has the Chinese tallowtree which is tolerant to flooding and salt stress and can establish self-replacing monocultures that provide less foraging value to migrating birds and interrupt the natural succession of woody species (LACPR, 2009). It should be noted that disturbed ecosystems are more vulnerable to invasive species than stable ecosystems; therefore, invasive species are a severe threat to biodiversity and ecological function in the study area. An additional invasive species found throughout the study area are nutria. This species of wildlife impacts the vegetative resources by increasing seedling mortality and reducing natural regeneration.

2.3.5 Needs

According to the 2004 LCA report, critical needs for restoration of coastal Louisiana include:

Prevent future land loss where predicted to occur: Addressing this need would create and sustain diverse coastal habitats, sustain wildlife and plant diversity, and sustain socio-economic resources. Effective measures to reverse coastal land loss should affect plant communities, in their root zone, in such a way as to promote healthy growth and reproduction, plant succession, or revegetation of denuded surfaces. Increasing nutrients and sediment in the estuarine area would increase the growth of marsh vegetation and slow the rate of land loss. Increased plant growth would result in greater production of organic detritus that is essential for a high rate of fisheries and wildlife production. Production of phytoplankton and zooplankton would increase in areas where turbidity is not limiting, and, as a result, the harvest of sport and commercial finfish and shellfish that depend on these microorganisms would increase.

Restore fundamentally impaired or mimic deltaic processes through river reintroductions: Addressing this need would reduce habitat deterioration by increasing nutrients and sediment delivered to the estuarine-marsh areas, which would increase marsh vegetation sustainability and improve fish and wildlife production. In addition, restoring riverine influences to coastal wetlands and creating wetlands would help address the need to reduce the nutrient loading into the northern gulf and to reduce the hypoxic zone. This need can be met by restoring or mimicking distributary flows, crevasses, and over-bank flow, as well as mechanical marsh creation with river sediment, if sustained by freshwater reintroductions.

Restore or preserve endangered critical geomorphic structures: Addressing this need would restore geomorphic structures, such as natural levee ridges, lake rims, land bridges, gulf shoreline barrier islands, barrier headlands, and chenier ridges. These features are essential to maintaining the integrity of coastal ecosystems because they are an integral part of the overall system and in many instances represent the first line of defense against marine influences and tropical storm events.

Protect vital local, regional, and national socioeconomic resources: Addressing this need would reduce the increased risk of damage to cultures, communities, infrastructure, business and industry, and flood protection. Accelerated land loss and ecosystem degradation places over $100 billion of infrastructure at increased risk to damage as a result of storm events. This need could be met by increasing the marsh's capacity to buffer hurricane-induced flooding through wetland creation, and sustenance and retention of barrier island systems.

The critical needs for the LCA ARDC Modification project study area were developed based on those included in the 2004 LCA report and include the following:

Prevent future conversion of freshwater swamp habitat to freshwater marsh and ultimately open water: Addressing this need would help to reverse the trend of land degradation occurring within the LCA ARDC study area and contribute to maintaining critical habitat for numerous species of vegetation, fish, and wildlife species native to freshwater swamp habitats. The habitat degradation occurring within the study area is previously depicted in Figure 2.2.

Restore the natural processes necessary for a functioning and healthy freshwater swamp habitat: Addressing this need would preserve and improve the functions provided by bald cypress-tupelo swamp habitat, vital to numerous wildlife and vegetative species. Functions would include natural hydrologic cycles, hurricane protection, and improved water quality. Restoring these functions increases the likelihood of producing a sustainable ecosystem.

Preserve and protect local socioeconomic resources: Addressing this need would prevent the loss of socioeconomic resources available within the LCA ARDC study area, resulting from continued habitat degradation and land loss. This includes the reduction in storm surge and hurricane winds provided by a healthy freshwater swamp, and improved water quality.

2.3.5.1 Future Without Project Condition

Without Federal action, the swamp habitat surrounding the ARDC would continue to degrade resulting in the eventual conversion from a freshwater swamp to a freshwater marsh and open water. The FWOP condition would be the continued impoundment of swamp water within the study area, a reduction in tree canopy, water quality, hydrologic connectivity, and a transition towards marsh and salinity-tolerant vegetation. Storm surges from tropical cyclone events would increase salinity levels, and the frequency of saltwater inundation is expected to increase with Relative Sea Level Rise (RSLR). The FWOP is the basis to compare the alternatives in Plan Formulation (Section 3).

It is anticipated that the swamp will continue to convert to fresh marsh and eventually to open water (Figure 2.2). The lack of exchange of freshwater, sediments, and nutrients will continue to lead to reduced tree vigor and growth, increased tree mortality, increased invasive species stands, and loss of ecological functions. Likely, with the expected RSLR rise, the swamp degradation would accelerate in the future. Major portions of subunits NE-2, SE-2, and SE-1, would likely deteriorate to fresh marsh within 30 years (Figure 2.2), some areas have already converted to fresh marsh. Additionally, the fresh marsh habitat will convert to open water and additional wetland functions will be lost. The effects of the FWOP on each resource are presented in Table 5.1.

Functions lost include habitat for wildlife and aquatic species, recreational opportunities, aesthetics, and storm surge protection. The freshwater marsh does offer some of the functions of the freshwater swamp, but certain functions are lost, such as habitat for avian species and some storm surge protection. Based on the findings of the 2004 LCA report, preserving and protecting freshwater swamp habitat is of national significance.

Analysis has shown that there has been some recovery for relic open areas in subunit SW-2. However, these relic open areas were not caused by the ARDC dredged material banks. All analyses and investigations to date have suggested that the ARDC dredged material berms have, and likely will continue, to cause degradation of the fresh water swamp habitat.

Indirect impacts resulting from the continued habitat degradation would be the continued decline of wildlife, fishery, and vegetative resources. Flora and fauna species could experience stress due to saline waters not being flushed from the system, and may change as salt-tolerant species replace fresh water species. Air quality would decline due to population growth in Livingston and Ascension Parishes and increased numbers of vehicles and further commercialization and industrialization. Existing swamp habitat would convert to water bottoms and alter the benthic community, and decrease available nutrients and detritus. The habitat quality would continue to degrade, thereby creating a stressful environment for species present. Continued degradation would result in loss of habitats for protected species that utilize the study area, including the West Indian manatee, and Gulf sturgeon. Degraded viewscapes for the study area would be a result of degradation. Coastal Louisiana's wetland loss and the depletion of wetland-dependent natural resources could result in a decline of job opportunities and personal income throughout rural coastal areas. Existing and future infrastructure present within the study area would be adversely affected. Maurepas Wildlife Management Area (WMA), is the only public lands located within a portion of the study area, would be affected. There would be increased exposure of existing oil, gas, and utility pipelines to coastal land loss, which would increase operations, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs, as well as increase the required investment in facilities and pipelines. Coastal forest habitat provides protection from tropical cyclone events; consequently, there could be an increase in storm surge and risk of flooding. Wetland loss would impact commercially important species, including black drum, brown and white shrimp, and blue crab, leading to declining abundances.

Cumulative impacts would be shoreline erosion and land loss resulting in a projected conversion of 18,204 acres of swamp soils to fresh marsh and open water. There would be decreased flows into and out of the swamp due to dredged material berms along the ARDC, increased water levels due to coastal wetland loss and increased runoff due to increased urbanization of the Pontchartrain Basin. The water and air treatment functions of wetlands would subside. The integrity of existing cultural, historical, and recreational resources, as well as aesthetics within the study area would be compromised. Infrastructure, public facilities, and businesses would be adversely impacted. Property values may decline as wetlands continue to degrade. Public lands would be adversely affected. Localized storm surge and storm wave damages are likely to increase. A loss of commercial fishery habitat is likely. Impacts on all forms of vegetation include continued deterioration, and loss of vegetation and wetland habitat acreage. Continued nationwide wetland loss would lead to increased acreage of shallow water bottoms. Benthic populations and plankton would respond to perturbations with a shift towards saline-oriented species as land loss and saltwater intrusion continue. Land loss within the study area would threaten the existence and integrity of cultural and historic resources. Loss of vegetation would degrade the visually complex environment and reduce opportunities for viewing wildlife. The degradation and loss of wetlands would contribute to increased maintenance costs of infrastructure. Several of the current residential subdivisions within the study area may expand, creating additional roads, bridges and associated utilities. As populations continue to migrate to coastal communities, increasing investment in hurricane and flood control levees, pump stations, and other flood control facilities are likely to increase.

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.

2.3.6 Opportunities

The 2004 LCA report listed opportunities for ecosystem restoration for coastal Louisiana as:

- Freshwater reintroductions and outfall management - Diverting water from the Mississippi River into hydrologic basins can (1) nourish existing marshes to increase their productivity and build wetlands in areas of open water, (2) potentially reduce the extent of the hypoxic zone in the gulf, (3) help satisfy the need for maintaining salinity gradients that correspond to the diversity of vegetative habitat, and (4) reintroduce and distribute sediment and nutrients throughout the ecosystem;

- Barrier island restoration, through placement of sand from offshore sources or the Mississippi River, could sustain these geomorphic structures, which would provide additional protection from hurricane storm surges and protect the ecology of estuarine bays and marshes by reducing gulf influences, as well as protect Nationally important water bird nesting areas;

- Hydrologic modification, such as degrading excavated dredged material banks or reestablishing ridges or natural banks, can help restore salinity and marsh inundation patterns and provide fishery access in previously unavailable habitats; and

- The use of sediment material from dedicated dredging or maintenance dredging (e.g., beneficial use) to create a marsh platform can create large amounts of coastal habitat quickly.

The 2004 LCA report emphasizes that many of the above techniques can be applied in combination to produce synergistic effects while minimizing disruptions to the surrounding ecology and economy (e.g., dedicated dredging in conjunction with a small river diversion to increase the sustainability of the created marsh).

Opportunities for the LCA ARDC Modification project have been identified to improve habitat conditions and address many of the problems identified in the study area. These opportunities were chosen based on the potential for ecosystem restoration that exists for portions of the study area and were used as the foundation of the Plan Formulation process.

Opportunities for ecosystem restoration within the LCA ARDC study area as described in the 2004 report are to:

- Improve the hydrologic processes impaired by dredged material berm construction, including connectivity, sheet flow, and freshwater nutrient inflow and outflow;
- Prevent future bald cypress swamp degradation and transition currently predicted to occur;
- Improve areas that have been degraded and transitioned to fresh marsh or open water; and
- Protect vital socioeconomic and public resources.

2.4 PLANNING OBJECTIVES

Study goals, objectives, and constraints were developed to comply with the study authority and to respond to study area problems and opportunities.

2.4.1 Goals

The goal of the LCA ARDC Modification project is to reverse the degradation trend within the western Maurepas Swamp ecosystem that has been adversely affected by the construction of the ARDC. The project would provide nutrients and sediment to facilitate organic deposition in the swamp, improve biological productivity, and prevent further swamp deterioration. According to the 2004 LCA Ecosystem Restoration report, the exchange of flow would occur during flood events on the river and from the runoff of localized rainfall events. The project maximizes the use of restoration strategies that reintroduce historic flows of river water, nutrients, and sediment to coastal wetlands, and that maintain the structural integrity of the coastal ecosystem. Execution of the LCA Plan would make significant progress towards achieving and sustaining a coastal ecosystem that can support and protect the environment, economy, and culture of southern Louisiana and thus, contribute to the economy and well-being of the Nation. Benefits to and effects on existing infrastructure, including navigation, hurricane protection, flood control, land transportation works, agricultural lands, and oil and gas production and distribution facilities were considered in the formulation of coastal restoration plans.

2.4.2 Objectives

The planning objectives identified in the 2004 LCA report include the following:

Hydrogeomorphic Objectives

1. Establish dynamic salinity gradients that reflect natural cycles of freshwater availability and marine forcing (fluctuation related to normal daily and seasonal tidal action or exchange).

2. Increase sediment input from sources outside estuarine basins, and manage existing sediment resources within estuarine basins, to sustain and rejuvenate existing wetlands and rebuild marsh substrate.

3. Maintain or establish natural landscape features and hydrologic processes that are critical to sustainable ecosystem structure and function.

Ecosystem Objectives

1. Sustain productive and diverse fish and wildlife habitats.

2. Reduce nutrient delivery to the Continental shelf by routing Mississippi River waters through estuarine basins while minimizing potential adverse effects.

The project would provide nutrients and sediment to facilitate organic deposition in the swamp, improve biological productivity, and prevent further swamp deterioration.

The objectives identified in 2004 and further investigation of the problems and opportunities in the study area led to the establishment of the following planning objectives. In general, the objectives of the LCA ARDC Modification project are to introduce freshwater, nutrients and sediments into western Maurepas Swamp to reverse the current trend of deterioration.

Specific Project Objectives

1. Increase hydrologic connectivity between the degraded swamp and bottomland hardwood habitats within the study area and the ARDC by increasing the exchange of freshwater, sediments, and nutrients over the 50-year period of analysis.

2. Reduce habitat conversion of swamp to open water within the study area over the 50-year period of analysis.

3. Facilitate natural hydrologic cycle within the study area over the 50-year period of analysis by reducing impoundment in degraded swamp and bottomland hardwood habitats adjacent to the ARDC to improve tree productivity and seedling germination.

4. Improve fish and wildlife habitat within the study area over the 50-year period of analysis.

Performance measures and desired outcomes to determine project success in meeting these project objectives have been developed and are presented within the Adaptive Management and Monitoring Plan (Appendix I).

2.5 PLANNING CONSTRAINTS

Development and evaluation of restoration alternatives for the proposed project are constrained by a number of factors. Specific Planning Constraints identified for the LCA ARDC Modification project include the following:

Flood Control: The ARDC is a component of the AR&T (1956) flood control channel. Project plans must not significantly decrease the performance and original intent of the ARDC and the AR&T project.

Designated Scenic Rivers: Blind River, located on the perimeter of the study area, is a designated Scenic River. Designated Scenic Rivers are protected by a set of use restrictions including channelization, clearing and snagging, channel realignment, reservoir construction, and commercial cutting or harvesting of trees or timber in violation of the Louisiana Scenic Rivers Act. Such restrictions may affect the type of project features that could be constructed along the Blind River.

Hydroperiod: Water levels within the ARDC exhibit seasonal high channel flow and low channel flow intervals. The natural variability of the hydroperiod necessitates a project design that allows the project to function as intended under a variety of flow regimes, ensuring that the project both introduces nutrients and sediments to the adjacent swamps during high channel flow events and allows draining of swamps for seedling establishment during low channel flow events.

Other items that were taken into consideration during plan development and plan selections include:

Drainage Infrastructure: Existing drainage infrastructure within or adjacent to the study area, such as culverts and canals, performs the vital function of conveying excess water out of the area during heavy rainfall or flood events. Formulating a project design that does not impair the capacity of the existing drainage system with additional waters would help to ensure that residential flooding is minimized in the area.

Recreation: Minimize disruption of existing recreational use of the area and ARDC vessel traffic to the extent practicable.

Existing Development: Existing development along portions of the ARDC dredge material berms. This existing development will be considered as implementation of a project in these areas would require the demolition and replacement of certain residential structures and recreational facilities.

Water Quality: Planning objectives of the proposed project include the periodic draining of the swamp during low-flow intervals in the channel and flushing the adjacent habitat during high-flow intervals. Previous studies have indicated that swamps may release phosphorus sequestered within their substrates when subjected to a freshwater reintroduction. The introduction of phosphorus and other constituents into the ARDC and the potential impacts to downstream water bodies are identified ecosystem constraints for the proposed action. Development of a project design that minimizes potential negative impacts to downstream water quality is recommended.

3.0 ALTERNATIVES

3.1 PLAN FORMULATION RATIONALE

3.1.1 Plan Rationale

The plan formulation process is iterative, comprehensive and includes a number of detailed evaluations of potential measures and combinations of restoration measures, and an iterative refinement process for alternative development. This section presents a streamlined overview of the plan formulation process for the LCA ARDC Modification project. Specifically, management measures are presented, screening criteria are discussed, and initial alternative plans are presented along with the screening process to obtain the final array of alternatives. The alternative plans identified through the plan formulation process are 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 evaluation: completeness, effectiveness, efficiency, and acceptability. These criteria are described in Section 3.1.2 of this report. Additionally, ecosystem benefits, cost-effectiveness, and environmental impacts were considered to ensure that the Recommended Plan best meets the project objectives. This section also describes the Tentatively Selected Plan (TSP) as the confirmed Recommended Plan and its implementation requirements.

As part of plan formulation, a Value Engineering (VE) study was conducted to identify potential modifications of restoration measures and plan configurations that could improve the performance and cost-effectiveness of the preliminary measures. The results of the VE study for this project were fully considered and were used to refine the measures and alternatives being considered.

A Value Engineering (VE) Study Report was completed to summarize the events of the VE workshop conducted May 18-22, 2009 for the U.S. Army Corps of Engineers (USACE), New Orleans District, by Value Management Strategies, Inc (Appendix H). The subject of the study was a group of three Louisiana Coastal Area (LCA) ecological restoration projects of which the Amite River Diversion Canal (ARDC) Modification project was one.

The three alternatives that were considered for the ARDC Modification project were:

- Increase the size and number of gaps in the railroad ridge.
- Use railroad ridge as an oak tree habitat.
- Develop an alternative that maximizes the long-term fresh water content of Lake Maurepas as a potential buffer to a major salt water inflow event.

The key recommended strategy from the VE study decided upon with regard to the ARDC Modification project was to increase the size and number of gaps in the railroad ridge. This was applied to the project alternatives as appropriate and is included as a part of the Recommended Plan.

3.1.2 Plan Criteria

3.1.2.1 Completeness

Completeness is the extent that an alternative provides and accounts for all investments and actions required to ensure the planned output is achieved. These criteria may require that an alternative consider the relationship of the plan to other public and private plans if those plans affect the outcome of the project. Completeness also includes consideration of real estate issues, operations, maintenance, repair, replacement, and rehabilitation (OMRR&R), monitoring, and sponsorship factors. Adaptive management plans formulated to address project uncertainties also have to be considered.

3.1.2.2 Effectiveness

Effectiveness is defined as the degree to which the plan would achieve the planning objective. The plan must make a significant contribution to the problem or opportunity being addressed.

3.1.2.3 Efficiency

The project must be a cost-effective means of addressing the problem or opportunity. The plan outputs cannot be produced more cost-effectively by another institution or agency.

3.1.2.4 Acceptability

A plan must be acceptable to Federal, state, and local government in terms of applicable laws, regulation, and public policy. The project should have evidence of broad-based public support and be acceptable to the non-Federal cost sharing partner.

3.1.3 Environmental Operating Principles

In 2002, the U.S. Army Corps of Engineers (USACE) formalized a set of Environmental Operating Principles applicable to decision-making in all programs. The principles are consistent with National Environmental Policy Act (NEPA); the Army Strategy for the Environment; other environmental statutes, and the Water Resource Development Act (WRDA) that govern USACE activities. The

Environmental Operating Principles inform the plan formulation process and are integrated into all project management processes. Section 3.7.7 of this report provides information on the effectiveness of the Recommended Plan in meeting all Environmental Operating Principles. Alternatives were formulated for this project consistent with the Environmental Operating Principles.

The USACE 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, 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 constitute an alternative plan by itself or, alternately, can be combined with other management measures to form an alternative plan.

3.2.1 Development of Management Measures

Management measures were developed to address planning objectives, study area problems, and capitalize on study area opportunities. These management measures were derived from a variety of sources including prior studies, the NEPA public scoping process, the VE study, academia, and through the expertise of the interagency project delivery team (PDT).

The management measures were screened based on project objectives, constraints, effectiveness, and practicality. A total of 105 management measures were developed to address study area problems and to capitalize on study area opportunities.

3.2.2 Description of Management Measures

The management measures developed and evaluated for the ARDC study area can be grouped into the following categories:

Freshwater Reintroduction Measures

- Bank Openings (BO): Discrete openings at various locations along the ARDC dredged material berms, the relict railroad grade, and the natural banks of other study area waterways within the component subunits of the study area were considered. These measures could contribute to establishing hydrologic connectivity by allowing seasonal drying, promoting water circulation to improve water quality, and introducing nutrients and sediment to swamps. Bank openings could include open cuts, culverts, or bridged gaps. The locations for these openings would be chosen based on natural topography within the study area and LIDAR photographs of the study area. The placement of the dredged material would create bottomland hardwood habitat as a means of combating the effects of sea level rise within the study area.

- Berm Degradation (BD): Degradation of the entire ARDC dredged material berm complex, dredged material berm degradation within the component subunits of the study area, and degradation of the relict railroad grade were all considered. These measures could contribute to establishing hydrologic connectivity, allowing seasonal drying, promoting water circulation to improve water quality, and introducing nutrients and sediment to swamps.

- Conveyance Channel (CC): Construction of conveyance channels in the component subunits of the study area to establish a hydrologic interface between the ARDC and interior swamp locations was considered. These measures could contribute to establishing hydrologic connectivity, allowing seasonal drying, promoting water circulation to improve water quality, and introducing nutrients and sediment to swamps. The placement of the dredged material to create bottomland hardwood habitat was also considered.

- Hydraulic Pump (PU): Installation of hydraulic pumps between the ARDC and interior swamp locations within each subunit was considered. These measures could contribute to establishing hydrologic connectivity, allowing seasonal drying, promoting water circulation to improve water quality, and introducing nutrients and sediment to swamps. Additionally, a ring levee could be utilized to help offset the effects of relative sea level rise.

- Siphon Installation (SI): Installation of siphons in the component subunits of the study area to establish hydrologic connectivity between the ARDC and interior swamp locations was considered. These measures could contribute to establishing hydrologic connectivity, allowing seasonal drying or promoting water circulation to improve water quality, and introducing nutrients and sediment to swamps.

- Weir Construction (WC): Construction of weirs along the ARDC dredged material berms at various locations within the component subunits of the study area was considered. These measures could contribute to establishing some hydrologic connectivity at specific water stages and introducing nutrients and sediment to swamps.

- Weir Rehabilitation (WR): Rehabilitation of the existing weir at French Settlement at the confluence of the ARDC and the Amite River was considered. This measure could reduce the flow down the ARDC, thereby promoting the draining of the swamp in specific areas where existing cuts are located and impoundment is reduced.

- Wastewater Reintroduction (WWR): The reintroduction of wastewater from local industries and campsites was considered as a means of adding nutrients to the swamp habitat. An increase in nutrients could be provided to the areas currently impounded and therefore cut off from any nutrient supply. The nutrients would increase the production of tree species within the interior swamp.

- Maximize Lake Maurepas Freshwater Content to Act as a Saltwater Buffer (MLM): Measures were considered which would increase the overall freshwater content within Lake Maurepas in order to reduce saltwater intrusion from within this area. A reduction in saltwater intrusion would result in lower salinity levels within the swamp habitat and could allow for more production and regeneration of native swamp tree species.

Channel Restoration Measures

- Shoal Removal (SR): Removal of shoals or sediment plugs from the mouths of Bayou Pierre, the lower Amite River, and the Blind River were considered.

These measures could contribute to establishing hydrologic connectivity, allowing seasonal drying, promoting water circulation to improve water quality, and (in the case of Bayou Pierre) introducing nutrients and sediment to swamps.

- Clearing and Snagging (CS): Clearing and snagging of natural waterways was considered at various locations within the component subunits of the study area. These measures could contribute to establishing hydrologic connectivity, allowing seasonal drying and promoting water circulation to improve water quality.

- Channel Dredging (CD): Channel dredging of natural waterways at various locations within the component subunits of the study area was considered. These measures could contribute to establishing hydrologic connectivity, allowing seasonal drying and promoting water circulation to improve water quality.

Habitat Restoration Measures

- Non-Structural Vegetative Planting (VP): Vegetative planting to restore bald cypress-tupelo communities in degraded areas throughout the study area was considered. This measure could contribute to preventing habitat conversion and future land loss, increasing swamp vegetative productivity, and restoring and preserving wildlife habitat. Plantings would serve as a means of creating a seed source in the study area for future regeneration as well. Nutria, which inhabit the study area, would increase seedling mortality. Nutria guards would be installed to protect the vegetative plantings.

- Spray Dredging (SD): Spray dredging of degraded areas adjacent to the ARDC was considered. This measure is a form of marsh creation in which dredged material is broadcast within a specific area in order to create marsh habitat. This measure could contribute to preventing habitat conversion and future land loss and restoring and preserving wildlife habitat. This measure was also considered a means by which to combat the effects of sea level rise within the study area.

- Habitat Creation via Placement of Dredged Material (HC): The placement of dredged material as additional upland and bottomland hardwood habitat was considered. These areas could serve as refuge for some species of wildlife during high-water events while also providing areas to implement supplemental plantings of bottomland hardwood tree species.

- Dedicated Dredging (DD): Dedicated dredging of Lake Maurepas for beneficial use material in marsh creation was considered. Dedicated dredging is a form of marsh creation in which the material is mechanically or hydraulically placed within a specified area in order to create marsh habitat. This measure could contribute to preventing habitat conversion and future land loss and restoring and preserving wildlife habitat. This measure was also considered a means by which to combat the effects of sea level rise within the study area.

3.2.3 Screening/Evaluation of Management Measures

All 105 measures were screened based upon many criteria including: project objectives and constraints, benefits gained, expected subunit degradation, effectiveness, adverse environmental impacts, and practicability. Measures were screened out if they did not partially achieve any project objectives or if there were more effective or efficient measures available. Even though each measure was evaluated against its ability to accomplish the project objectives, no measure was eliminated if a specific objective was not achieved. Consideration was given to those measures which failed to achieve any of the stated objectives, but could be combined with other measures to achieve the project objectives. The effectiveness of each measure was considered to ensure that the objectives would be adequately met. If a measure resulted in overall, negative environmental impacts it was screened out. The practicability of each measure was considered to ensure that each measure could be implemented with a feasible amount of effort. From the 105 measures considered, 14 were retained for further study. Some measures originally considered, such as the removal of the entire dredged material berm along the ARDC, were screened out prior to the final development of all 105 management measures. Conversely, upon further feedback from the PDT, some measures were introduced after the initial group of measures was developed, such as the clearing and snagging of existing channels and bayous. Through this iterative process, the final 105 management measures were developed.

The screening strategy also included the evaluation of the study areas hydrologic subunits (Table 3.1) to determine subunits with the most near-term degradation, in keeping with the overall LCA goals to first address near-term degradation. The resultant subunits and management measures were further evaluated based on aerial photography, additional information, and field investigations. Of the nine subunits, four were retained for further study and evaluation.

Aerial photography indicated the general health or historical decline of some of the subunits within the study area. Most degradation could be linked with impoundment or a lack of hydrologic connectivity. However, for subunit SW-2 breaks in the canopy were identified in some of the earlier photographs, before construction of the ARDC. In order to account for these openings, additional analysis of the aerial photographs was conducted as stated in Table 3.1.

Table 3.1. Evaluation of Hydrologic Subunits

Hydrologic Subunit	Description	Reason Eliminated
NW-1	This subunit is connected hydrologically by Bayou Pierre and the Amite River. This area also contains an extensive housing development. Aerial photography and field investigation indicated that there was little degradation and thus little to no opportunity for restoration.	Eliminated because hydrologic connectivity with Bayou Pierre and Amite River already exist within this area. No restorative actions are warranted, therefore this subunit was eliminated
NW-2	This subunit contains the healthiest portion of the western Maurepas Swamp. Aerial photography and field investigation indicated that there was little opportunity for restoration.	This subunit provides a comparison for other degraded areas due to its healthy state. No restorative actions are warranted, therefore this subunit was eliminated.
NE-1	**This subunit is in need of restoration and there is an opportunity for restoration.**	**This subunit was found to be a degraded area, therefore this subunit was retained.**
NE-2	**This subunit has a high degree of habitat degradation and there is an opportunity for restoration.**	**This subunit was found to be a highly degraded area, therefore this subunit was retained.**
NE-3	This subunit has a degree of habitat change; however, no hydrologic measures were identified that would benefit the area. Aerial photography and field investigation indicated that there was little opportunity for restoration.	Due to a lack of impoundment, no hydrologic or restorative measures were identified that would benefit the area. Therefore this subunit was eliminated.
SW-1	This subunit is in good health and contains a series of culverts that provide hydrologic connectivity between the swamp and the ARDC. Aerial photography and field investigation indicated that there was little opportunity for restoration.	Due to existing hydrologic connectivity between the swamp and ARDC there are no measures that could benefit this subunit. Therefore this subunit was eliminated.

Hydrologic Subunit	Description	Reason Eliminated
SW-2	This subunit does not appear to need restoration. Initial review of aerial photographs suggested that degradation may be occurring due to the presence of some open water areas. However, a more detailed review of historic aerial photographs dating to 1940, before the construction of the ARDC, indicated that these openings historically existed (Figures 3.1-3.3). The aerial review indicated that the canopy in these open areas are developing a more closed canopy, suggesting recovery is already underway. Louisiana Department of Wildlife and Fisheries personnel recommended not dredging the bayous off the Petite Amite River on the WMA to drain ponds because standing water is beneficial to wildlife during droughts. During droughts, these open areas provide refugia for many aquatic and semi-aquatic species as well as drinking water for terrestrial wildlife. The open areas appear to be a natural feature of the landscape and not a human-induced phenomenon, and does not need restoration.	Based on a review of historic aerial photography, no apparent habitat degradation has occurred in this subunit due to construction of the ARDC. Therefore, no restorative actions are warranted and the subunit was eliminated.
SE-1	**This subunit has degraded areas, although not as degraded as NE-1 and NE-2. There are opportunities to restore and reduce degradation by increasing freshwater, sediment, and nutrient exchange.**	**There are opportunities to restore and improve this subunit by increasing connectivity to the ARDC, therefore it was retained.**
SE-2	**This subunit has degradation associated with stagnation and saltwater intrusion. There are opportunities to increase connectivity with the ARDC to increase connectivity and flush higher salinity waters after tropical storm events. Although the swamps of SE-2 are hydrologically connected to Blind River, this area needs fresh water, nutrients, and sediments, including the flushing of high saltwater intrusion events.**	**Sediment, water, and nutrient connectivity and inflow from the ARDC would benefit this area, including the flushing of saltwater intrusion after tropical storm events. While connectivity with Blind River does exist within the southern portions of this subunit, overall hydrologic connectivity between the ARDC and the northern portions of this subunit would provide additional nutrients and flush saltwater intrusion introduced by high-water events via Blind River. Therefore, this subunit was retained.**

As part of an initial screening process, the nine hydrologic subunits (NW-1, NW-2, NE-1, NE-2, NE-3, SW-1, SW-2, SE-1, SE-2) were examined to determine the degree of degradation, level of existing hydrologic connectivity, and identification of hydrologic measures that would benefit the area, and subunits NE-1, NE-2, SE-1 and SE-2 were retained for further study (Table 3.1). The most near-term degradation is expected to occur in the easternmost subunits and the opportunity to restore habitat is the greatest in these four subunits. Although there is some degradation in NE-3, it is not caused by the ARDC or other man-made sources. There does not appear to be an opportunity for restoration in NE-3. The westernmost subunits, NW-1 and SW-1 appear to be healthy and no restoration is needed. NW-2 is overall a very healthy system, mainly due to the connectivity with the Petite Amite River. SW-2 is a mostly healthy system with some areas expected to become marsh within 20-30 years. Public comments initially indicated that degradation had occurred within subunit SW-2. However, based on analysis of aerial photography and discussions with the Louisiana Department of Wildlife and Fisheries, it was determined that any perceived degradation existed within the subunit before construction of the ARDC (Figures 3.1 through 3.3). This analysis also showed that portions of SW-2 improved from 1940 to 2005. Therefore, it was concluded that subunit SW-2 was not degraded due to the construction of the ARDC or any problems stipulated in Section 2.3 of this report.

As a result of the initial screening process, several of the hydrologic subunits were determined to be healthy freshwater swamp habitat, with little to no habitat degradation. This emphasized a lack of near-term ecosystem restoration opportunities for these areas and deemphasized a need for immediate restoration action. However, this does not imply that other restoration actions would not be warranted, but that any other restoration effort would be beyond the scope of this project. The long-term preservation of these areas through acquisition by the state of Louisiana or a private land trust would help to maintain healthy habitat within these areas.

After evaluating each hydrologic subunit, the measures were screened based on project objectives, constraints, effectiveness, impacts, and practicability (Table 3.2). The measures carried forward for further evaluation were assembled into alternative plans designed to address study goals and objectives. All management measures considered were deemed consistent with Administration budget policy, specific USACE policies for ecosystem restoration, and Federal laws, regulations, and Executive Orders.

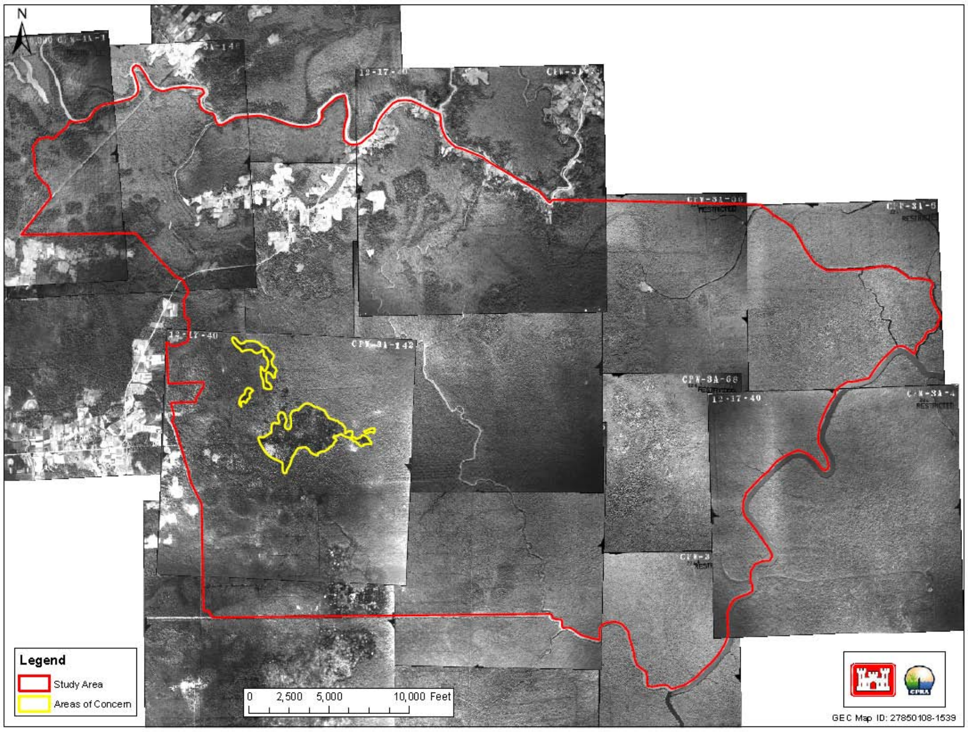


Figure 3.1. 1940 Aerial Photography with Area of Impact Outlined

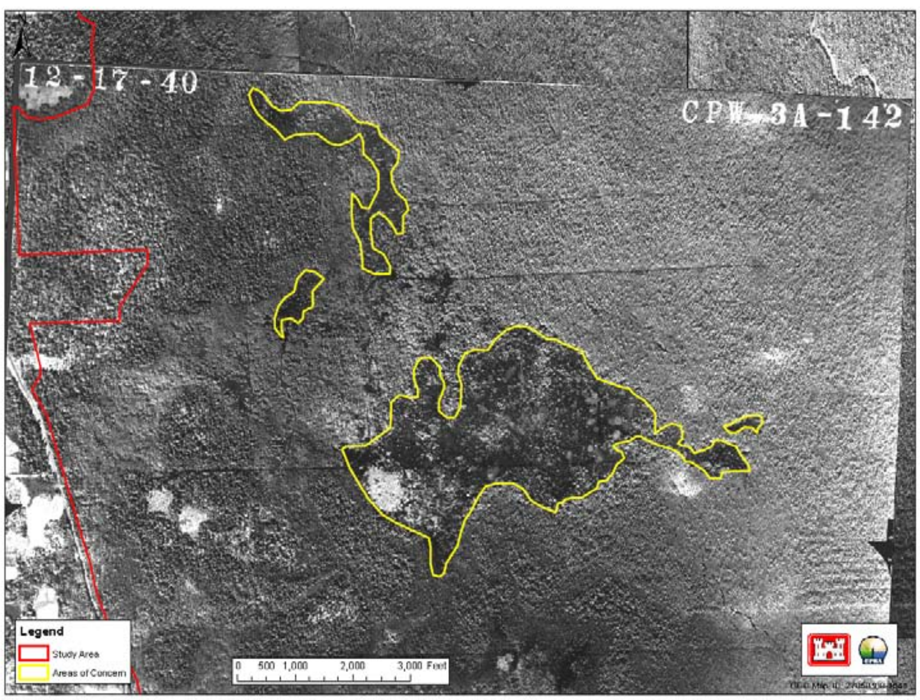


Figure 3.2. 1940 Aerial Photography -- Close-Up of Area of Interest

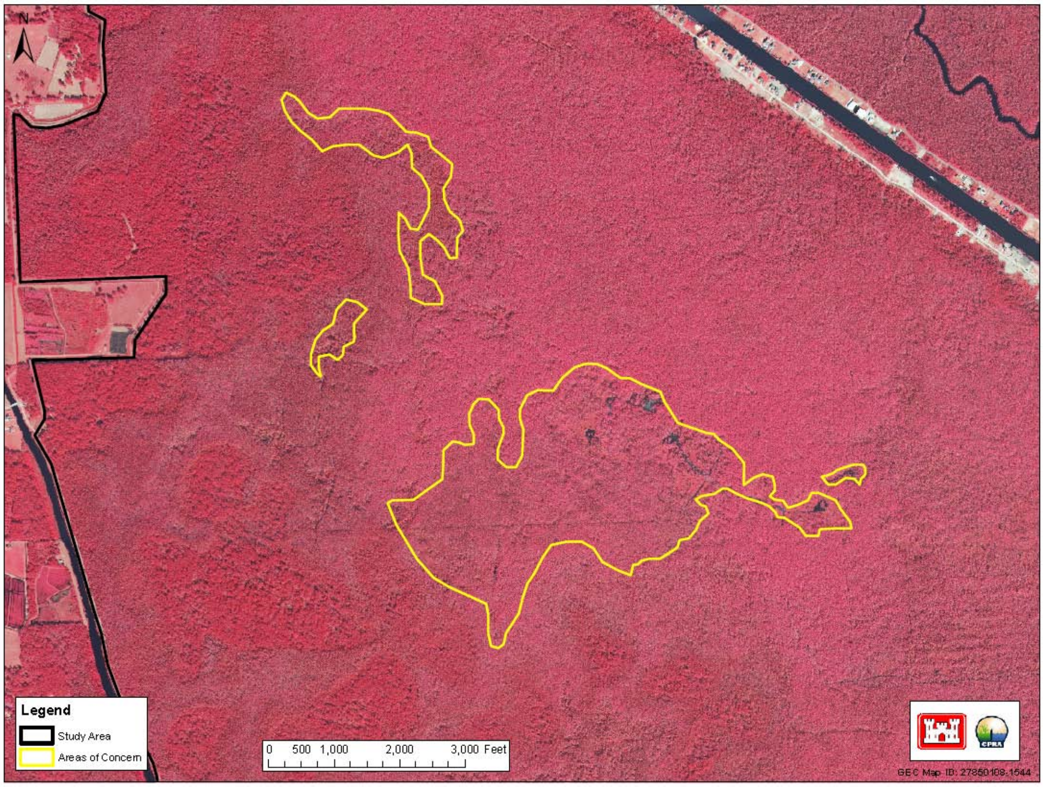


Figure 3.3. 2005 Color Infrared Photography -- Area of Interest

3.2.4 Management Measures Not Carried Forward for Further Analysis

Of the 105 original measures developed, 91 measures (Table 3.2) were eliminated from further consideration due to screening of the hydrologic subunits, failure to partially meet project objectives, or the measure was deemed impracticable or ineffective due to project constraints. Fourteen measures were retained for further study (Table 3.2). Vegetative planting, a non-structural measure, was retained in conjunction with other measures; not as a standalone measure, because it was determined that plantings would not provide benefits without restored hydrologic connectivity. Some measures, such as dedicated dredging with ring levees, were considered as mitigation of RSLR. However, further investigation suggested that impacts would be great and benefits would be low; these measures were eliminated.

Table 3.2. Management Measures Considered with Screening Results

Management Measure	Description	Screening Results
BD-01	Degradation of the entire ARDC dredged material berm	Eliminated due to a lack of practicality. Removal of large portions or all of the dredged material berms is not necessary to achieve any of the project objectives. Bank openings are viewed as a more feasible measure. Implementation of this measure would also destroy existing upland habitat found within the study area.
BO-01	Opening at confluence of Bayou Pierre and ARDC at LA-22, SW-2	Historic aerial photograph analysis and field investigations indicated that while some minor degradation exists within portions of SW-2, the Petite Amite does provide adequate hydrologic connectivity. Analysis also revealed that canopy loss within SW-2 existed before the ARDC was constructed. Therefore, no opportunity for restoration exists and the measure was eliminated.
BO-02	Opening at confluence of Bayou Pierre and ARDC south of LA-22, SW-2	Historic aerial photograph analysis and field investigations indicated that while some minor degradation exists within portions of SW-2, the Petite Amite does provide adequate hydrologic connectivity. Analysis also revealed that canopy loss within SW-2 existed before the ARDC was constructed. Therefore, no opportunity for restoration exists and the measure was eliminated.
BO-03	Openings along ARDC throughout study area, at intersections of relict channels	Eliminated as a standalone measure, but other BO and CC measures would be located in the low areas of relic channels as much as practicable.
BO-04	Openings on lower Amite River, NW-1	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project.
BO-05	Openings on lower Amite River, NW-2	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project.
BO-06	Openings on south bank Bayou Chene Blanc, NE-1	Eliminated because additional field investigation determined adequate hydrologic connectivity already exists in these areas; and habitat would have little to no improvement with these measures.
BO-07	Openings on south bank Bayou Chene Blanc, NE-2	Eliminated because additional field investigation determined adequate hydrologic connectivity already exists in these areas; and habitat would have little to no improvement with these measures.
BO-08	Openings on west bank Blind River, NE-2	Eliminated because additional field investigation determined adequate hydrologic connectivity already exists in these areas; and habitat would have little to no improvement with these measures.
BO-09	Openings on west bank Blind River, SE-1	Eliminated because additional field investigation determined adequate hydrologic connectivity already exists in these areas; and habitat would have little to no improvement with these measures.

Management Measure	Description	Screening Result
BO-10	Openings on west bank Blind River, SE-2	Eliminated because additional field investigation determined adequate hydrologic connectivity already exists in these areas, and habitat would have little to no improvement with these measures.
BO-11	Openings on east bank of Petite Amite River, NE-1	Eliminated because additional field investigation determined adequate hydrologic connectivity already exists in these areas, and habitat would have little to no improvement with these measures.
BO-12	Openings on east bank of Petite Amite River, SE-1	Eliminated because additional field investigation determined adequate hydrologic connectivity already exists in these areas, and habitat would have little to no improvement with these measures.
BO-13	Openings on north bank ARDC, NE-1	Eliminated because it would be problematic to develop a bank opening through an existing subdivision, due to utility relocations; hydrologic connectivity could be achieved for the easternmost portion of NE-1 (the only portion that is degraded) via a connection through NE-2.
BO-14	**Openings on north bank ARDC, NE-2**	**Retained (Meets Objective 2, Objective 3 and Objective 4). Would provide connectivity for freshwater, nutrients, and sediments when combined with a bank opening.**
BO-15	**Openings on south bank ARDC, SE-2**	**Retained (Meets Objective 2, Objective 3 and Objective 4). Would provide connectivity for freshwater, nutrients, and sediments when combined with a bank opening.**
BO-16	**Openings on south bank ARDC, SE-1**	**Retained (Meets Objective 2, Objective 3 and Objective 4). Would provide connectivity for freshwater, nutrients, and sediments when combined with a bank opening.**
BO-17	Openings on south bank ARDC, SW-2	Historic aerial photograph analysis and field investigations indicated that while some minor degradation exists within portions of SW-2, the Petite Amite does provide adequate hydrologic connectivity. Analysis also revealed that canopy loss within SW-2 existed before the ARDC was constructed. Therefore, no opportunity for restoration exists and the measure was eliminated.
BO-18	Openings on south bank ARDC, SW-1	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project.
BO-19	Openings on north bank ARDC, NW-1	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project.

Management Measure	Description	Screening Result
BO-20	Openings on north bank ARDC, NW-2	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project.
BO-21	Openings on west bank of Petite Amite River, SW-2	Historic aerial photograph analysis and field investigations indicated that while some minor degradation exists within portions of SW-2, the Petite Amite does provide adequate hydrologic connectivity. Analysis also revealed that canopy loss within SW-2 existed before the ARDC was constructed. Therefore, no opportunity for restoration exists and the measure was eliminated.
BO-22	Openings on west bank of Petite Amite River, NW-2	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project.
BO-23	**Openings on railroad grade, NE-1/NE-2**	**Retained (Meets Objective 2, Objective 3 and Objective 4). Would provide connectivity for freshwater, nutrients, and sediments when combined with a bank opening.**
BO-24	**Openings on railroad grade, SE-1/SE-2**	**Retained (Meets Objective 2, Objective 3 and Objective 4). Would provide connectivity for freshwater, nutrients, and sediments when combined with a bank opening.**
CC-01	**Conveyance channel, NE-1/NE-2**	**Retained (Meets Objective 1, Objective 2, Objective 3 and Objective 4)**
CC-02	Conveyance channel, NW-1/NW-2	Eliminated because hydrologic connectivity already exists within both subunits and little to no habitat restoration would occur. Conveyance channels were retained as a design feature and combined with bank openings. This combination was retained for further study.
CC-03	**Conveyance channel, SE-1/SE-2**	**Retained (Meets Objective 1, Objective 2 and Objective 4). Would provide connectivity for freshwater, nutrients, and sediments when combined with a bank opening.**
CC-04	Conveyance channel, SW-1/SW-2	Historic aerial photograph analysis and field investigations indicate that little to no degradation exists in the areas near the convergence of SW-1 and SW-2. Adequate hydrologic connectivity already exists within both subunits. Therefore, no opportunities exist for restoration. Conveyance channels were retained as a design feature and combined with bank openings. This combination was retained for further study, while the stand-alone measure was eliminated.
CD-01	Channel dredging, Bayou Chene Blanc, NE-1/NE-2	Eliminated because further field investigations determined that surface water connections in this portion of these areas are adequate. Furthermore, it was determined that the bayou has already reached a natural equilibrium and would therefore silt back in within a few years of over-excavating.

Management Measure	Description	Screening Result
CD-02	Channel dredging, Bayou Pierre, NW-1/NW-2, SW-2	Historic aerial photograph analysis and field investigations indicated that while some minor degradation exists within portions of SW-2, adequate hydrologic connectivity exists. Analysis also revealed that canopy loss within SW-2 existed before the ARDC was constructed. Therefore, no opportunity for restoration exists and the measure was eliminated. Furthermore, it was determined that the bayou has already reached a natural equilibrium and would therefore silt back in within a few years of over-excavating.
CD-03	Channel dredging, Blind River, NE-2/SE-1/SE-2	Eliminated because further field investigations indicated that these areas are hydrologically connected with Blind River and therefore, no restoration opportunities exist. Furthermore, it was determined that the bayou has already reached a natural equilibrium and would therefore silt back in within a few years of over-excavating.
CD-04	Channel dredging, Lower Amite River, NW-1/NW-2	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project. Furthermore, it was determined that the river has already reached a natural equilibrium and would therefore silt back in within a few years of over-excavating.
CD-05	Channel dredging, Petite Amite River, NW-2/NE-1	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and that hydrologic connectivity already exists for this portion of the study area. Furthermore, it was determined that the river has already reached a natural equilibrium and would therefore silt back in within a few years of over-excavating.
CD-06	Channel dredging, Petite Amite River, SW-2/SE-1	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and that hydrologic connectivity already exists for this portion of the study area. Furthermore, it was determined that the river has already reached a natural equilibrium and would therefore silt back in within a few years of over-excavating.
CS-01	Clearing and snagging of Bayou Chene Blanc, NE-1/NW-2	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and that hydrologic connectivity already exists for this portion of the study area. Furthermore, clearing and snagging is not needed and would result in no added flow though the bayou.
CS-02	Clearing and snagging of Bayou Pierre, SW-2	Historic aerial photograph analysis and field investigations indicated that while some minor degradation exists within portions of SW-2, adequate hydrologic connectivity exists. Analysis also revealed that canopy loss within SW-2 existed before the ARDC was constructed. Therefore, no opportunity for restoration exists and the measure was eliminated.
CS-03	Clearing and snagging of Bayou Pierre, NW-1	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project. Furthermore, clearing and snagging is not needed and would result in no added flow though the bayou.

Management Measure	Description	Screening Result
CS-04	Clearing and snagging of Bayou Pierre, NW-2	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project. Furthermore, clearing and snagging is not needed and would result in no added flow though the bayou.
CS-05	Clearing and snagging of Blind River, NE-2/SE-2	Eliminated because further field investigations determined that surface water connections in this area are adequate. Furthermore, clearing and snagging is not needed and would result in no added flow though the river.
CS-06	Clearing and snagging of lower Amite River, NW-1/NW-2	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project. Furthermore, clearing and snagging is not needed and would result in no added flow though the river.
CS-07	Clearing and snagging of Petite Amite River, NW-2/NE-1	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project. Furthermore, clearing and snagging is not needed and would result in no added flow though the river.
CS-08	Clearing and snagging of Petite Amite River, SW-2/SE-1	Historic aerial photograph analysis and field investigations indicated that while some minor degradation exists within portions of SW-2, adequate hydrologic connectivity exists. Analysis also revealed that canopy loss within SW-2 existed before the ARDC was constructed. Therefore, no opportunity for restoration exists and the measure was eliminated.
DD-01	Dedicated dredging of borrow areas and placement within ring-levees to combat subsidence and sea level rise within the study area	Eliminated because these measures would result in a substantial habitat loss, placement of this material would be difficult, and the ecosystem benefits would be limited.
HC-01	**Placement of dredged material from the construction of conveyance channels as additional upland and bottomland hardwood habitat in NE-1/NE-2**	**Retained (Meets Objective 4)**
HC-02	Placement of dredged material from the construction of conveyance channels as additional upland and bottomland hardwood habitat in NW-1/NW-2	Eliminated because hydrologic connectivity already exists within both subunits and little to no habitat restoration would occur, therefore conveyance channels were eliminated as a management measure within these subunits.

Management Measure	Description	Screening Result
HC-03	**Placement of dredged material from the construction of conveyance channels as additional upland and bottomland hardwood habitat in SE-1/SE-2**	**Retained (Meets Objective 4)**
HC-04	Placement of dredged material from the construction of conveyance channels as additional upland and bottomland hardwood habitat in SW-1/SW-2	Eliminated because hydrologic connectivity already exists within both subunits and little to no habitat restoration would occur, therefore conveyance channels were eliminated as a management measure within these subunits.
MLM-01	Increasing the overall freshwater content within Lake Maurepas in order to reduce saltwater intrusion from within this area.	Eliminated because the reduction of salinity levels through the introduction of freshwater from other rivers or lakes is beyond the scope of this project. This issue will be addressed by other projects outside the study area.
MPDT-1	Removing the entire railroad grade	Eliminated because much of the existing railroad grade is characterized as bottomland hardwood habitat and complete removal of the railroad grade would destroy this important and valuable habitat.
MPDT-2	Dredging the entire railroad grade to use as conveyance	Eliminated because implementation would destroy existing bottomland hardwood wildlife habitat. In addition, the railroad grade is not located in an area that would effectively drain the swamp. Conveyance channels would provide a more effectively drain of the swamp.
MPDT-3	Constructing openings in the banks of Blind River at NE-3.	Eliminated because no impoundment exists within NE-3, therefore bank openings would provide no additional hydrologic connectivity or benefits.
MPDT-4	Dredging Bayou Chene Blanc	Eliminated because no dredging is needed. It was determined that the bayou has already reached a natural equilibrium and would therefore silt back in within a few years of over-excavating.
MPDT-5	Clearing and snagging Bayou Chene Blanc and Little Bayou Chene Blanc	Eliminated because clearing and snagging is not needed and would result in no added flow though the bayou.
MPDT-6	**NE-2 dredging the pullboat channel**	**Retained (Meets Objective 1, Objective 2 and Objective 4)**

Management Measure	Description	Screening Result
MPDT-7	Introducing secondary treated wastewater into SW-2	Historic aerial photograph analysis and field investigations indicated that while some minor degradation exists within portions of SW-2, adequate hydrologic connectivity exists. Analysis also revealed that canopy loss within SW-2 existed before the ARDC was constructed. Therefore, no opportunity for restoration exists and the measure was eliminated.
MPDT-8	**Use dredged ARDC opening material to create additional habitat**	**Retained (Meets Objective 4)**
PU-01	Hydraulic Pumps, NE-1	Eliminated because the OMRR&R and size of pumps required to improve the swamp habitat are impracticable and would have reduced reliability as well as lost restoration opportunities when the pumps fail.
PU-02	Hydraulic Pumps, NE-2	Eliminated because the OMRR&R and size of pumps required to improve the swamp habitat are impracticable and would have reduced reliability as well as lost restoration opportunities when the pumps fail.
PU-03	Hydraulic Pumps, NW-1	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project. Additionally, the OMRR&R and size of the pumps required to improve the swamp habitat are impracticable and would have reduced reliability as well as lost restoration opportunities when the pumps fail.
PU-04	Hydraulic Pumps, NW-2	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project. Additionally, the OMRR&R and size of the pumps required to improve the swamp habitat are impracticable and would have reduced reliability as well as lost restoration opportunities when the pumps fail.
PU-05	Hydraulic Pumps, SE-1	Eliminated because the OMRR&R and size of pumps required to improve the swamp habitat are impracticable and would have reduced reliability as well as lost restoration opportunities when the pumps fail.

Management Measure	Description	Screening Result
PU-06	Hydraulic Pumps, SE-2	Eliminated because the OMRR&R and size of pumps required to improve the swamp habitat are impracticable and would have reduced reliability as well as lost restoration opportunities when the pumps fail.
PU-07	Hydraulic Pumps, SW-1	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project. Additionally, the OMRR&R and size of the pumps required to improve the swamp habitat are impracticable and would have reduced reliability as well as lost restoration opportunities when the pumps fail.
PU-08	Hydraulic Pumps, SW-2	Historic aerial photograph analysis and field investigations indicated that while some minor degradation exists within portions of SW-2, adequate hydrologic connectivity exists. Analysis also revealed that canopy loss within SW-2 existed before the ARDC was constructed. Therefore, no opportunity for restoration exists and the measure was eliminated. Additionally, the OMRR&R and size of the pumps required to improve the swamp habitat are impracticable and would have reduced reliability as well as lost restoration opportunities when the pumps fail.
PU-09	Hydraulic Pumps with a Ring-Levee, SE-1/SE-2, NE-1/NE-2	Eliminated because the OMRR&R and size of pumps required to improve the swamp habitat are impracticable and would have reduced reliability as well as lost restoration opportunities when the pumps fail.
RG-01	Removal of entire railroad grade, NE-1/NE-2	Eliminated because much of the existing railroad grade is characterized as bottomland hardwood habitat and complete removal of the railroad grade would destroy this important and valuable habitat.
RG-02	Removal of entire railroad grade, SE-1/SE-2	Eliminated because much of the existing railroad grade is characterized as bottomland hardwood habitat and complete removal of the railroad grade would destroy this important and valuable habitat.
RS-01	Removal of entire ARDC north dredged material berm, NE-1	Eliminated because complete removal is not needed to achieve adequate connectivity into the adjacent swamp habitat and removal would lead to a large loss of bottomland hardwood habitat.

Management Measure	Description	Screening Result
RS-02	Removal of entire ARDC north dredged material berm, NE-2	Eliminated because complete removal is not needed to achieve adequate connectivity into the adjacent swamp habitat and removal would lead to a large loss of bottomland hardwood habitat.
RS-03	Removal of entire ARDC north dredged material berm, NW-1	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project. Furthermore, removal would lead to a large loss of bottomland hardwood habitat.
RS-04	Removal of entire ARDC north dredged material berm, NW-2	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project. Furthermore, removal would lead to a large loss of bottomland hardwood habitat.
RS-05	Removal of entire ARDC south dredged material berm, SE-1	Eliminated because complete removal is not needed to achieve adequate connectivity across the railroad grade and removal would lead to a large loss of bottomland hardwood habitat.
RS-06	Removal of entire ARDC south dredged material berm, SE-2	Eliminated because complete removal is not needed to achieve adequate connectivity across the railroad grade and removal would lead to a large loss of bottomland hardwood habitat.
RS-07	Removal of entire ARDC south dredged material berm, SW-1	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project. Furthermore, removal would lead to a large loss of bottomland hardwood habitat.
RS-08	Removal of entire ARDC south dredged material berm, SW-2	Historic aerial photograph analysis and field investigations indicated that while some minor degradation exists within portions of SW-2, adequate hydrologic connectivity exists. Analysis also revealed that canopy loss within SW-2 existed before the ARDC was constructed. Therefore, no opportunity for restoration exists and the measure was eliminated. Furthermore, removal would lead to a large loss of bottomland hardwood habitat.
RS-09	Removal of both ARDC dredged material berms, entire lengths	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project. Furthermore, removal would lead to a large loss of bottomland hardwood habitat.
SD-01	Spray dredging and ring-levees for degraded areas within study area	Eliminated because these measures would result in a substantial habitat loss, placement of this material would be difficult and the ecosystem benefits would be limited.

Management Measure	Description	Screening Result
SI-01	Siphons, NE-1	Eliminated because the OMRR&R, and size and volume of siphons required to improve the swamp habitat is impracticable and would have reduced reliability. Additionally, since little head differential is present, it would be very difficult for siphons to function to move enough volume of fresh water to improve the habitat.
SI-02	Siphons, NE-2	Eliminated because the OMRR&R, and size and volume of siphons required to improve the swamp habitat is impracticable and would have reduced reliability. Additionally, since little head differential is present, it would be very difficult for siphons to function to move enough volume of fresh water to improve the habitat.
SI-03	Siphons, NW-1	Eliminated because the proposed area of implementation is not considered degraded and there would be no habitat improvement with these measures. Additionally, since little head differential is present, it would be very difficult for siphons to function to move enough volume of fresh water to improve the habitat. Furthermore, field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project.
SI-04	Siphons, NW-2	Eliminated because the proposed area of implementation is not considered degraded and there would be no habitat improvement with these measures. Additionally, since little head differential is present, it would be very difficult for siphons to function to move enough volume of fresh water to improve the habitat. Furthermore, field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project.
SI-05	Siphons, SE-1	Eliminated because the OMRR&R, and size and volume of siphons required to improve the swamp habitat is impracticable and would have reduced reliability. Additionally, since little head differential is present, it would be very difficult for siphons to function to move enough volume of fresh water to improve the habitat.
SI-06	Siphons, SE-2	Eliminated because the OMRR&R, and size and volume of siphons required to improve the swamp habitat is impracticable and would have reduced reliability. Additionally, since little head differential is present, it would be very difficult for siphons to function to move enough volume of fresh water to improve the habitat.
SI-07	Siphons, SW-1	Eliminated because the proposed area of implementation is not considered degraded and there would be no habitat improvement with these measures. Additionally, since little head differential is present, it would be very difficult for siphons to function to move enough volume of fresh water to improve the habitat. Furthermore, field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project.

Management Measure	Description	Screening Result
SI-08	Siphons, SW-2	Eliminated because the proposed area of implementation only exhibits minor degradation and there would be no habitat improvement with these measures. Additionally, since little head differential is present, it would be very difficult for siphons to function to move enough volume of fresh water to improve the habitat. Furthermore, field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project.
SR-01	Shoal removal, mouth of Amite River (outside study area)	Eliminated because removal of these shoals would have no hydraulic effect on the ARDC in the degraded areas. Field investigations determined that water exchange in this area is adequate and these measures would not affect water surfaces controlled by Lake Maurepas.
SR-02	Sediment plug removal, mouth of Bayou Pierre, east of LA 22, SW-2	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas have no opportunity for restoration. Furthermore, it was determined that the bayou has already reached a natural equilibrium and would therefore silt back in within a few years of over-excavating.
SR-03	Shoal removal, mouth of Blind River (outside study area)	Eliminated because removal of these shoals would have no hydraulic effect on the ARDC in the degraded areas. Field investigations determined that water exchange in this area is adequate and these measures would not affect water surfaces controlled by Lake Maurepas.
VE-01	Increase the size and number of gaps in the railroad ridge	Numerous natural cuts in the railroad grade already exist within degraded areas. Cuts in the railroad grade provide some connectivity in specific areas and help facilitate sheet flow when combined with other alternatives, but these cuts alone would not provide the hydrologic connectivity needed to restore the degraded areas within the swamp.
VE-02	Use the railroad ridge as an oak tree habitat	Further field investigation determined that a quality bottomland hardwood habitat already exists on the railroad grade and there would be little to no habitat improvements to plant additional trees.
VE-03	Maximize long-term fresh water content of Lake Maurepas as a potential buffer to a major saltwater inflow event	Eliminated because it does not meet the project objectives for the LCA ARDC Modification project and is beyond the scope of the authorized action.
VE-04	**Use dredged railroad material to create additional habitat**	**Retained (Meets Objective 4)**

Management Measure	Description	Screening Result
VP-01	**Vegetative planting, such as (including bald cypress and tupelo seedlings), in degraded areas**	**Retained (Meets Objective 4)**
VP-02	**Vegetative planting, such as (including water oak and sweetgum seedlings), on material placed from excavation of the dredged material berms.**	**Retained (Meets Objective 4)**
WC-01	Construction of weir on north ARDC bank, NE-1	Eliminated because these structures would impede flow and connectivity. Weirs also could lead to semi-impounding situations, which would actually harm, rather than restore habitat. More open structures are needed to create connectivity and maximize the freshwater, nutrient, and sediment input.
WC-02	Construction of weir on north ARDC bank, NE-2	Eliminated because these structures would impede flow and connectivity. Weirs also could lead to semi-impounding situations, which would actually harm, rather than restore habitat. More open structures are needed to create connectivity and maximize the freshwater, nutrient, and sediment input.
WC-03	Construction of weir on north ARDC bank, NW-1	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project. Furthermore, these structures would impede flow and connectivity. Weirs also could lead to semi-impounding situations, which would actually harm, rather than restore habitat. More open structures are needed to create connectivity and maximize the freshwater, nutrient, and sediment input.
WC-04	Construction of weir on north ARDC bank, NW-2	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas have no opportunity for restoration. Furthermore, these structures would impede flow and connectivity. Weirs also could lead to semi-impounding situations, which would actually harm, rather than restore habitat. More open structures are needed to create connectivity and maximize the freshwater, nutrient, and sediment input.
WC-05	Construction of weir on south ARDC bank, SE-1	Eliminated because these structures would impede flow and connectivity. Weirs also could lead to semi-impounding situations, which would actually harm, rather than restore habitat. More open structures are needed to create connectivity and maximize the freshwater, nutrient, and sediment input.

Management Measure	Description	Screening Result
WC-06	Construction of weir on south ARDC bank, SE-2	Eliminated because these structures would impede flow and connectivity. Weirs also could lead to semi-impounding situations, which would actually harm, rather than restore habitat. More open structures are needed to create connectivity and maximize the freshwater, nutrient, and sediment input.
WC-07	Construction of weir on south ARDC bank, SW-1	Eliminated because further field investigations and historic aerial photograph analysis indicated that these areas were not degraded and therefore did not meet the objectives of the project. Furthermore, these structures would impede flow and connectivity. Weirs also could lead to semi-impounding situations, which would actually harm, rather than restore habitat. More open structures are needed to create connectivity and maximize the freshwater, nutrient, and sediment input.
WC-08	Construction of weir on south ARDC bank, SW-2	Eliminated because further field investigations and historic aerial photograph analysis indicated that these no opportunity for restoration exists for this subunit. Furthermore, these structures would impede flow and connectivity. Weirs also could lead to semi-impounding situations, which would actually harm, rather than restore habitat. More open structures are needed to create connectivity and maximize the freshwater, nutrient, and sediment input.
WR-01	Rehabilitation of existing weir at French Settlement, NW-1/SW-1	Eliminated because Lake Maurepas water levels control the water levels in the ARDC near the degraded areas. Therefore, changes to this existing weir would have little effect on restoring the degraded habitat. In addition, this weir is outside the LCA ARDC study area.
WWR-01	Reintroduction of wastewater from local industries and campsites	Eliminated because implementation this measure would result in environmental damages that outweigh any benefits. Additionally, the most highly-degraded portions of the study area are located the furthest from potential wastewater sources.

BO = Bank Openings; BD= Berm Degradation; CC = Conveyance Channels; CD = Channel Dredging; CS = Clearing and Snagging; DD = Dedicated Dredging; HC=Habitat Creation; MLM= Maximize Lake Maurepas Freshwater Content to act as a buffer; MPDT = Measures from Project Delivery Team; PU = Pumps; RG = Railroad Grade; RS = Removal of Dredged Material Berm; SD = Spray Dredging; SI = Siphons; SR = Shoal Removal; VE = Value Engineering; VP = Vegetative Planting; WC = Weir Construction; WR = Weir Rehabilitation; WRR= Wastewater Reintroduction;

Note: Bolded measures were retained for further consideration.

3.3 PRELIMINARY ALTERNATIVE PLANS

The plan formulation process includes development of a reasonable range of alternative plans to address the specific problems, needs, and objectives of the study described in Section 2. Alternative plans are combinations of management measures. The 14 restoration measures retained for further consideration were combined and developed into a preliminary array of 45 alternatives that collectively met study goals and objectives and were within the defined study constraints. All alternatives developed and the reasons for eliminating particular alternatives are listed in Table 3.3.

Table 3.3. Description and Screening Results of Alternatives, Including the Final Array

Alternative	Description	Screening Result
1	One or more openings in the north bank of the ARDC in NE-2; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure.
2	One or more openings in the north bank of the ARDC in NE-2; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, VP-01, VP-02)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure.
3	One or more openings in the north bank of the ARDC in NE-2; dredging bayous leading from Blind River into NE-2; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02, MPDT-6)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure. Furthermore, dredging would benefit only a limited area. It was determined that the bayous have already reached a natural equilibrium and would therefore silt back in within a few years.
4	One or more openings in the north bank of the ARDC in NE-2; dredging pullboat traces/bayous leading from Blind River into NE-2 and dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, VP-01, VP-02, MPDT-6)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure. Furthermore, dredging would benefit only a limited area. It was determined that the bayous have already reached a natural equilibrium and would therefore silt back in within a few years. Therefore, dredging the bayous would not be effective or sustainable.

Alternative	Description	Screening Result
5	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in NE-1/NE-2; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02, BO-23,VE-04)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore, dredging the bayous would not be effective or sustainable.
6	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in NE-1/NE-2; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-23, VE-04, VP-01, VP-02)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore, dredging the bayous would not be effective or sustainable.
7	One or more openings in the north bank of the ARDC in NE-2; dredging pullboat traces/bayous leading from Blind River into NE-2; one or more gaps in the railroad grade in NE-1/NE-2; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02, BO-23, VE-04, MPDT-6)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure. Furthermore, dredging would benefit only a limited area. It was determined that the bayous have already reached a natural equilibrium and would therefore silt back in within a few years. Therefore, dredging the bayous would not be effective or sustainable.
8	One or more openings in the north bank of the ARDC in NE-2; dredging pullboat traces/bayous leading from Blind River into NE-2; one or more gaps in the railroad grade in NE-1/NE-2; dredged material berm and swamp floor vegetative plantings (BO14, MPDT-8, BO-23, VE-04, VP-01, VP-02, MPDT-6)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure. Furthermore, dredging would benefit only a limited area. It was determined that the bayous have already reached a natural equilibrium and would therefore silt back in within a few years. Therefore, dredging the bayous would not be effective or sustainable.
9	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in SE-1/SE-2; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02, BO-24, VE-04)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure.
10	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in SE-1/SE-2; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-24, VE-04, VP-01, VP-02)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure.

Alternative	Description	Screening Result
11	One or more openings in the north bank of the ARDC in NE-2; dredging pullboat traces/bayous leading from Blind River into NE-2; one or more gaps in the railroad grade in SE-1/SE-2; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02, BO-24, VE-04, MPDT-6)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure. Furthermore, dredging would benefit only a limited area. It was determined that the bayous have already reached a natural equilibrium and would therefore silt back in within a few years. Therefore, the bayous are not effective or sustainable. Therefore, dredging the bayous would not be effective or sustainable.
12	One or more openings in the north bank of the ARDC in NE-2; dredging pullboat traces/bayous leading from Blind River into NE-2; one or more gaps in the railroad grade in SE-1/SE-2; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-24, VE-04, VP-01, VP-02, MPDT-6)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure. Furthermore, dredging would benefit only a limited area. It was determined that the bayous have already reached a natural equilibrium and would therefore silt back in within a few years. Therefore, dredging the bayous would not be effective or sustainable.
13	One or more openings in the north bank of the ARDC in NE-2; one or more openings in the south bank of the ARDC in SE-1; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02, BO-16)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure.
14	One or more openings in the north bank of the ARDC in NE-2; one or more openings in the south bank of the ARDC in SE-1; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-16, VP-01, VP-02)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure.
15	One or more openings in the north bank of the ARDC in NE-2; dredging pullboat traces/bayous leading from Blind River into NE-2; one or more openings in the south bank of the ARDC in SE-1; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02, BO-16, MPDT-6)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure. Furthermore, dredging would benefit only a limited area. It was determined that the bayous have already reached a natural equilibrium and would therefore silt back in within a few years. Therefore, dredging the bayous would not be effective or sustainable.

Alternative	Description	Screening Result
16	One or more openings in the north bank of the ARDC in NE-2; dredging pullboat traces/bayous leading from Blind River into NE-2; one or more openings in the south bank of the ARDC in SE-1; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-16, VP-01, VP-02, MPDT-6)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure. Furthermore, dredging would benefit only a limited area. It was determined that the bayous have already reached a natural equilibrium and would therefore silt back in within a few years.
17	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in SE-1/SE-2; one or more openings in the south bank of the ARDC in SE-1; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02, BO-24, VE-04, BO-16)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure.
18	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in SE-1/SE-2; one or more openings in the south bank of the ARDC in SE-1; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-24, VE-04, BO-16, VP-01, VP-02)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure.
19	One or more openings in the north bank of the ARDC in NE-2; dredging pullboat traces/bayous leading from Blind River into NE-2; one or more gaps in the railroad grade in SE-1/SE-2; one or more openings in the south bank of the ARDC in SE-1; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02, BO-24, VE-04, BO-16, MPDT-6)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure. Furthermore, dredging would benefit only a limited area. It was determined that the bayous have already reached a natural equilibrium and would therefore silt back in within a few years. Therefore, dredging the bayous would not be effective or sustainable.
20	One or more openings in the north bank of the ARDC in NE-2; dredging pullboat traces/bayous leading from Blind River into NE-2; one or more gaps in the railroad grade in SE-1/SE-2; one or more openings in the south bank of the ARDC in SE-1; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-24, VE-04, BO-16, VP-01, VP-02, MPDT-6)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure. Furthermore, dredging would benefit only a limited area. It was determined that the bayous have already reached a natural equilibrium and would therefore silt back in within a few years. Therefore, dredging the bayous would not be effective or sustainable.

Alternative	Description	Screening Result
21	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in NE-1/NE-2; one or more gaps in the railroad grade in SE-1/SE-2; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02, BO-23, VE-04, BO-24)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure. Furthermore, this alternative would result in limited benefits by only cutting gaps into the railroad grade in SE-1/SE-2 without also improving hydraulic connectivity with the ARDC through proposed conveyance channels.
22	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in NE-1/NE-2; one or more gaps in the railroad grade in SE-1/SE-2; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-23, VE-04, BO-24, VP-01, VP-02)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure. Furthermore, this alternative would result in limited benefits by only cutting gaps into the railroad grade in SE-1/SE-2 without also improving hydraulic connectivity with the ARDC through proposed conveyance channels.
23	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in NE-1/NE-2; one or more gaps in the railroad grade in SE-1/SE-2; dredging pullboat traces/bayous leading from Blind River into NE-2; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02, BO-23, BO-24, VE-04, MPDT-6)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure. Furthermore, this alternative would result in limited benefits by only cutting gaps into the railroad grade in SE-1/SE-2 without also improving hydraulic connectivity with the ARDC through proposed conveyance channels. Dredging would benefit only a limited area as well. It was determined that the bayous have already reached a natural equilibrium and would therefore silt back in within a few years. Therefore, dredging the bayous would not be effective or sustainable.
24	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in NE-1/NE-2; one or more gaps in the railroad grade in SE-1/SE-2; dredging pullboat traces/bayous leading from Blind River into NE-2; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-23, BO-24, VE-04, VP-01, VP-02, MPDT-6)	This alternative was eliminated because it was determined that added conveyance channels into the swamp, was necessary to achieve hydrological connectivity and would result in greater benefits. Furthermore, this alternative would result in limited benefits by only cutting gaps into the railroad grade in SE-1/SE-2 without also improving hydraulic connectivity with the ARDC through proposed conveyance channels. Dredging would benefit only a limited area as well. It was determined that the bayous have already reached a natural equilibrium and would therefore silt back in within a few years. Therefore, dredging the bayous would not be effective or sustainable.

Alternative	Description	Screening Result
25	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in NE-1/NE-2; one or more openings in the south bank of the ARDC in SE-1; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02, BO-23, VE-04, BO-16)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure.
26	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in NE-1/NE-2; one or more openings in the south bank of the ARDC in SE-1; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-23, VE-04, BO-16, VP-01, VP-02)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure.
27	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in NE-1/NE-2; one or more gaps in the railroad grade in SE-1/SE-2; openings in the south bank of the ARDC in SE-1; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02, BO-23, VE-04, BO-24, BO-16)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure.
28	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in NE-1/NE-2; one or more gaps in the railroad grade in SE-1/SE-2; openings in the south bank of the ARDC in SE-1; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-23, BO-24, VE-04, BO-16, VP-01, VP-02)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure.
29	One or more openings in the north bank of the ARDC in NE-2; dredging pullboat traces/bayous leading from Blind River into NE-2; one or more gaps in the railroad grade in NE-1/NE-2; one or more openings in the south bank of the ARDC in SE-1; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02, BO-23, VE-04, BO-16, MPDT-6)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure.
30	One or more openings in the north bank of the ARDC in NE-2; dredging pullboat traces/bayous leading from Blind River into NE-2; one or more gaps in the railroad grade in NE-1/NE-2; one or more openings in the south bank of the ARDC in SE-1; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-23, VE-04, BO-16, VP-01, VP-02, MPDT-6)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure.
31	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in NE-1/NE-2; one or more in the railroad grade in SE-1/SE-2; dredging pullboat traces/bayous leading from Blind River into NE-2; one or more openings in the south bank of the ARDC in SE-1; dredged material berm vegetative plantings (BO-14, MPDT-8, VP-02, BO-23, BO-24, VE-04, BO-16, MPDT-6)	This alternative was eliminated because it was determined that just bank openings would not be effective without conveyance channels to provide hydrological connectivity into the swamp. Therefore bank openings were eliminated as a stand-alone measure. Furthermore, dredging would benefit only a limited area. It was determined that the bayous have already reached a natural equilibrium and would therefore silt back in within a few years. Therefore, dredging the bayous would not be effective or sustainable.

Alternative	Description	Screening Result
32	One or more openings in the north bank of the ARDC in NE-2; one or more gaps in the railroad grade in NE-1/NE-2; one or more gaps in the railroad grade in SE-1/SE-2; dredging pullboat traces/bayous leading from Blind River into NE-2, one or more openings in the south bank of the ARDC in SE-1; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-23, VE-04, BO-24, BO-16, VP-01, VP-02, MPDT-6)	This alternative was eliminated because it was determined that added conveyance channels into the swamp, was necessary to achieve hydrological connectivity and would result in greater benefits. Furthermore, dredging would benefit only a limited area. It was determined that the bayous have already reached a natural equilibrium and would therefore silt back in within a few years. Therefore, dredging the bayous would not be effective or sustainable.
33	Three openings in the north bank of the ARDC in NE-2 with the westernmost cut also extending through the railroad grade into NE-1; bifurcated conveyance channels; sidecasting of dredged material; one cut in the railroad grade located approximately 0.9 miles north of the ARDC in NE-1/NE-2; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-23, VE-04, CC-01, VP-01, VP-02, HC-01).	**Retained as a final alternative. This alternative would provide the connectivity for freshwater, nutrients, and sediments. Additionally, the alternative would meet all project objectives.**
34	One opening in the south bank of the ARDC in SE-1 west of and within close proximity to the railroad grade that extends east and through the railroad grade between SE-1/SE-2 into SE-2; bifurcated conveyance channels; sidecasting of dredged material; two cuts in the railroad grade located 0.9 and 2 miles south of the ARDC in SE-1/SE-2; dredged material berm and swamp floor vegetative plantings (BO-24, VE-04, BO-15, BO-16, CC-03, VP-01, VP-02, HC-03).	**Retained as a final alternative. This alternative would provide the connectivity for freshwater, nutrients, and sediments. Additionally, the alternative would meet all project objectives.**
35	One opening in the south bank of the ARDC in SE-1; bifurcated conveyance channels; sidecasting of dredged material; dredged material berm plantings (BO-16, MPDT-8, VP-02, CC-03, HC-03).	**Retained as a final alternative. This alternative would provide the connectivity for freshwater, nutrients, and sediments. Additionally, the alternative would meet all project objectives.**
36	Three openings in the north bank of the ARDC in NE-2 with the westernmost cut also extending through the railroad grade into NE-1; bifurcated conveyance channels; sidecasting of dredged material; one cut in the railroad grade located approximately 0.9 miles north of the ARDC in NE-1/NE-2; one opening in the south bank of the ARDC in SE-1 west of and within close proximity to the railroad grade that extends east and through the railroad grade between SE-1/SE-2 into SE-2; two cuts in the railroad grade located 0.9 and 2 miles south of the ARDC in SE-1/SE-2; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-23, VE-04, BO-24, BO-15, BO-16, CC-01, CC-03, VP-01, VP-02, HC-01, HC-03).	**Retained as a final alternative. This alternative would provide the connectivity for freshwater, nutrients, and sediments. Additionally, the alternative would meet all project objectives.**

Alternative	Description	Screening Result
37	Two openings in the south bank of the ARDC in SE-1; bifurcated conveyance channels; sidecasting of dredged material; one opening located just west of the natural ridge that intersects the south bank of the ARDC and one west of and within close proximity to the railroad grade, that extends east and through the railroad grade between SE-1 and SE-2 into SE-2; two additional cuts in the railroad grade located 0.9 and 2 miles south of the ARDC in SE-1/SE-2; dredged material berm and swamp floor vegetative plantings (MPDT-8, BO-15, BO-16, BO-24, VE-04, CC-03, VP-01, VP-02, HC-03).	**Retained as a final alternative. This alternative would provide the connectivity for freshwater, nutrients, and sediments. Additionally, the alternative would meet all project objectives.**
38	Three openings in the north bank of the ARDC in NE-2 with the westernmost cut also extending through the railroad grade into NE-1; bifurcated conveyance channels; sidecasting of dredged material; one cut located approximately 0.9 miles north of the ARDC in NE-1/NE-2; one opening in the south bank of the ARDC in SE-1; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-16, BO-23, VE-04, CC-01, CC-03, VP-01, VP-02, HC-01, HC-03).	**Retained as a final alternative. This alternative would provide the connectivity for freshwater, nutrients, and sediments. Additionally, the alternative would meet all project objectives.**
39	Three openings in the north bank of the ARDC in NE-2 with the westernmost cut also extending through the railroad grade into NE-1; bifurcated conveyance channels; sidecasting of dredged material; two openings in the south bank of the ARDC in SE-1, with one cut located west of and within close proximity to the railroad grade, that extends east and through the railroad grade between SE-1/SE-2 into SE-2; three cuts in the railroad grade, one cut located approximately 0.9 miles north of the ARDC in NE-1/NE-2 and two additional cuts in the railroad grade located 0.8 and 2 miles south of the ARDC in SE-1/SE-2; dredged material berm and swamp floor vegetative plantings (BO-14, MPDT-8, BO-23, BO-24, VE-04, BO-15, BO-16, CC-01, CC-03, VP-01, VP-02, HC-01, HC-03).	**Retained as a final alternative. This alternative would provide the connectivity for freshwater, nutrients, and sediments. Additionally, the alternative would meet all project objectives.**
40	Three openings in the north bank of the ARDC in NE-2 with the westernmost cut also extending through the railroad grade into NE-1; bifurcated conveyance channels; sidecasting of dredged material; one cut in the railroad grade located approximately 0.9 miles north of the ARDC in NE-1/NE-2; dredged material berm vegetative plantings (BO-14, MPDT-8, BO-23, VE-04, CC-01, VP-02, HC-01).	This alternative was eliminated because it was determined that vegetative plantings, located within the highly-degraded portions of the study area, are essential to the near-term restoration of critical freshwater swamp habitat. It was determined that natural regeneration would not occur within these areas for several decades without the implementation of vegetative plantings.

Alternative	Description	Screening Result
41	One opening in the south bank of the ARDC in SE-1 west of and within close proximity to the railroad grade that extends east and through the railroad grade between SE-1/SE-2 into SE-2; bifurcated conveyance channels; sidecasting of dredged material; two cuts in the railroad grade located 0.9 and 2 miles south of the ARDC in SE-1/SE-2; dredged material berm vegetative plantings (BO-24, VE-04, BO-15, BO-16, CC-03, VP-02, HC-03).	This alternative was eliminated because it was determined that vegetative plantings, located within the highly-degraded portions of the study area, are essential to the near-term restoration of critical freshwater swamp habitat. It was determined that natural regeneration would not occur within these areas for several decades without the implementation of vegetative plantings.
42	Three openings in the north bank of the ARDC in NE-2 with the westernmost cut also extending through the railroad grade into NE-1; bifurcated conveyance channels; sidecasting of dredged material; one cut in the railroad grade located approximately 0.9 miles north of the ARDC in NE-1/NE-2; one opening in the south bank of the ARDC in SE-1 west of and within close proximity to the railroad grade that extends east and through the railroad grade between SE-1/SE-2 into SE-2; two cuts in the railroad grade located 0.9 and 2 miles south of the ARDC in SE-1/SE-2; dredged material berm vegetative plantings (BO-14, MPDT-8, BO-23, VE-04, BO-24, BO-15, BO-16, CC-01, CC-03, VP-02, HC-01, HC-03).	This alternative was eliminated because it was determined that vegetative plantings, located within the highly-degraded portions of the study area, are essential to the near-term restoration of critical freshwater swamp habitat. It was determined that natural regeneration would not occur within these areas for several decades without the implementation of vegetative plantings.
43	Two openings in the south bank of the ARDC in SE-1; bifurcated conveyance channels; sidecasting of dredged material; one opening located just west of the natural ridge that intersects the south bank of the ARDC and one west of and within close proximity to the railroad grade, that extends east and through the railroad grade between SE-1 and SE-2 into SE-2; two additional cuts in the railroad grade located 0.9 and 2 miles south of the ARDC in SE-1/SE-2; dredged material berm vegetative plantings (MPDT-8, BO-15, BO-16, BO-24, VE-04, CC-03, VP-02, HC-03).	This alternative was eliminated because it was determined that vegetative plantings, located within the highly-degraded portions of the study area, are essential to the near-term restoration of critical freshwater swamp habitat. It was determined that natural regeneration would not occur within these areas for several decades without the implementation of vegetative plantings.
44	Three openings in the north bank of the ARDC in NE-2 with the westernmost cut also extending through the railroad grade into NE-1; bifurcated conveyance channels; sidecasting of dredged material; one cut located approximately 0.9 miles north of the ARDC in NE-1/NE-2; one opening in the south bank of the ARDC in SE-1; dredged material berm vegetative plantings (BO-14, MPDT-8, BO-16, BO-23, VE-04, CC-01, CC-03, VP-02, HC-01, HC-03).	This alternative was eliminated because it was determined that vegetative plantings, located within the highly-degraded portions of the study area, are essential to the near-term restoration of critical freshwater swamp habitat. It was determined that natural regeneration would not occur within these areas for several decades without the implementation of vegetative plantings.

Alternative	Description	Screening Result
45	Three openings in the north bank of the ARDC in NE-2 with the westernmost cut also extending through the railroad grade into NE-1; bifurcated conveyance channels; sidecasting of dredged material; two openings in the south bank of the ARDC in SE-1, with one cut located west of and within close proximity to the railroad grade, that extends east and through the railroad grade between SE-1/SE-2 into SE-2; three cuts in the railroad grade, one cut located approximately 0.9 miles north of the ARDC in NE-1/NE-2 and two additional cuts in the railroad grade located 0.8 and 2 miles south of the ARDC in SE-1/SE-2; dredged material berm vegetative plantings (BO-14, MPDT-8, BO-23, BO-24, VE-04, BO-15, BO-16, CC-01, CC-03, VP-02, HC-01, HC-03).	This alternative was eliminated because it was determined that vegetative plantings, located within the highly-degraded portions of the study area, are essential to the near-term restoration of critical freshwater swamp habitat. It was determined that natural regeneration would not occur within these areas for several decades without the implementation of vegetative plantings.

3.3.1 Development of Alternative Plans

The development of alternatives is an iterative process and alternatives were revised and added throughout the progression of the project. If an alternative was revised and changed from what was initially considered the alternative received a new number designation. Through the iterative planning process, a total of 45 alternatives were developed. The final array consisted of seven action Alternatives 33-39 and the No-Action Alternative. Within the final array, Alternatives 33, 34, and 35 represent individual Alternatives, while Alternatives 36, 37, 38, and 39 are combinations of the Alternatives 33, 34, and 35.

Vegetative plantings were added to the alternative arrays. Based on research and additional site investigations, it was determined that the most highly degraded areas within NE-2 and SE-2 would need to consider vegetative plantings on the swamp floor (Measure VP-01) as a component proposed within these subunits. (See Section 3.3.1.1 for further information). Planting of bottomland hardwood species were also added to alternatives (Measure VP-02) to beneficially use the dredged material placement resulting from excavation of the conveyance channels, by creating additional bottomland hardwood habitat.

Conveyance channels were added to the proposed gaps to ensure that a hydraulic connection between the ARDC and the adjacent swamp was achieved. The need for these conveyance channels were based on the hydrological and hydraulic analysis, field reconnaissance, and previous project experience on Davis Pond Freshwater Diversion project. The conveyance channel dimensions were based on the existing conveyance channels within the study area and were designed using the width, depth, and profile of existing sustainable channels. It was determined that if only gaps were constructed, without conveyance channels, there would not likely be enough water exchange to keep these gaps open or to improve the swamp habitat. It was also determined that gaps, with associated conveyance channels, would be sustainable and allow for adequate water exchange between the ARDC and the impaired swamp.

3.3.1.1 Inclusion of Vegetative Plantings into Alternatives

Vegetative plantings in highly-degraded freshwater swamp habitats are a critical component utilized for establishing ecological restoration and obtaining ecological benefits. The Coastal Wetland Forest Conservation and Use Science Working Group (CWFCUSWG, 2005) indicated that: "In those areas where flooding prevents or limits the natural regeneration of the cypress-tupelo forest, artificial regeneration through tree planting is the only currently viable mechanism to regenerate the forest. Some swamps are altered to such a significant extent that even artificial regeneration is not possible." Once hydraulic connection is restored within a degraded freshwater swamp, tree vigor and stand productivity will increase (Shaffer *et al*. 2009). In areas with an existing canopy, mid-story, and established regeneration, vegetative plantings would not be necessary. These areas would have an adequate seed source and stocking levels needed to recover. However, if an area has degraded to the point that the canopy, mid-story, and established regeneration is limited or severely stressed, vegetative plantings are essential to achieve required stocking levels. If a natural seed source is not present for regeneration to become established, the areas that have already begun transition to marsh will continue the transition and the severely degraded swamp areas will not be able to convert back to a functioning swamp habitat. Due to the highly-degraded conditions found in portions of the LCA ARDC study area (NE-2 and SE-2), natural regeneration would not likely become established within the 50 year period of analysis and would not contribute to the restoration of this Near-Term critical habitat or meet the goals and objectives of the project. Additionally, vegetative plantings are needed to allow for the establishment of a native tree community by providing an opportunity for natural succession to occur prior to the establishment of invasive species, such as the Chinese tallow (*Sapium sebiferum*).

Reestablishing freshwater swamps through the implementation of vegetative plantings would generate healthy stand conditions and adequate canopy cover that will be necessary to establish a swamp prior to the onset of the effects of RSLR to the study area (Section 3.5.2). Over time, the effects of RSLR would continue to reach a point in which regeneration of native species is inhibited. Souther and Shaffer, 2000, indicated that newly-germinated cypress seedlings (less than two weeks of age) may be capable of surviving up to one and one-half months of submergence, but will suffer complete mortality after a period of submergence longer than 57 days. However, one-year-old seedlings experience up to a 75 percent survival rate when they are submerged for as long as five months (Souther and Shaffer 2000). Middleton (1995) suggests a longer dry period is necessary for cypress establishment. According to Middleton (1995), cypress seedlings require a drawdown of two years, and once established saplings will tolerate flooding better than seedlings. Additionally, Clason (personal communication) stated that the dry period should extend through the growing season (April-October) during the first several years to allow seedlings to develop aggressive root systems.

Based on RSLR estimates and H&H modeling, it is estimated that much of the LCA ARDC study area would become permanently inundated within 40 years. Established freshwater swamp habitats can however provide good productivity, even once permanently inundated, provided there is adequate hydrologic connection, freshwater exchange, and an established stand with sufficient canopy cover. According to Dr. Gary Shaffer (personal communication, October 2009), cypress seedlings and trees should experience many pulses of nutrient-rich fresh water during the growing season, and once the seedlings are above high water, they can handle permanent flooding if the water is fresh and moving.

Invasive species also play a role in the degradation of freshwater swamp habitat within the study area. It is well documented that nutria (*Myocastor coypu*) will dramatically damage or destroy newly-planted seedlings and generally deter cypress regeneration (Conner and Toliver 1987, 1988, Johnson and Foote 1997, Flynn 1986, Conner and Day 1989, Myers *et al.* 1995, and Burnam and Mengak 2007). Myers *et al.* (1995) reported 100 percent mortality of unprotected seedlings in southeastern Louisiana and found that PVC protectors were an effective deterrent against nutria. In most cases, nutria seek out newly-planted seedlings and remove enough of the bark to kill the tree, normally within a few days or weeks. Nearly all mitigation banks that plant seedlings in areas where nutria exist use rodent guards or some form of nutria protection. Methods to control nutria include: habitat modification, exclusion, repellants, toxicants, trapping, and shooting (Burnam and Mengak 2007). Habitat modification may only prove partially-effective within the LCA ARDC study area because much of the area would become moderately inundated, which is ideal habitat for nutria. Repellants are marginally effective only in the short-term. Zinc phosphate is the only toxicant registered for nutria control, but may not be effective in a swamp environment because it may get diluted. Trapping and shooting may be effective, but would require coordination with the Louisiana Department of Wildlife and Fisheries and would be difficult to implement this method as part of any proposed action at this time. Therefore, it was determined that the most feasible method of nutria control would be an exclusion device that creates a barrier between the nutria and the tree, such as nutria guards. Nutria guards would act as a barrier on the newly-planted seedlings until the seedlings are large enough that the nutria would no longer damage or kill the tree.

In summary, it was determined that vegetative plantings along with the reestablishment of hydrologic connectivity are essential in highly degraded areas (NE-2 and SE-2) to reestablish a productive stand and adequate canopy cover where natural regeneration would not likely occur within the period of record and before the effects of RSLR permanently inundated the system. Permanent inundation would prevent planted or naturally regenerated species from becoming established; however, the added hydrologic connectivity will allow for continued success of an already established swamp. Vegetative plantings are also needed for native trees to become reestablished and overcome competition from exotic and invasive species. Nutria exclusion methods will be included on all plantings to prevent nutria from damaging or killing newly-planted seedlings.

3.3.2 Description of Alternative Plans

Descriptions of all 45 alternatives developed are listed in Table 3.3. A matrix of management measures used to formulate each alternative is presented in Table 3.4.

3.3.3 Screening/Evaluation of Alternative Plans

Once developed, all alternatives were evaluated. This evaluation process was based on the ability of each alternative to meet project objectives, information gathered from field investigations, technical discussions, the overall effectiveness of each alternative, and the adverse environmental impacts that may result from the alternatives in question. Results of the screening were previously presented in Table 3.3. The rationale utilized for each screening criteria is detailed below.

- **Ability to Meet Project Objectives and Alternative Effectiveness** – Each alternative was evaluated on the basis of its ability to meet the four project objectives described in Section 2.4.2 of this report. Each action listed in the initial array of alternatives is made up of a combination of measures that were retained based on their ability to meet one or more of the project objectives. Therefore, a comparison was made between the alternatives to ascertain the degree to which the overall list of objectives would be accomplished by implementation of the proposed action. Some alternatives were not retained if a similar, but different alternative was deemed to be more effective in accomplishing the stated project objectives.
- **Information Gathered from Field Investigations** – The initial array of alternatives was also evaluated, based on information and data gathered during field investigations. For portions of the study area these field investigations helped to determine the level to which hydrologic connectivity exists, the existence of gaps within the dredged material berm and railroad grade, the level of existing degradation and the corresponding need for restoration, and the feasibility of implementing each alternative. This information helped determine which actions should be retained or screened out.
- **Adverse Environmental Impacts** – Any adverse environmental impacts that would result from the proposed alternatives were considered throughout the screening process as well. The environmental impacts considered ranged from habitat loss that would occur to reductions

Table 3.4. Matrix of Management Measures Used to Formulate the Alternatives

Alternatives	Measures													
	BO-14	BO-15	BO-16	BO-23	BO-24	CC-01	CC-03	HC-01	HC-03	MPDT-6	MPDT-8	VE-04	VP-01	VP-02
	Openings on north bank ARDC, strategically located, NE-2	Openings on south bank ARDC, strategically located, SE-2	Openings on south bank ARDC, strategically located, SE-1	Openings on railroad grade, strategically located, NE-1/NE-2	Openings on railroad grade, strategically located, SE-1/SE-2	Conveyance channel, NE-1/NE-2	Conveyance channel, SE-1/SE-2	Beneficial use of dredged material from conveyance channels, NE-1/NE-2	Beneficial use of dredged material from conveyance channels, SE-1/SE-2	NE-2 dredging the pullboat channel	Use dredged ARDC opening material to create additional habitat	Use dredged railroad material to create additional habitat	Vegetative planting, such as (including bald cypress and tupelo seedlings), in degraded areas	Vegetative planting, such as (including water oak and sweetgum seedlings), on material placed from excavation of the dredged material berms.
1	✓										✓			✓
2	✓										✓		✓	✓
3	✓									✓	✓			✓
4	✓									✓	✓		✓	✓
5	✓			✓							✓	✓		✓
6	✓			✓							✓	✓	✓	✓
7	✓			✓						✓	✓	✓		✓
8	✓			✓						✓	✓	✓	✓	✓
9	✓				✓						✓	✓		✓
10	✓				✓						✓	✓	✓	✓
11	✓				✓					✓	✓	✓		✓
12	✓				✓					✓	✓	✓	✓	✓
13	✓		✓								✓			✓
14	✓		✓								✓		✓	✓
15	✓		✓							✓	✓			✓
16	✓		✓							✓	✓		✓	✓
17	✓		✓		✓						✓	✓		✓
18	✓		✓		✓						✓	✓	✓	✓
19	✓		✓		✓					✓	✓	✓		✓
20	✓		✓		✓					✓	✓	✓	✓	✓
21	✓			✓	✓						✓	✓		✓
22	✓			✓	✓						✓	✓	✓	✓
23	✓			✓	✓					✓	✓	✓		✓
24	✓			✓	✓					✓	✓	✓	✓	✓
25	✓		✓	✓							✓	✓		✓
26	✓		✓	✓							✓	✓	✓	✓
27	✓		✓	✓	✓						✓	✓		✓
28	✓		✓	✓	✓						✓	✓	✓	✓
29	✓		✓	✓						✓	✓	✓		✓
30	✓		✓	✓						✓	✓	✓	✓	✓
31	✓		✓	✓	✓					✓	✓	✓		✓
32	✓		✓	✓	✓					✓	✓	✓	✓	✓
33	✓			✓		✓		✓			✓	✓	✓	✓
34		✓	✓		✓		✓		✓		✓	✓	✓	✓
35			✓				✓		✓		✓			✓
36	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
37		✓	✓		✓		✓		✓		✓	✓	✓	✓
38	✓		✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
39	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
40	✓			✓		✓		✓			✓	✓		✓
41		✓	✓		✓		✓		✓		✓	✓		✓
42	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓
43		✓	✓		✓		✓		✓		✓	✓		✓
44	✓		✓	✓		✓	✓	✓	✓		✓	✓		✓
45	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓

in environmental parameters such as water quality. The cumulative impacts to the local, state, and national resources similar to the study area were also considered. Only proposed actions with minimal to no adverse environmental impacts were retained for the final array.

Additional discussions involved aspects of each proposed alternative which could potentially effect screening decisions.

3.3.4 Alternative Plans Not Carried Forward for Further Analysis

Due to the need to facilitate flow from the interior swamp to the ARDC, it was determined that interface connections alone would not create enough connectivity. A true hydraulic connection would be needed to ensure enough water exchange between the ARDC and the swamp. Alternatives that did not have conveyance channels were eliminated and only alternatives with conveyance channels were retained through to the final array of alternatives (Table 3.3).

Alternatives were also eliminated if they included channel dredging. It was determined that the bayou has already reached a natural equilibrium and would therefore silt back in within a few years of over-excavating. Therefore, the implementation of channel dredging would provide reduced benefits and would be considered unsustainable. Alternatives which did not include the implementation of vegetative plantings, within the most highly-degraded portions of the study area, were eliminated based on the justification described in Section 3.3.1.1.

3.4 FINAL ARRAY OF ALTERNATIVES (ALTERNATIVES STUDIED IN DETAIL)

Each alternative within the final array was retained from the initial array of alternatives (Table 3.3). Seven alternatives plus the no-action alternative were further evaluated. Of the seven alternatives, three are individual alternatives, while the other four are combinations of these three. All alternatives within the final array would have no adverse impacts on flood control, navigation, recreation, or any type of Federal or non-Federal project.

3.4.1 No-Action Alternative (Future Without Project condition)

The No-Action Alternative consists of not implementing any restoration actions in the LCA ARDC study area and is the Future Without Project (FWOP) condition to which each alternative in the Final Alternative Array will be compared. This alternative would not address any of the project objectives stated in Section 2.4.2.

Consideration of the No-Action Alternative is required by National Environmental Policy Act [NEPA §1502.14(d)] and the current Federal Principles and Guidelines (P&G §1.10.1).

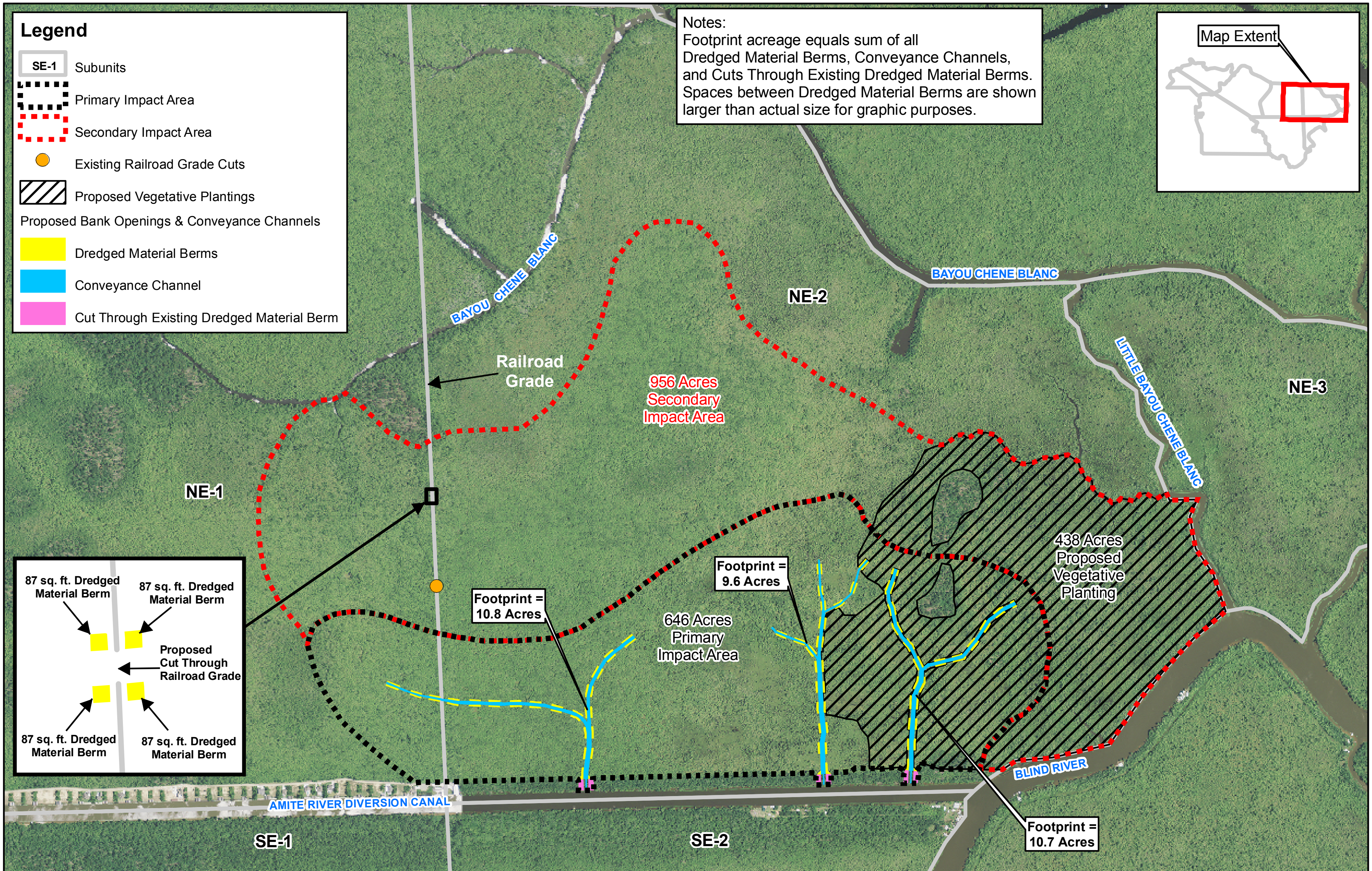
3.4.2 Alternative 33 (NE-1/NE-2)

Alternative 33 (Figure 3.4) includes:

- Three dredged material bank openings and three bifurcated conveyance channels in the north bank of the ARDC in NE-2 with the westernmost channel in the north bank of the ARDC also extending through the railroad grade into NE-1 to add connectivity between NE-1, NE-2, and the ARDC.
- Dredged material (5.0 acres) from the bank openings and the conveyance channels would be sidecast on both sides of the proposed channels. Gaps will be left in the disposal berms so sheet flow is not reduced.
- One cut would be created in the railroad grade approximately 0.9 miles north of the ARDC to improve sheet flow.
- Initial and secondary vegetative plantings of bottomland hardwood/freshwater swamp tree species on 5.0 acres of dredged material berms.
- Initial and secondary vegetative plantings of freshwater swamp tree species within 438 acres of the swamp floor.
- Installation of nutria guards on all newly planted trees to protect against tree loss.

Three natural low areas or relict channels have been identified as potential bank opening and conveyance channel sites. Openings would enable impounded water to be drained from the swamp and provide hydrologic connectivity between the swamp and the ARDC. Additionally, the placement of a cut in the railroad grade would provide further hydrologic connectivity between NE-1 and NE-2. Openings would promote the introduction of freshwater, sediments, and nutrients into the swamp and allow the oxidation of sediments and removal of toxic metabolites. This alternative is anticipated to improve the degraded swamp and decrease the transition to marsh and ultimately, open water. This alternative represents the minimum effort that would meet the goals and objectives of the project. Alternative 33 would benefit approximately 1,602 acres of existing freshwater swamp, recreate 144 acres of freshwater swamp from freshwater marsh, and create 5.0 acres of upland habitat from dredged material placement. This alternative would address all of the project objectives stated in Section 2.4.2.

All excavation through the dredged material berms, as well as the conveyance channels through the swamp, would be based on four design cross-sections (Figures 3.5 through 3.8). These cross-sections were developed in an effort to mimic natural, existing channels within the study area, which have been determined to be self-maintaining. Several existing channels were surveyed for depth, dimension,



N

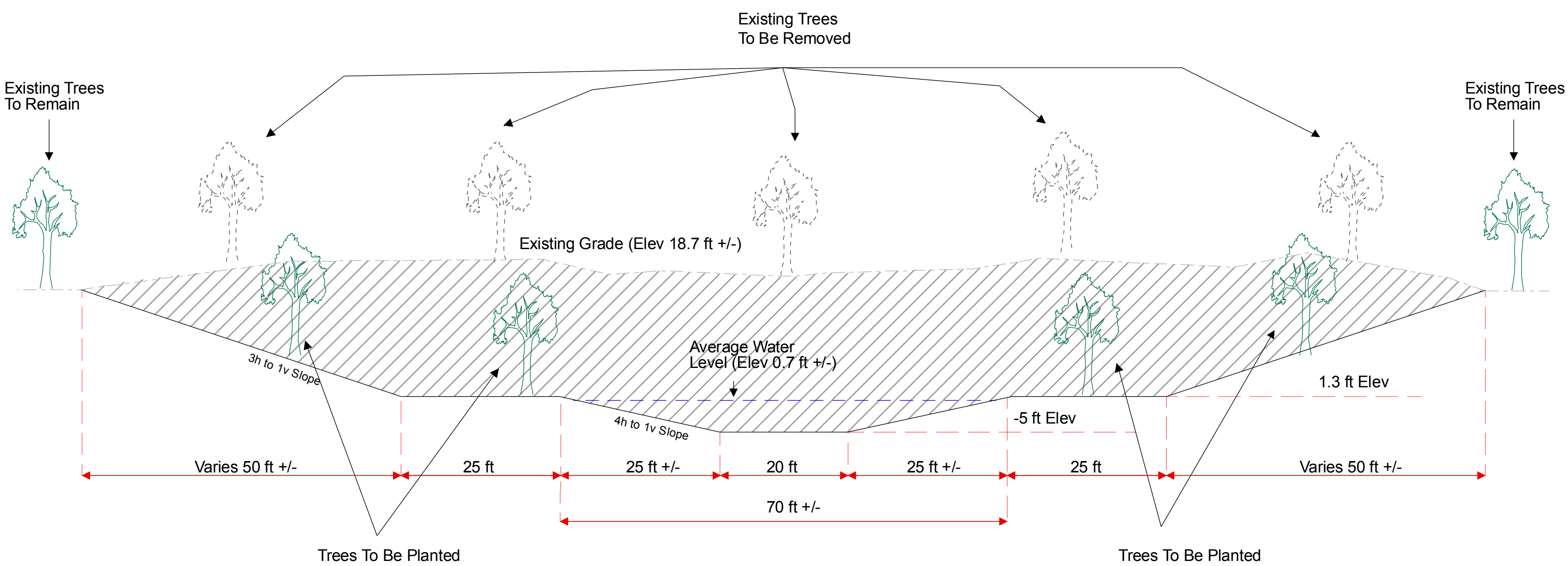
0 1,000 2,000 3,000 Feet

ALTERNATIVE 33

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 3.4
Date: December 2009
Scale: 1:24,000
Source: USGS/GEC
Map ID: 27850108-1868



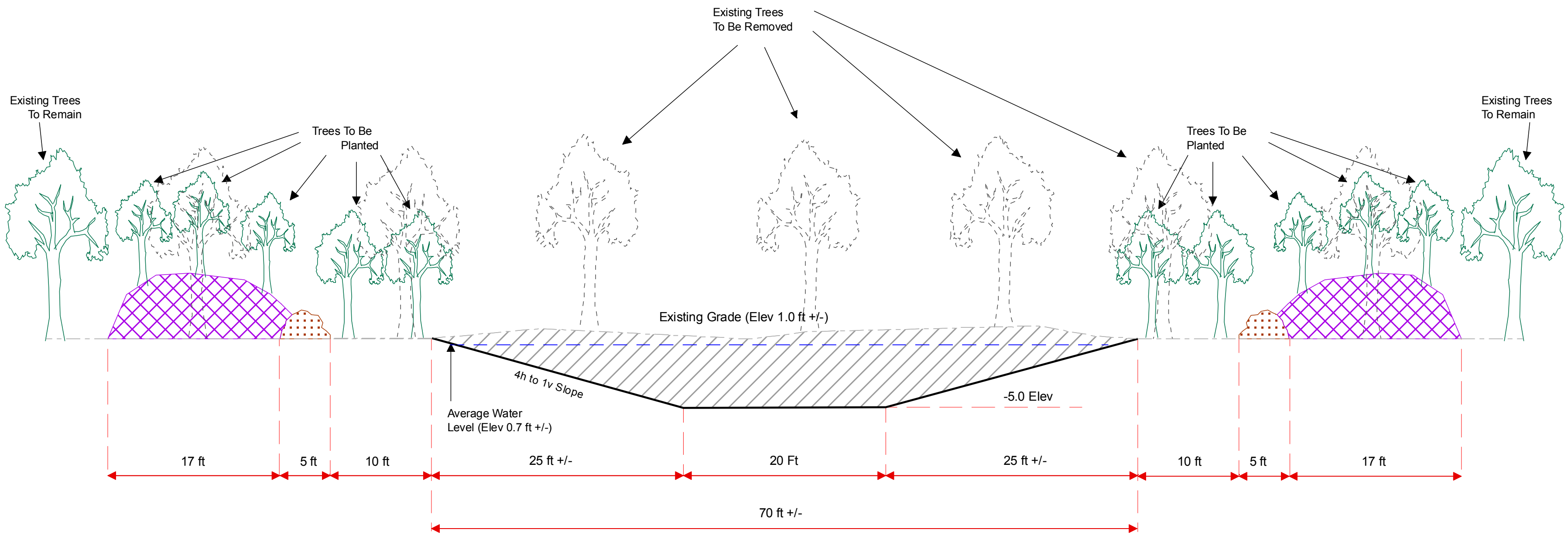
Legend

- Existing Grade
- Dimensions
- Average Water Level
- Channel Cut
- Dredge Area

Typical 70 ft. Cross Section through ARDC Dredged Material Berm

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Figure: 3.5
Date: January 2010
Not to Scale
Source: GEC
Map ID: 27850108-1741



Legend

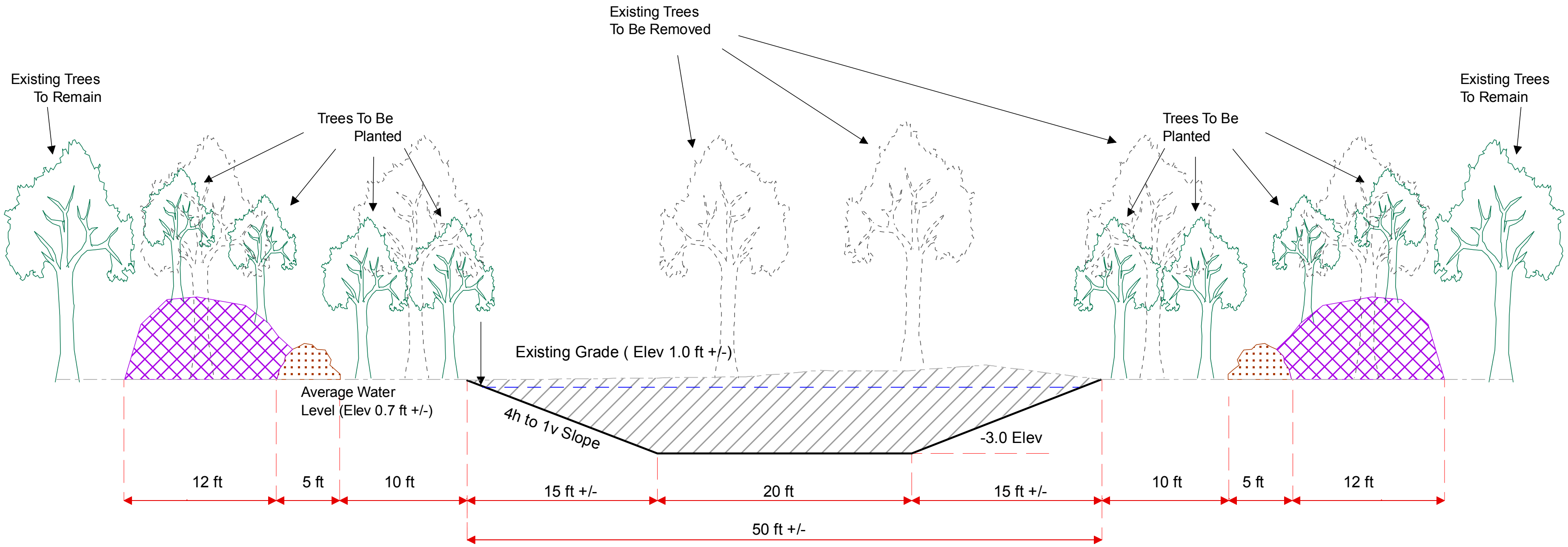
- Existing Grade
- Dimensions
- Average Water Level
- Channel Cut
- Dredge Material Placement
- Stumps
- Dredge Area

Note: Dredged material to be deposited along the proposed conveyance channel at approximately 300 foot intervals with 50 foot gaps included.

Typical 70 ft. Cross Section through ARDC Native Swamp

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Figure: 3.6
Date: January 2010
Not to Scale
Source: GEC
Map ID: 27850108-1741



Legend

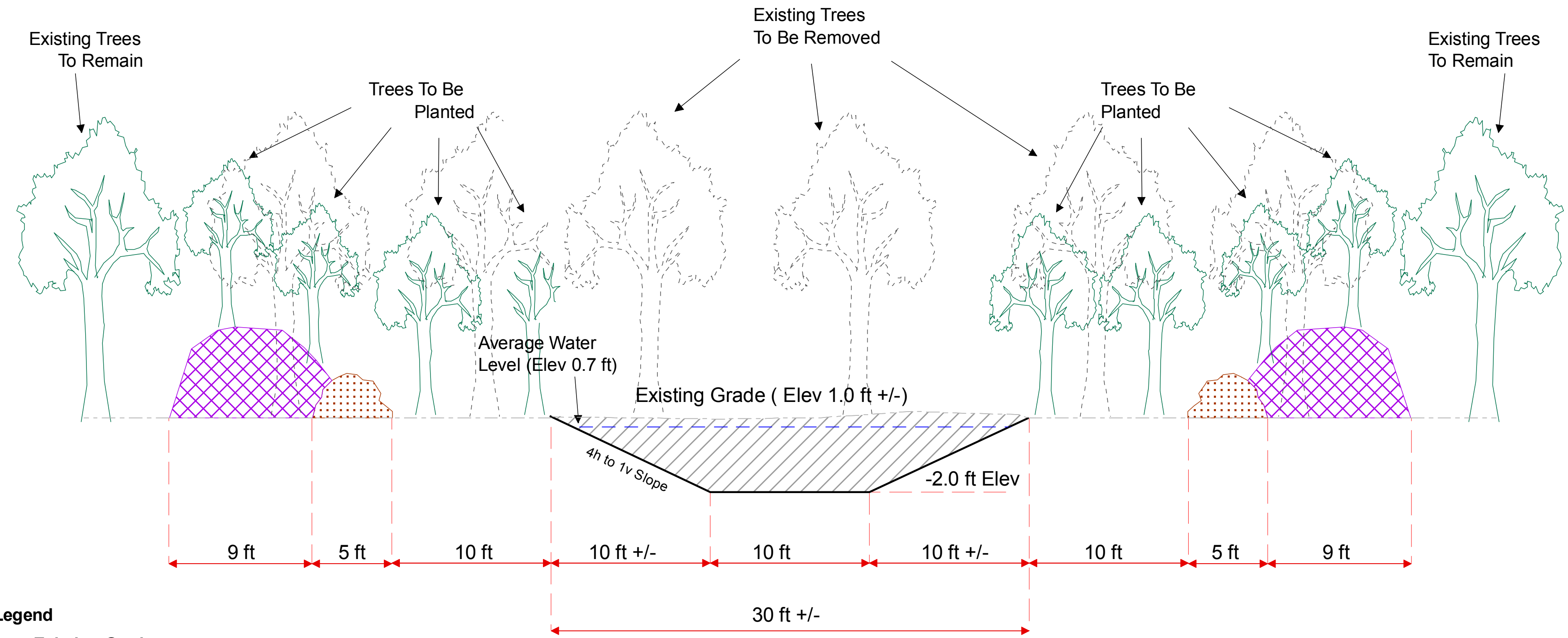
- Existing Grade
- Dimensions
- Average Water Level
- Channel Cut
- Dredge Material Placement
- Stumps
- Dredge Area

Note: Dredged material to be deposited along the proposed conveyance channel at approximately 300 foot intervals with 50 foot gaps included.

Typical 50 ft. Cross Section through ARDC Native Swamp

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Figure: 3.7
Date: January 2010
Not to Scale
Source: GEC
Map ID: 27850108-1741



Legend

- Existing Grade
- Dimensions
- Average Water Level
- Channel Cut
- Dredge Material Placement
- Stumps
- Dredge Area

Note: Dredged material to be deposited along the proposed conveyance channel at approximately 300 foot intervals with 50 foot gaps included.

Typical 30 ft. Cross Section through ARDC Native Swamp

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Figure: 3.8	
Date: January 2010	
Not to Scale	
Source: GEC	
Map ID: 27850108-1741	

and profile. The cross-sections include a 70-foot wide cut section with benches through the dredged material berm, a 70-foot wide cut section, a 50-foot wide cut section and a 30-foot wide cut section. The benches are 25-foot wide flat areas, located above the average water level, on both sides of the conveyance channel. These benches will be included in the portions of the conveyance channel to be cut through the existing dredged material berms. The 70-foot cut section with benches was designed to allow increased amounts of flow to pass beyond the existing dredged material berm during high-water events. The material dredged from the existing berms would be placed along the swamp-side of the excavated cut as new bottomland hardwood habitat. All material dredged during construction of the conveyance channels would be placed along the channels, with gaps included, to allow sufficient sheet flow to be conveyed from the swamp. The quantities associated with each alternative are found in Table 3.5. A typical depiction of the conveyance channels is found in Figure 3.9.

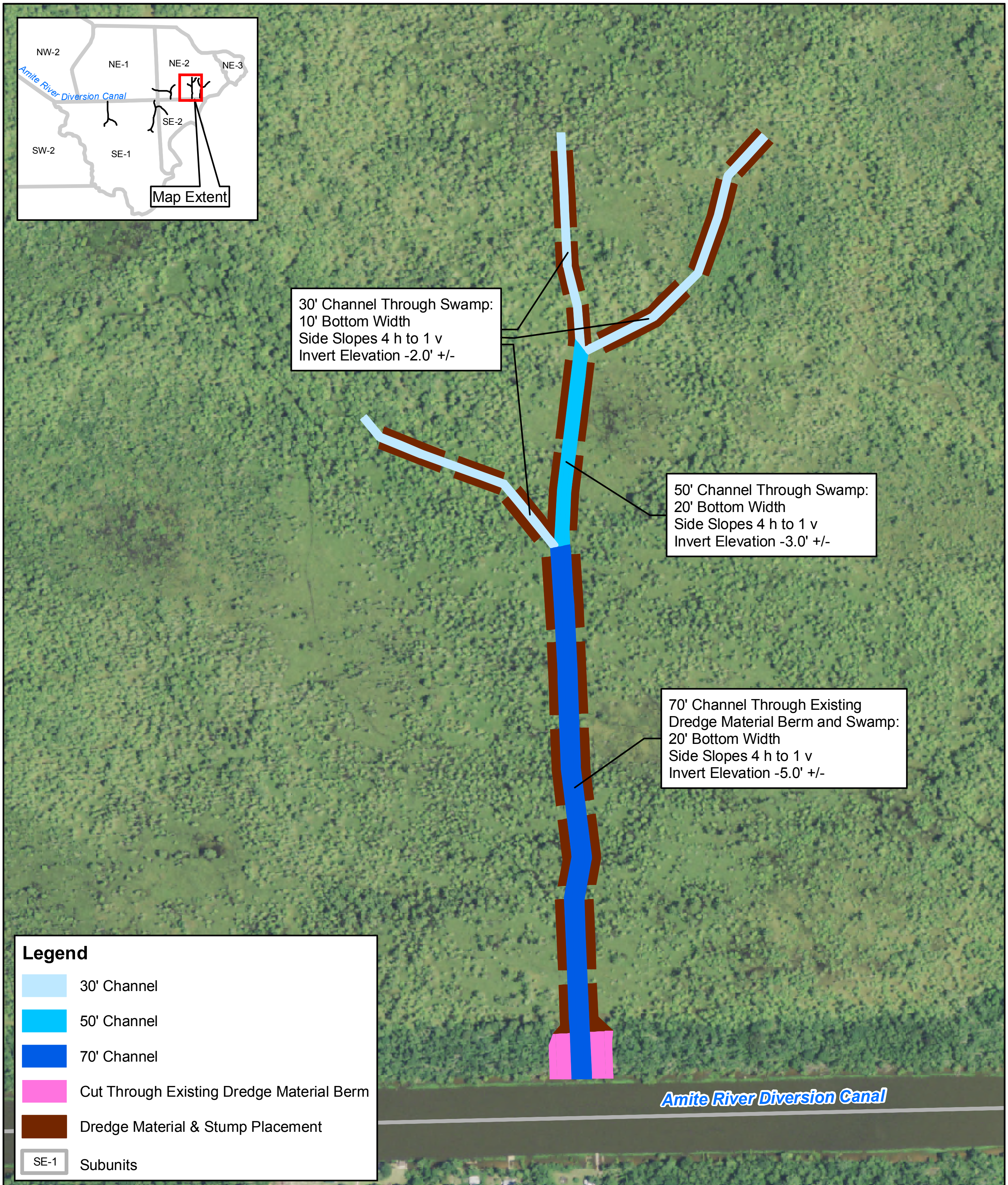
Table 3.5. Alternative Quantities

	Footprints (Acres)						Excavation (Cubic Yards)*		
	Berm		Swamp						
Alternative	Slopes and Benches	Channel	Channel	10' Gaps and Stumps	Material Placement	Total	Dredged Material Berm Cut	Channel Cut	Total
33	1.8	0.8	17.8	5.8	5.0	31.2	13,753	81,694	95,447
34	2.5	0.9	9.6	3.1	2.7	18.8	27,867	45,873	73,740
35	1.8	0.6	6.6	2.1	2.2	13.3	25,527	34,941	60,468
36	4.3	1.7	27.4	8.8	7.8	50.0	41,620	127,567	169,187
37	4.3	1.5	16.2	5.2	4.9	32.1	53,394	80,814	134,208
38	3.6	1.4	24.4	7.9	7.2	44.5	39,280	116,635	155,915
39	6.1	2.3	34.0	11.0	9.9	63.3	67,147	162,508	229,655

3.4.3 Alternative 34 (SE-1/SE-2)

Features of Alternative 34 (Figure 3.10) include:

- One dredged material bank opening and one bifurcated conveyance channel in the south bank of the ARDC in SE-1 with the conveyance channel extending through the railroad grade into SE-1 would facilitate hydrologic connectivity between the ARDC, SE-1, and SE-2.
- Dredged material (2.7 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps will be left in the disposal berms so sheet flow is not reduced. Vegetative plantings of bottomland hardwood/freshwater swamp tree species on 2.7 acres of dredged material berm.
- Two cuts would be created in the railroad grade to improve sheet flow. One cut would be approximately 0.9 miles south of the ARDC. The second cut would be approximately 2.0 miles south of the ARDC.
- Initial and secondary vegetative plantings of freshwater swamp tree species within 487 acres of the swamp floor.

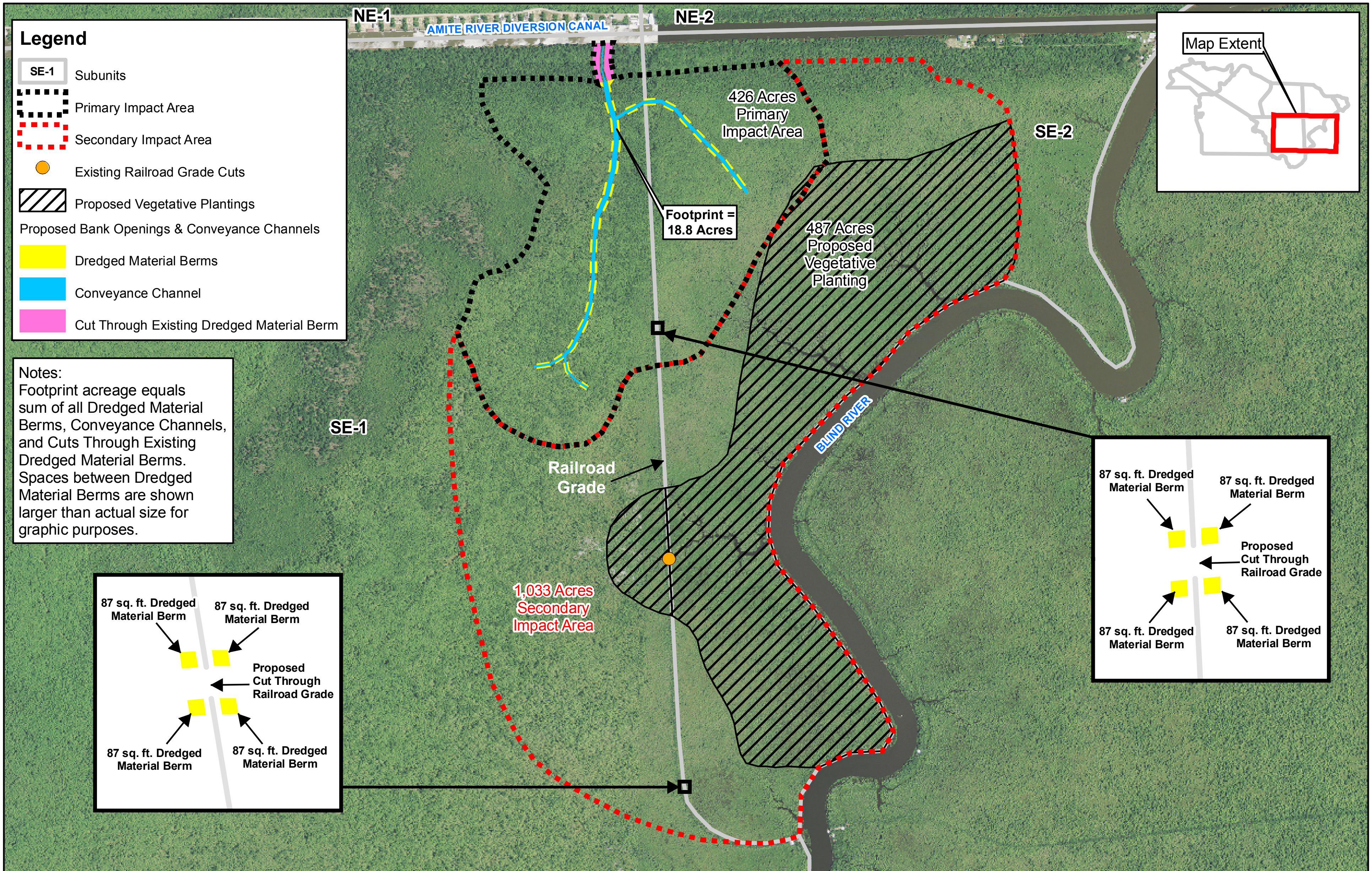


TYPICAL CONVEYANCE CHANNEL

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 3.9
Date: January 2010
Scale: 1:5,600
Source: USDA/GEC
Map ID: 27850108-1889



N

0 1,000 2,000 3,000 Feet

ALTERNATIVE 34

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 3.10
Date: December 2009
Scale: 1:24,000
Source: USGS/GEC
Map ID: 27850108-1869

- Installation of nutria guards on all newly planted trees to protect against tree loss.

The opening in the south bank of the ARDC, coupled with the two gaps in the railroad grade, would facilitate hydrologic connectivity between the ARDC, SE-1, and SE-2. These openings would promote an influx of fresh water, nutrients, and sediments into these areas, which would help flush high salinity waters from the swamp, restore the degraded swamp habitat, and reverse the transition to marsh and open water. Alternative 34 would benefit approximately 1,459 acres of existing freshwater swamp, recreate 146 acres of freshwater swamp from freshwater marsh, and create 2.7 acres of upland habitat from dredged material placement. This alternative would address all the project objectives stated in Section 2.4.2.

Descriptions of the proposed cuts through the dredged material berms and the conveyance channels proposed within the primary impact areas will be implemented as described for Alternatives 33 and 39 in Sections 3.4.2 and 3.4.8, respectively.

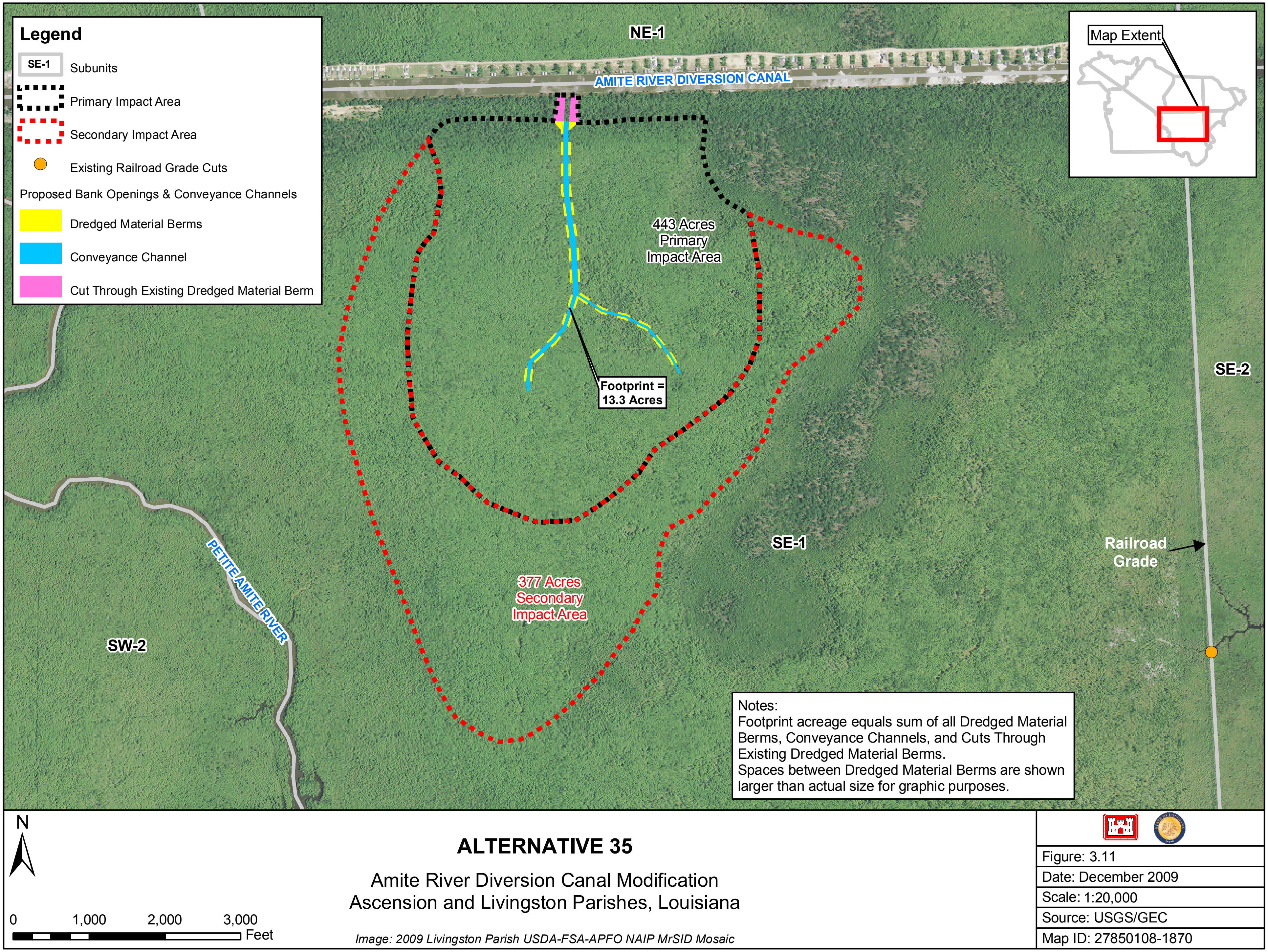
3.4.4 Alternative 35 (SE-1)

Features of Alternative 35 (Figure 3.11) include:

- One dredged material bank opening and one bifurcated conveyance channel in the south bank of the ARDC in SE-1.
- Dredged material (2.2 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps will be left in the disposal berms so sheet flow is not reduced.
- Initial and secondary vegetative plantings of bottomland hardwood/freshwater swamp tree species on 2.2 acres of the dredged material berms.
- Installation of nutria guards on all newly planted trees to protect against tree loss.

The opening would promote an influx of fresh water, nutrients, and sediments into these areas, which would help flush high salinity waters from the swamp, improve the degraded swamp habitat, and decrease the transition to marsh and open water. Alternative 35 would benefit approximately 820 acres of existing freshwater swamp and create 2.2 acres of upland habitat from dredged material placement. This alternative would address all the project objectives stated in Section 2.4.2.

Descriptions of the proposed cuts through the dredged material berms and the conveyance channels proposed within the primary impact areas will be implemented as described for Alternatives 33 and 39 in Sections 3.4.2 and 3.4.8, respectively.



ALTERNATIVE 35

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 3.11	
Date: December 2009	
Scale: 1:20,000	
Source: USGS/GEC	
Map ID: 27850108-1870	

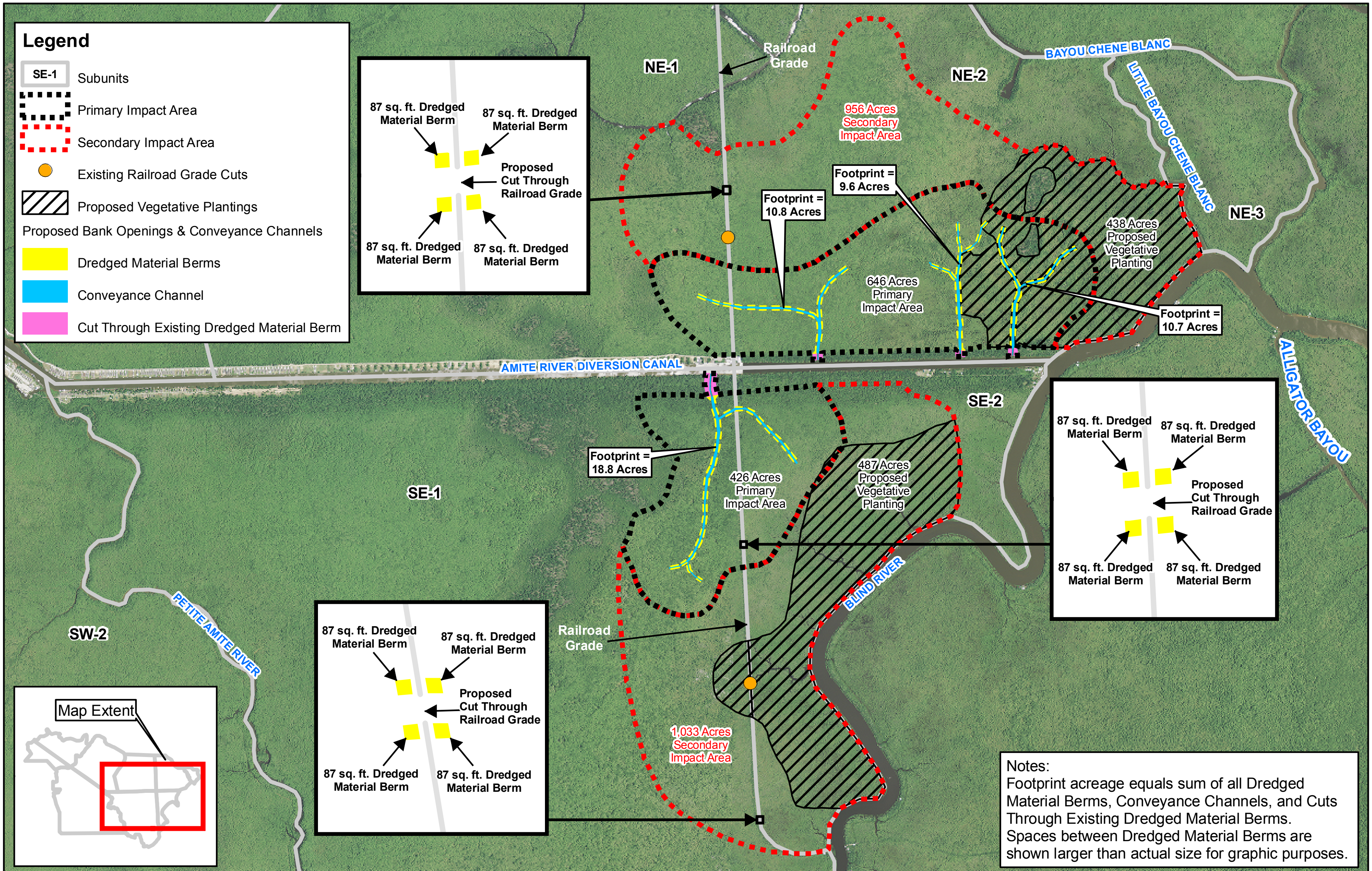
3.4.5 Alternative 36 (NE-1/NE-2, SE-1/SE-2)

Features of Alternative 36 (Figure 3.12: Combinations of Alternatives 33 and 34) include:

- Three dredged material bank openings and three bifurcated conveyance channels in the north bank of the ARDC in NE-2 with the westernmost cut in the north bank of the ARDC also extending through the railroad grade into NE-1 to add connectivity between NE-1 and NE-2, and the ARDC.
- One dredged material bank opening and one bifurcated conveyance channels in the south bank of the ARDC in SE-1 with the conveyance channels extending through the railroad grade into SE-1 would facilitate hydrologic connectivity between the ARDC, SE-1, and SE-2.
- Dredged material (7.8 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps will be left in the disposal berms so sheet flow is not reduced.
- Three cuts would be created in the railroad grade to improve sheet flow. One cut would be approximately 0.9 miles north of the ARDC. The second cut would be approximately 0.9 miles south of the ARDC. The third cut would be approximately 2 miles south of the ARDC.
- Initial and secondary vegetative plantings of bottomland hardwood/freshwater swamp tree species on 7.8 acres of the dredged material berms.
- Initial and secondary vegetative plantings of freshwater swamp tree species within 925 acres of the swamp floor.
- Installation of nutria guards on all newly planted trees to protect against tree loss.

The openings would restore hydrologic connectivity of the habitats north and south of the ARDC with the ARDC. North of the ARDC, proper drainage of impounded waters in NE-2 would promote the restoration of the degraded swamp and the decreasing of marsh to swamp forest. South of the ARDC, the swamp habitats would benefit from the influx of fresh water, nutrients, and sediments. Alternative 36 would benefit approximately 3,061 acres of existing freshwater swamp, recreate 290 acres of freshwater swamp from freshwater marsh, and create 7.8 acres of upland habitat from dredged material placement. This alternative would address all of the project objectives stated in Section 2.4.2.

Descriptions of the proposed cuts through the dredged material berms and the conveyance channels proposed within the primary impact areas will be implemented as described for Alternatives 33 and 39 in Sections 3.4.2 and 3.4.8, respectively.



N

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ALTERNATIVE 36

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 3.12
Date: February 2010
Scale: 1:40,000
Source: USGS/GEC
Map ID: 27850108-1871

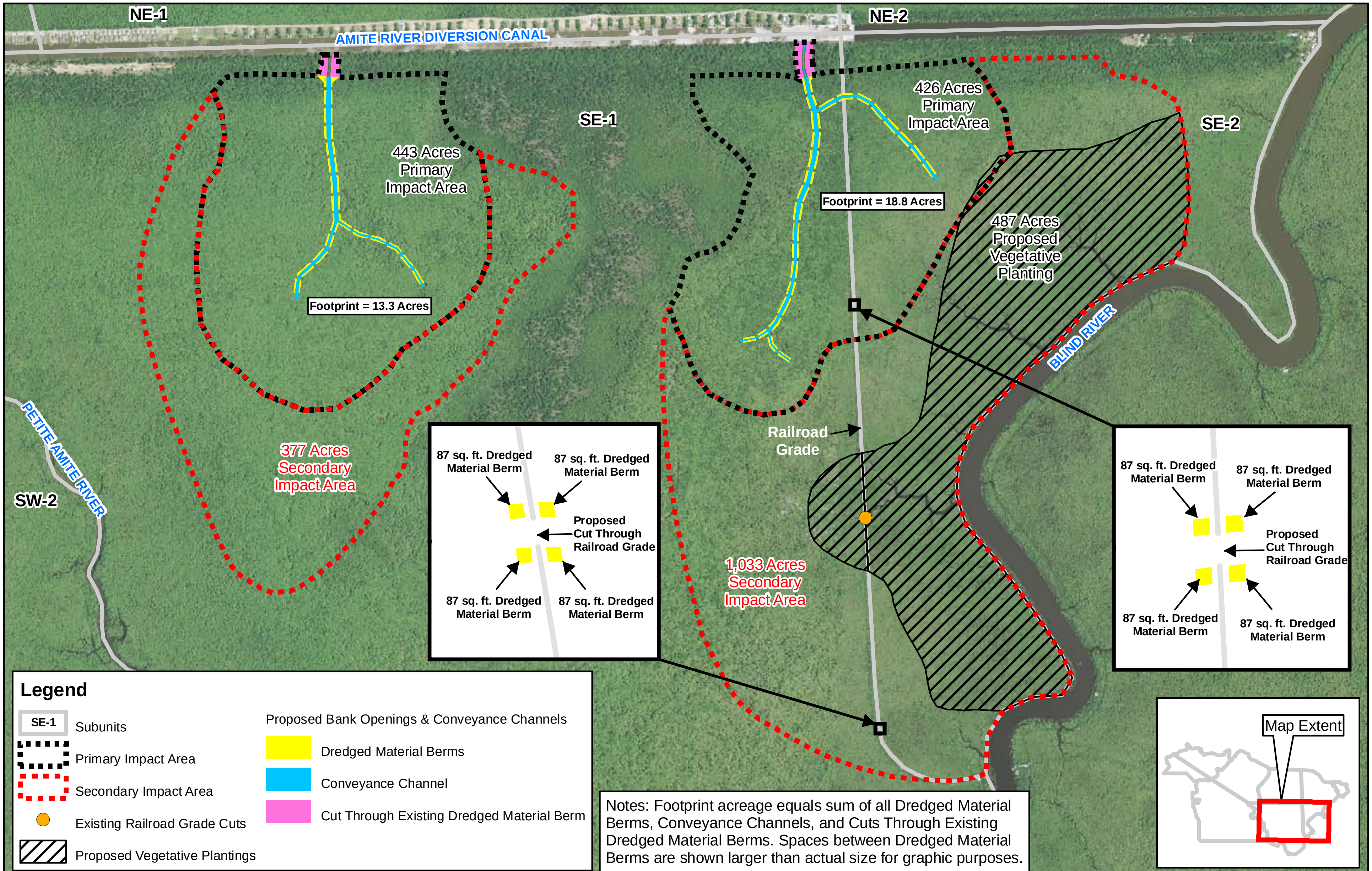
3.4.6 Alternative 37 (SE-1/SE-2, SE-1)

Features of Alternative 37 (Figure 3.13: Combinations of Alternatives 34 and 35) include:

- One dredged material bank opening and one bifurcated conveyance channel in the south bank of the ARDC in SE-1 with the conveyance channel extending through the railroad grade into SE-1 would facilitate hydrologic connectivity between the ARDC, SE-1, and SE-2.
- One bank opening and conveyance channels in the south bank of the ARDC in SE-1.
- Two cuts would be created in the railroad grade to improve sheet flow. One cut would be approximately 0.9 miles south of the ARDC. The second cut would be approximately 2.0 miles south of the ARDC.
- Dredged material (4.9 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps will be left in the disposal berms so sheet flow is not reduced.
- Initial and secondary vegetative plantings of bottomland hardwood/freshwater swamp tree species on 4.9 acres of dredged material berms.
- Initial and secondary vegetative plantings of freshwater swamp tree species within 487 acres of the swamp floor.
- Installation of nutria guards on all newly planted trees to protect against tree loss.

The openings would restore hydrologic connectivity of the area south of the ARDC with the ARDC. Subunits SE-1 and SE-2 would benefit from the influx of fresh water, nutrients, and sediments. This would maintain the swamp forests in SE-1 and improve the degraded swamp forest in the eastern portion of SE-1 and in SE-2, as well as decrease the transition from swamp to marsh to ultimately open water in SE-2. Alternative 37 would benefit approximately 2,279 acres of existing freshwater swamp, recreate 146 acres of freshwater swamp from freshwater marsh, and create 4.9 acres of upland habitat from dredged material placement. This alternative would address all the project objectives stated in Section 2.4.2.

Descriptions of the proposed cuts through the dredged material berms and the conveyance channels proposed within the primary impact areas will be implemented as described for Alternatives 33 and 39 in Sections 3.4.2 and 3.4.8, respectively.



N

0 1,000 2,000 3,000 Feet

ALTERNATIVE 37

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 3.13
Date: February 2010
Scale: 1:26,000
Source: USGS/GEC
Map ID: 27850108-1872

3.4.7 Alternative 38 (NE-1/NE-2, SE-1)

Features of Alternative 38 (Figure 3.14: Combinations of Alternatives 33 and 35) include:

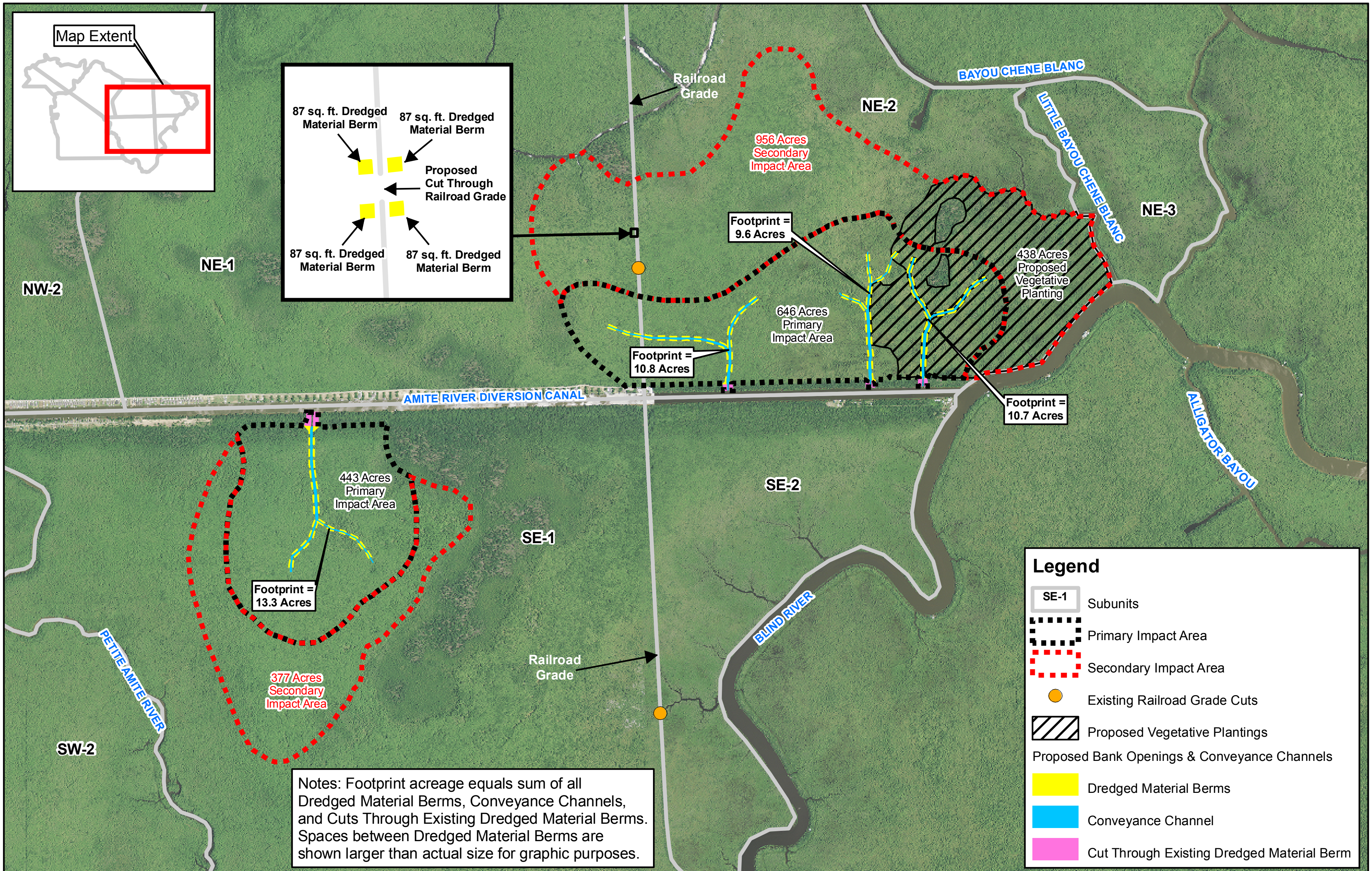
- Three dredged material bank openings and three bifurcated conveyance channels in the north bank of the ARDC in NE-2 with the westernmost cut in the north bank of the ARDC also extending through the railroad grade into NE-1 to add connectivity between NE-1 and NE-2.
- One bank opening and conveyance channels in the south bank of the ARDC in SE-1.
- One cut would be created in the railroad grade approximately 0.9 miles north of the ARDC to improve sheet flow.
- Dredged material (7.2 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps will be left in the disposal berms so sheet flow is not reduced.
- Initial and secondary vegetative plantings of bottomland hardwood/freshwater swamp tree species on 7.2 acres of dredged material berms.
- Initial and secondary vegetative plantings of freshwater swamp tree species within 438 acres of the swamp floor.
- Installation of nutria guards on all newly planted trees to protect against tree loss.

Implementation of this alternative would restore the hydrologic connectivity of NE-1, NE-2, and SE-1 with the ARDC. Within NE-1 and NE-2, the benefits would consist of proper drainage of impounded waters from NE-2, improvement of the degraded swamp, and decreasing the transition from swamp to march to ultimately open water. The cut in the south bank of ARDC would restore the hydrologic connectivity of the ARDC with SE-1 and help to maintain the health of the swamp forest along the western portion of SE-1. Alternative 38 would benefit approximately 2,422 acres of existing freshwater swamp, recreate 144 acres of freshwater swamp from freshwater marsh, and create 7.2 acres of upland habitat from dredged material placement. This alternative would address all of the project objectives stated in Section 2.4.2.

Descriptions of the proposed cuts through the dredged material berms and the conveyance channels proposed within the primary impact areas will be implemented as described for Alternatives 33 and 39 in Sections 3.4.2 and 3.4.8, respectively.

3.4.8 Alternative 39 (NE-1/NE-2, SE-1/SE-2 – All Subunits Combined)

Features of Alternative 39 (Figure 3.15: Combinations of Alternatives 33, 34 and 35) include:

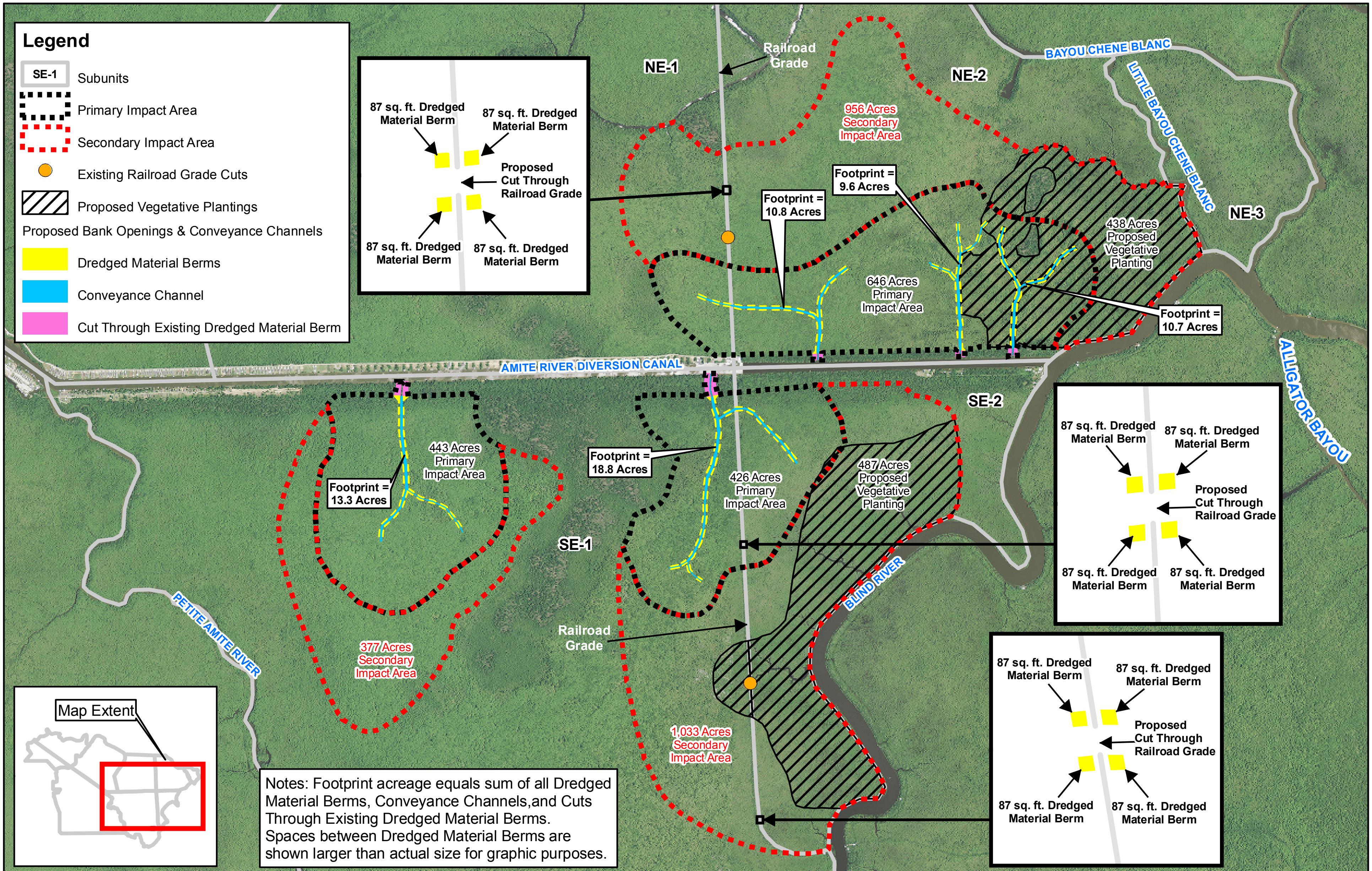


ALTERNATIVE 38

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 3.14	
Date: February 2010	
Scale: 1:40,000	
Source: USGS/GEC	
Map ID: 27850108-1873	



N

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ALTERNATIVE 39

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 3.15
Date: February 2010
Scale: 1:40,000
Source: USGS/GEC
Map ID: 27850108-1874

- Three dredged material bank openings and three bifurcated conveyance channels in the north bank of the ARDC in NE-2 with the westernmost cut in the north bank of the ARDC also extending through the railroad grade into NE-1 to add connectivity between NE-1 and NE-2.
- One dredged material bank opening and one bifurcated conveyance channel in the south bank of the ARDC in SE-1 with the conveyance channel extending through the railroad grade into SE-1 to add connectivity between SE-1 and SE-2, and the ARDC.
  One opening and one conveyance channel in the south bank of the ARDC in SE-1.
- Dredged material (9.9 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps will be left in the disposal berms so sheet flow is not reduced.
- Three cuts would be created in the railroad grade to improve sheet flow. One cut would be approximately 0.9 miles north of the ARDC. The second cut would be approximately 0.9 miles south of the ARDC. The third cut would be approximately two miles south of the ARDC.
- Initial and secondary vegetative plantings of bottomland hardwood/ freshwater swamp tree species on 9.9 acres of dredged material berms.
- Initial and secondary vegetative plantings of freshwater swamp tree species within 925 acres of the swamp floor.
- Installation of nutria guards on all newly planted trees to protect against tree loss.

Implementation of this alternative would restore the hydrologic connectivity between NE-1, NE-2, SE-1, and SE-2 with the ARDC. This alternative would provide the maximum effort to restore hydrologic connectivity of the wetlands to the ARDC. Alternative 39 would benefit approximately 3,881 acres of existing freshwater swamp, recreate 290 acres of freshwater swamp from freshwater marsh, and create 9.9 acres of upland habitat from dredged material placement. This alternative would address all of the project objectives stated in Section 2.4.2.

All excavation to take place for the cuts through the dredged material berms, as well as for the conveyance channels through the swamp, would be based on four design cross-sections (Figures 3.5 through 3.8). These cross-sections were developed in an effort to mimic natural, existing cuts within the study area, which have been determined to be self-maintaining. The cross-sections include a 70-foot wide cut section with benches, a 70-foot wide cut section, a 50-foot wide cut section and a 30-foot wide cut section. The benches are 25-foot wide flat areas, located above the average water level, on both sides of the conveyance channel. These benches will be included in the portions of the conveyance channel to be cut through the existing dredged material berms. The 70-foot cut section with benches is designed to allow increased amounts of flow to pass beyond the existing dredged material berm during high-water events. The material dredged from the existing berms would be placed along the swamp-side of the excavated cut as new bottomland hardwood habitat. All material dredged during construction of the conveyance channels would be placed along the channels, with gaps included, to allow sufficient sheet flow to be conveyed from the swamp. Table 3.5 gives specific quantities and areas associated with the construction of the final array of alternatives.

3.5 COMPARISON OF ALTERNATIVE PLANS

Of the seven alternatives that make up the final array, three are individual alternatives, while the other four are combinations of these three. The effects of the alternatives within the final array were evaluated against the No Action alternative (FWOP condition) in order to determine their overall impact over the 50-year period of analysis (2012 - 2062) of the project. Alternatives were then compared to each other (see Table 3.15). This includes environmental impacts to significant resources, WVA benefits, cost and contributions to project goals, planning objectives and constraints, contributions to the Federal objective, and the Principles and Guidelines (P&G)'s four evaluation criteria (completeness, effectiveness, efficiency and acceptability). A comparison of the features included in each alternative within the final array is found in Table 3.6.

Table 3.6. Comparison of Final Array of Alternatives

Alternative	North Bank Openings	South Bank Openings	Additional Railroad Grade Openings	Berm Plantings (Acres)	Swamp Plantings (Acres)
33	3	0	1	5.0	438
34	0	1	2	2.7	487
35	0	1	0	2.2	0
36	3	1	3	7.8	925
37	0	2	2	4.9	487
38	3	1	1	7.2	438
39	3	2	3	9.9	925

3.5.1 Cost Estimates for the Final Array

As part of the further development of the remaining alternatives, preliminary construction costs were developed to use in the Cost Effectiveness/Incremental Cost Analysis (CE/ICA) analysis. These costs are listed in Table 3.7. While the measures and alternatives recommended for the areas north and south of the ARDC are independent of each other, cost savings are obtained by combining the areas into one alternative (e.g., Alternative 39). These savings are represented by the reductions in the various mobilization and demobilization costs incurred through

Table 3.7. Summary of Costs Estimates for the Final Array

Item	Alt. 33	Alt. 34	Alt. 35	Alt. 36	Alt. 37	Alt. 38	Alt. 39
Mob/Demob	$250,000	$150,000	$150,000	$300,000	$200,000	$300,000	$350,000
Earthwork	$462,000	$332,000	$262,000	$788,000	$583,000	$698,000	$1,050,000
Erosion Protection	$46,000	$23,000	$23,000	$69,000	$45,000	$69,000	$92,000
Vegetative Plantings	$819,000	$906,000	$6,000	$1,720,000	$909,000	$822,000	$1,730,000
Surveying	$54,000	$22,000	$22,000	$70,000	$70,000	$70,000	$86,000
Markups	$631,000	$564,000	$176,000	$1,152,000	$695,000	$756,000	$1,289,000
Planning Eng. & Design	$189,000	$169,000	$53,000	$346,000	$209,000	$227,000	$387,000
Construction Management	$110,000	$99,000	$31,000	$202,000	$122,000	$132,000	$226,000
Total Construction Costs	$2,560,000	$2,270,000	$720,000	$4,650,000	$2,830,000	$3,070,000	$5,210,000
(25% Contingency)	$640,000	$568,000	$180,000	$1,160,000	$708,000	$768,000	$1,300,000
Real Estate	$136,000	$144,000	$62,000	$259,000	$185,000	$178,000	$301,000
Total First Costs*	$3,340,000	$2,980,000	$962,000	$6,070,000	$3,720,000	$4,020,000	$6,810,000
Interest During Construction**	$440,000	$390,000	$126,000	$797,000	$489,000	$528,000	$894,000
Total Construction Cost	$3,780,000	3,370,000	$1,090,000	$6,870,000	$4,210,000	$4,550,000	$7,700,000
Annual OMRR&R Costs	$10,000	$7,000	$7,000	$11,000	$8,000	$11,000	$12,000
Average Annual Costs**	$197,000	$174,000	$61,000	$351,000	$217,000	$236,000	$394,000

*First Quarter 2010 Dollars; ** Average annual costs were determined over the six-year construction period with a discount rate of 4.375 percent; Costs presented are preliminary costs used for planning purposes only and do not represent a fully funded cost estimate.

the implementation of Alternatives 33, 34, and 35, separately. Average annual costs were determined over the six-year construction period with a discount rate of 4.375 percent. The rationale and assumptions used for the development of unit costs and all cost estimates are described in Appendix L.

3.5.2 Wetland Value Assessment Model

WVA models are ecological benefit models designed to evaluate the existing, FWOP, and FWP condition. The CWPPRA WVA Swamp model was chosen for this study area over the Fresh Marsh model, even though portions of the study area have less than a 33 percent canopy cover, because the area provides functions and values more closely associated with a freshwater swamp than a freshwater marsh. The WVA produced Average Annual Habitat Units (AAHUs), a measure of change, for the 50-year period of analysis when comparing the FWP to the FWOP. The Habitat Suitability Index (HSI) is a unit less number bounded by 0 and 1 where 0 represents no habitat and 1 represents optimum habitat. The HSI for a particular area is multiplied by the size of the area for which the HSI was calculated to create the Habitat Unit (HU) value (HU = HSI x size of habitat). AAHUs are calculated by dividing the total number of HUs gained or lost as a result of a proposed action by the period of analysis. Performance measures and targets for the benefits to be achieved are defined in the Adaptive Management Plan in Appendix I.

The WVA calculates the benefits (FWP as compared to the FWOP) for years 0, 1, 10, 25, and 50. The habitat units for each from year 1 to year 50 are calculated. The cumulative habitat units generated for the 50 year period of analysis divided by 50 will determine the AAHU. The 50-year period of analysis is from 2012–2062. Thus the WVA accounts for tree growth and the timing for ecological restoration.

For example, if the net change between the FWOP and FWP is a +0.2 over 100 acres over the 50-year period of evaluation, then that alternative would produce 20 AAHUs of ecological benefit. The model is based upon Habitat Suitability Indices (HSIs) that are developed by evaluating several variables at the site and predicting the future changes, with and without the project. For the freshwater swamp model, variables include stand structure, stand maturity, water regime, and mean high salinity during the growing season. For the bottomland hardwoods model, variables include tree species composition, stand maturity, understory/midstory, size of contiguous forested area, suitability and traversability of surrounding land uses, and disturbance.

Details concerning the professional judgment and model-generated input data utilized in the WVA model are included in the WVA Project Information Sheet, found in Appendix K of this report. The WVA Suitability Index graphs were developed according to the following assumptions:

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.

WVA Benefits. The benefits of the alternatives are directly linked to increases in hydrologic exchange between the ARDC and the swamp (Figure 3.16). The critical issue for the ecosystem restoration is to restore the connectivity to and from the swamp. The H&H Model was used to assist in assigning values to V3, based on the expected days of drying associated with each alternative. This connectivity would not only create an exchange of freshwater, nutrients, and sediments, but it would also alleviate the impounding that is occurring in NE-1 and NE-2. The WVA analysis (Appendix K) used the information from the H&H modeling, to determine the values to be used for the water regime variable. Table 3.8 depicts the net habitat units (HUs) and the annualized cost associated with the No-Action alternative and the final array, over the 50-year period of analysis. Estimates of accretion are based upon work by Shaffer *et al*. 2006 and 2009. In areas of sediment poor, but sufficient freshwater and nutrients, swamps were able to develop accretions to balance RSLR. This information was incorporated in the evaluation of the FWP for V3.

The WVA analyses were run for each alternative within the final array to determine the quantitative benefits of each alternative, including the areas impacted by the construction of the bank openings, conveyance channels, and dredged material placement. This analysis took into account the fact that any future development of

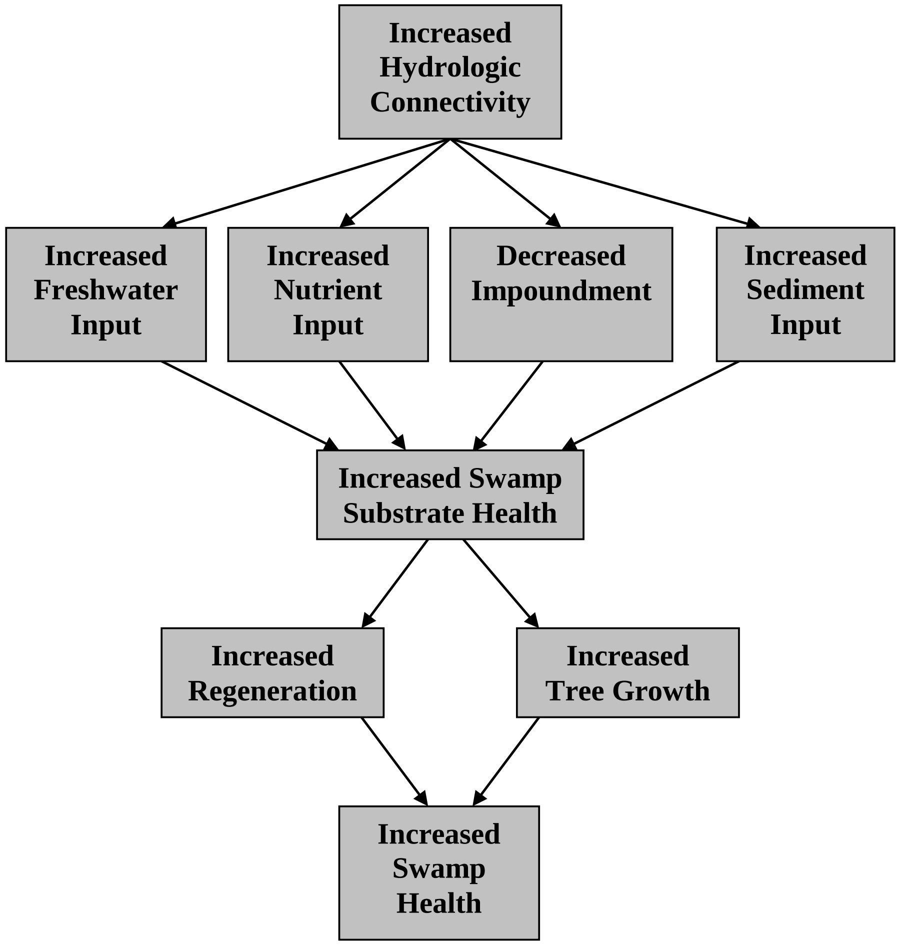

Figure 3.16. Project Benefits

Table 3.8. Summary of WVA Benefits of Final Array

Alternative No.	Total Benefits (HUs)	Annualized Benefits (AAHUs)
No Action	0	0
35	16,680	334
34	29,428	589
33	33,973	679
37	46,109	922
38	50,653	1,013
36	63,402	1,268
39	80,081	1,602

the dredged material berms, within the areas of impact, would have no effect on the benefits generated by the final array. The WVA initial analysis was completed on the primary and secondary impact areas for all alternatives for the low RSLR scenario (Table 3.9, Figures 3.4 and 3.10 - 3.15). The WVA analysis was also run on the intermediate and high RSLR scenarios for the NER and Recommended Plan. The concept of RSLR was introduced in Sections 2.3.3.3 and 2.3.5.1 of the report. Based on the fact that all alternatives within the final array implement similar features, in areas with very little fluctuation in land elevations, it was determined that RSLR would have the same effect on water levels for all alternatives in the final array and little to no variance in water levels would occur.

Table 3.9 Computed Exchange Channel Flows with RSLR

With project with no RSLR					
Reach (cut)	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	6,330	5,298	4,812	4,368	4,035
% time of inflow	23%	22%	29%	28%	28%
Volume outflow (ac-ft/yr)	6,874	7,160	3,392	3,696	4,088
% time of outflow	77%	78%	71%	72%	72%
With Project with 50 years of Low rate of RSLR					
Reach (cut)	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	23,175	20,734	14,522	13,503	12,903
% time of inflow	35%	34%	54%	53%	52%
Volume outflow (ac-ft/yr)	32,635	35,202	7,291	8,187	8,894
% time of outflow	65%	66%	46%	47%	48%

The primary and secondary impact areas for the final array of alternatives were developed after examining existing conveyance channels found within the study area. These channels are considered to be in a state of hydrologic equilibrium due to the lack of sediment buildup observed, when compared to other channels found within the same general area. The benefit areas for the proposed conveyance channels were developed by observing the dimensions and configurations of the drainage areas found along these existing channels.

The primary impact area would have more flow exchange and therefore more sediments and nutrients than the secondary impact area. The volume of water, which transports sediments and nutrients, is dependent on the duration of high stages in the ARDC. During the short duration of high stages in the ARDC, the benefits may be limited to the primary impact area. During normal hydrologic cycles, the primary impact area would receive a higher flow exchange than the secondary impact area. Table 3.10 and Figures 3.17 through 3.23 depict the net habitat units (HUs) obtained by the No-Action alternative and the final array over the 50-year period of analysis, and Figure 3.24 depicts the net benefits gained. It is apparent from the data that a net of 200 to 900 HUs is obtained for each of the seven alternatives. It is also apparent that each alternative obtains the maximum level of benefits at around year 25 and maintains these levels through the remaining 25 years of the period of analysis. This shows that all alternatives within the final array provide sustainable benefits. Maps depicting the impact acreages utilized by the WVA model for each habitat type within the study and impact areas are found in Appendix K.

Table 3.10. Final Array Benefits

Benefits Over the 50-Year Period of Analysis (HUs)						
Alternative		**Year**				
		0	**1**	**10**	**25**	**50**
33	No-Action	757	762	636	562	518
	With Project	757	889	1047	1390	1466
	Net	0	127	410	828	948
34	No-Action	607	611	545	506	461
	With Project	607	697	875	1228	1308
	Net	0	85	330	723	847
35	No-Action	471	474	410	358	291
	With Project	471	547	611	756	766
	Net	0	73	201	398	476
36	No-Action	1364	1373	1182	1068	979
	With Project	1364	1586	1922	2618	2774
	Net	0	213	740	1551	1795
37	No-Action	1078	1085	955	863	751
	With Project	1078	1243	1486	1984	2074
	Net	0	158	531	1121	1323
38	No-Action	1228	1236	1047	919	809
	With Project	1228	1436	1657	2146	2232
	Net	0	200	611	1226	1424
39	No-Action	1835	1843	1589	1423	1268
	With Project	1835	2137	2535	3377	3542
	Net	0	294	946	1954	2273

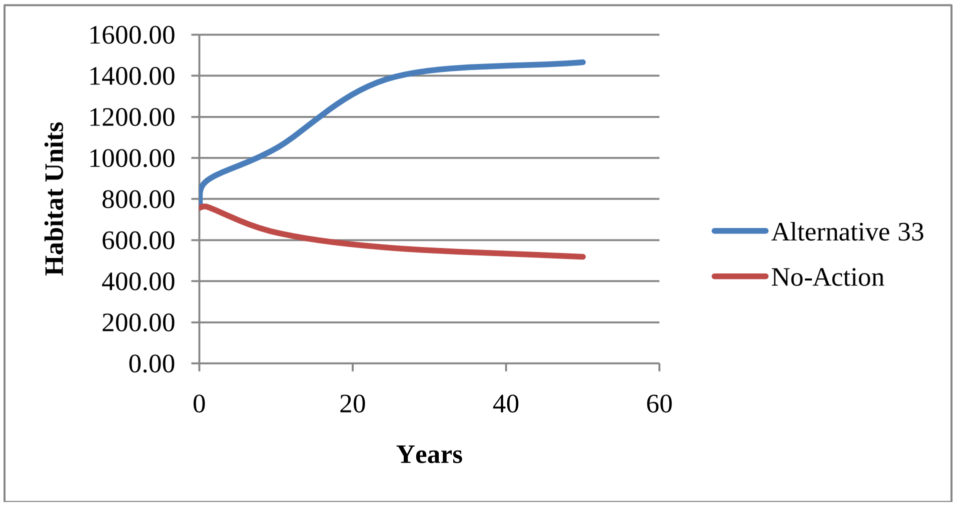

Figure 3.17. Comparison of Benefits for Final Array, Alternative 33

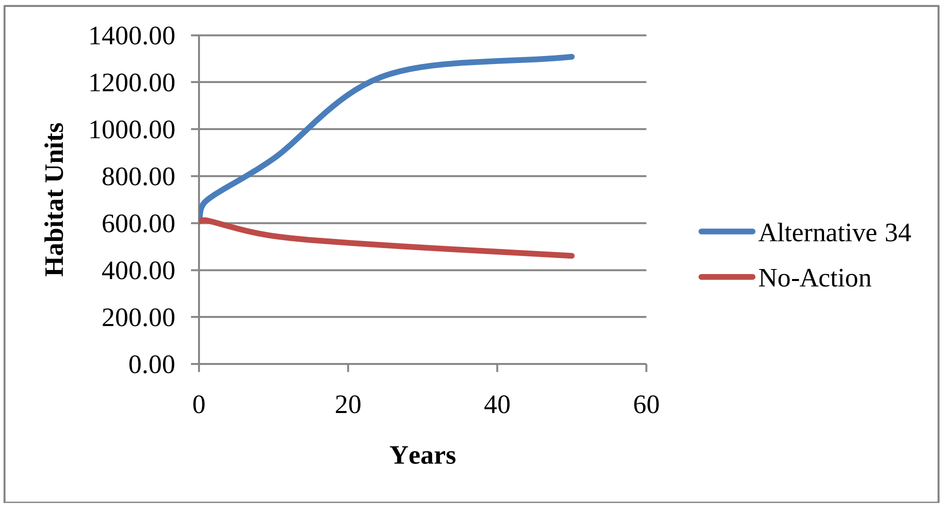

Figure 3.18. Comparison of Benefits for Final Array, Alternative 34

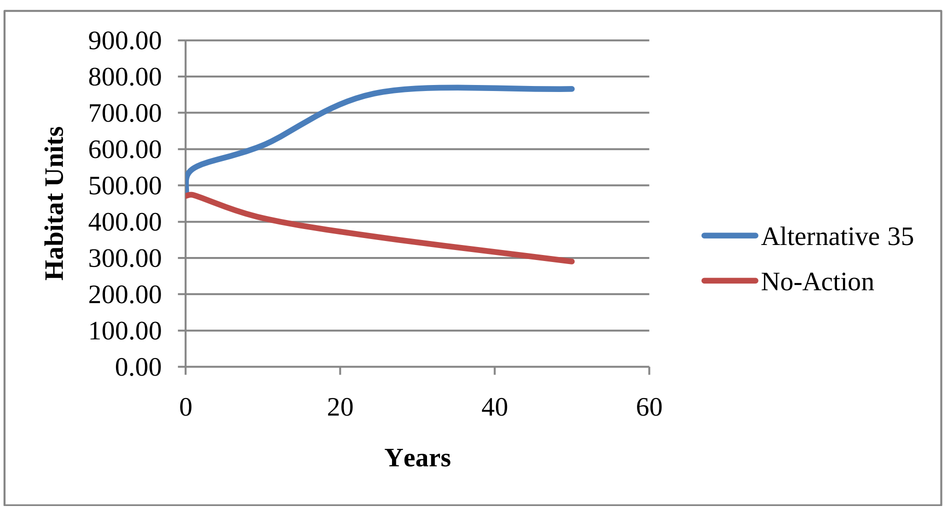

Figure 3.19. Comparison of Benefits for Final Array, Alternative 35

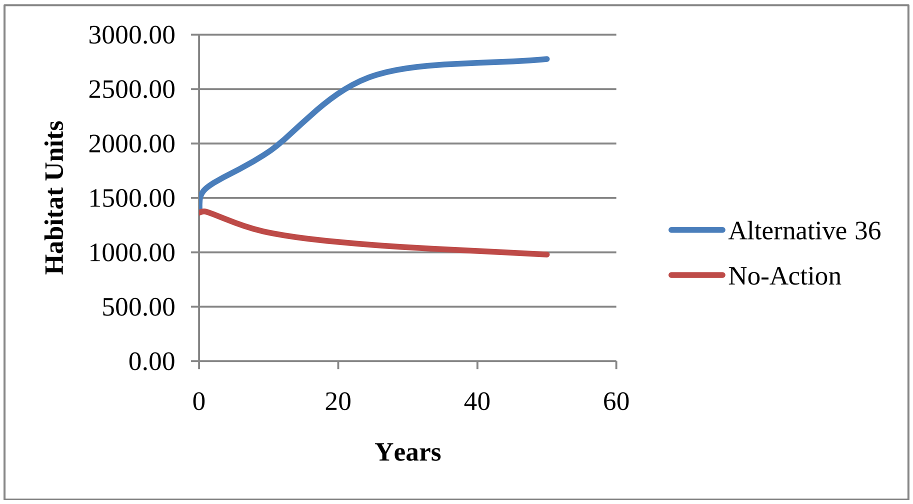

Figure 3.20. Comparison of Benefits for Final Array, Alternative 36

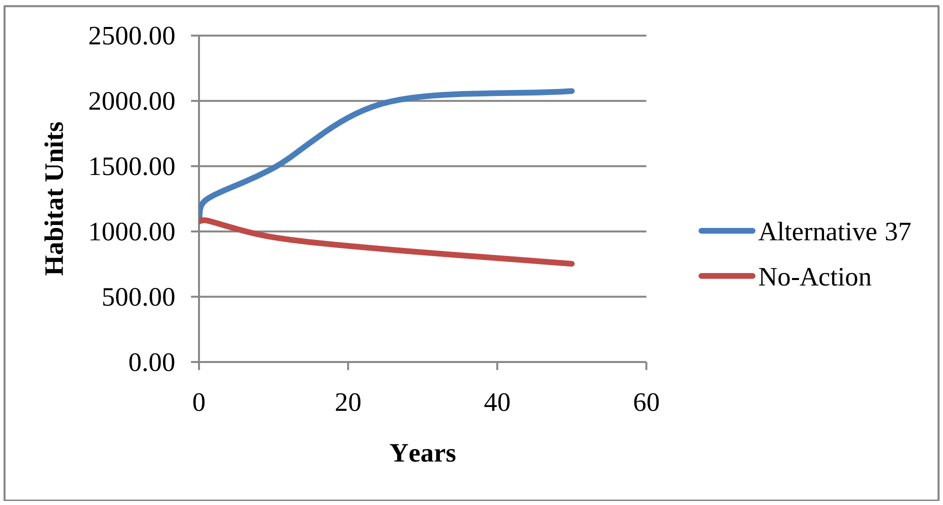

Figure 3.21. Comparison of Benefits for Final Array, Alternative 37

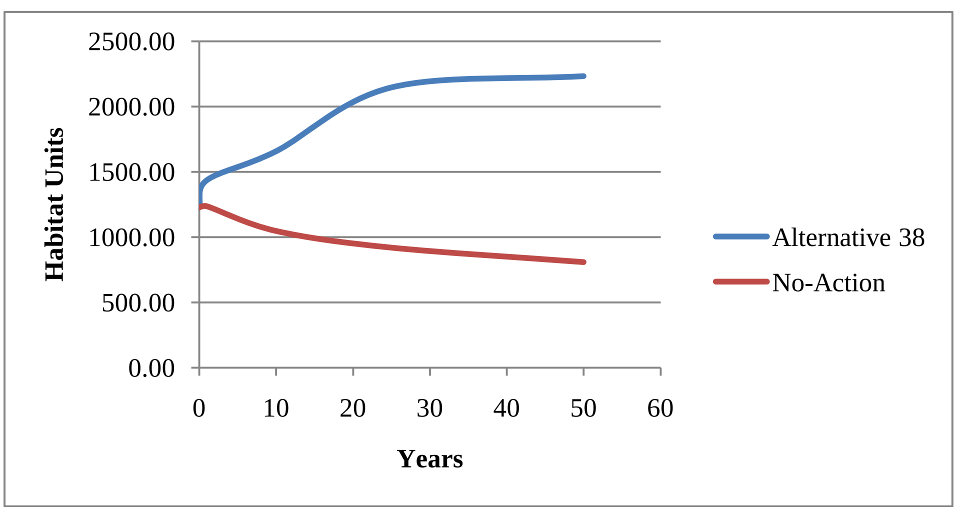

Figure 3.22. Comparison of Benefits for Final Array, Alternative 38

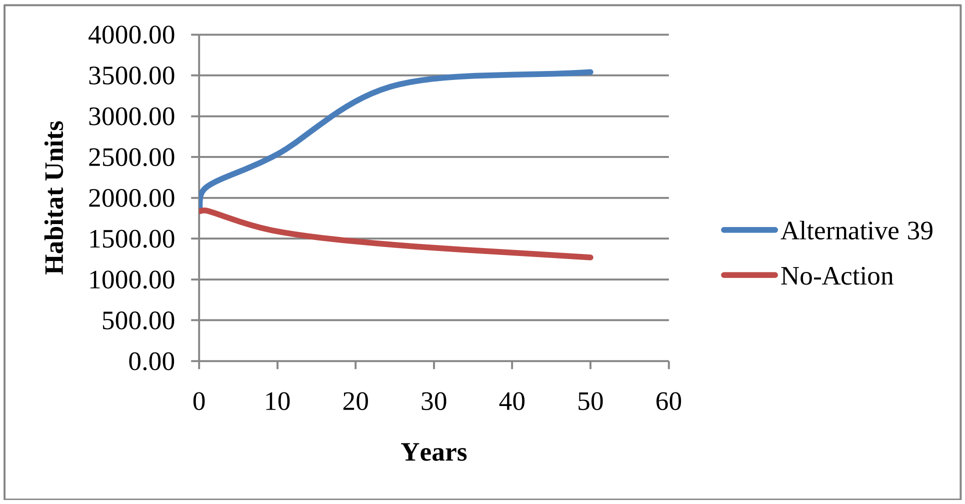

Figure 3.23. Comparison of Benefits for Final Array, Alternative 39

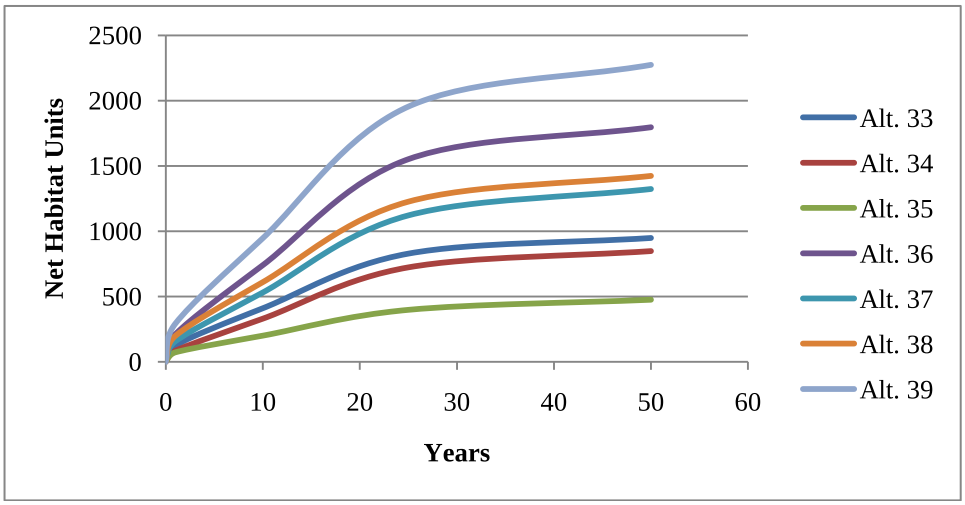

Figure 3.24. Net Benefits Gained by Final Array

Additionally, the H&H model shows that under the low RSLR estimate for the No-Action alternative, the areas of impact would be permanently inundated in 14 years. Without considering the impacts of biomass accretion, under the Future With Project conditions, the area of impacts would not be considered permanently inundated for 40 years. The introduction of freshwater, nutrients, and sediments, even under permanent inundation, would still improve that swamp habitat (Gary Shaffer, personal communication, October 2009). Low oxygen and reducing conditions restrict tree growth in inundated conditions. However, improved flow would increase oxygen and improve tree vigor, even in fully inundated conditions (Gary Shaffer, personal communication, October 2009). Therefore, as long as hydrologic connectivity is achieved and regeneration is established, benefits would be realized under permanently inundated conditions and project success would not be compromised. The plateaus depicted in Figures 3.17 through 3.24 indicate that a state of natural equilibrium is obtained over the 50-year period of analysis. This state of equilibrium is indicative of a system that would continue to exhibit ecological benefits despite the fact that it is a permanently inundated system as long as hydrologic connectivity is maintained. This is why it is critical to the success of this project to implement vegetative plantings in the portions of the study area which do not exhibit canopy cover and adequate stand densities, before permanent inundation occurs.

The increase in drying days, which would occur for the first 40 years of the period of analysis, would allow the substrate to oxidize, release bound nutrients, and allow for substrate compaction. The benefits from the drying days would reverse the conversion of swamp to marsh and open water (Shaffer *et al*., 2009, Bernard Wood personal communication, July 2009). Accretion may also play a role in reducing the effects of RSLR. It has been estimated that a net accretion of 8mm/year could be achieved within the healthy swamp habitat found in the study area (Bernard Wood, unpublished data, 2005 through 2009).

After comparing the final array of alternatives, based on the applicable criteria including benefits and impacts, the PDT ranked the alternatives in the order depicted in Table 3.11. These are rankings based on restoration opportunities provided by each alternative and do not take into account project constraints such as funding limitations. The rationale for selection of the Recommended Plan and is further discussed in Sections 3.7 and 3.7.11.1 of this report.

Table 3.11. Ranking of Final Array

Rank	Alternative	Reasoning
1	39	Produces the most benefits of any alternative and addresses the two most critical areas, plus SE-1 and NE-1.
2	36	Produces the second-most benefits of any alternative and addresses the most critical areas, plus SE-1 and NE-1.
3	38	Produces benefits within the most critical areas, plus SE-1. SE-1 is not considered as degraded as SE-2.
4	33	Includes the most critical area and benefits to NE-1.
5	37	Includes benefits for SE-1 and SE-2. Does not include the most critical area, NE-2.
6	34	Includes benefits in a smaller portion of SE-1 and SE-2. Does not include the most critical area, NE-2.
7	35	Includes benefits in SE-1 only. Does not include the most critical areas.
8	No-Action	Does not produce benefits within the study area.

WVA Model Certification. The WVA model is completing model certification in accordance with EC 1105-2-407, May 2005 Planning Models Improvement Program. 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 responses to the Battelle review 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 LCA ARDC Modification 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.

Hydraulic Analysis. The USACE Engineering Center River Analysis System (HEC-RAS) program was used to simulate FWOP and FWP conditions. The HEC-RAS models are used to simulate flow exchange and flood duration for the proposed actions. The results of the HEC-RAS model runs were then used to support the WVA model. Specifically, the model results were used to quantify flow/exchange and flooding duration (Variable V_3) in the WVA calculations. The HEC-RAS model was also used to assist in the evaluation of the impacts of RSLR.

WVA models are ecological benefit models designed to evaluate the project benefits associated with a proposed action. The benefits of the alternatives are linked to the flow exchange between the ARDC and the adjacent swamp (Variable V3). The HEC-RAS program does not estimate project benefits nor predict project success. A HEC-RAS model is a surface water model used to estimate stage and discharge relationships.

3.5.3 Institute of Water Resources Planning Suite Analysis

Each alternative within the final array was evaluated through a cost-effectiveness and incremental cost analysis (CE/ICA) by utilizing the Institute of Water Resources (IWR)-Planning Suite software. The 50-year evaluation period for the ARDC modification project was used. This software utilizes the annualized output from the WVA Model (AAHUs) and the annualized costs of each alternative to determine which proposed actions are deemed cost effective. Of the actions considered cost-effective by this analysis, some are given the designation of being considered a Best-Buy, meaning the proposed action provides the greatest increase in output for the least increases in cost. By default, the No Action alternative and the largest cost effective alternative (i.e., the cost effective alternative with the greatest annualized ecosystem outputs or benefits) are considered to be Best Buy alternatives. Any of the proposed actions that are found to be cost-effective during this analysis may be considered for selection as the TSP and ultimately the Recommended Plan. The information utilized by the software is listed in Table 3.12. However, according to guidance from ER 1105-2-100, E-41 c., rarely will the NER plan not be among the best buy plans. The reason for such a selection should be clearly explained in the supporting documentation as well as the potential implications for cost sharing. The background information utilized for the CE/ICA analysis is found in Appendix K.

Table 3.12. Alternatives Costs and Benefits

Alternative	Acres of Benefit	AAHUs	Total Construction Cost	Annualized Cost**	Annualized Cost/AAHU
35*	820	334	$1,090,000	$61,000	$180
38*	2,422	1,013	$4,550,000	$236,000	$230
37	2,279	922	$4,210,000	$217,000	$240
39*	3,881	1,602	$7,700,000	$394,000	$250
36	3,061	1,268	$6,870,000	$351,000	$280
33	1,602	679	$3,780,000	$197,000	$290
34	1,459	589	$3,360,000	$174,000	$300

* Denotes Best Buy Plan
**Average annual costs were determined over the six-year construction period with a discount rate of 4.375 percent. Costs represent preliminary costs for planning purposes only and do not represent a fully funded cost estimate.

The results of the IWR Planning Suite analysis are found in Table 3.13 and Figures 3.25 and 3.26. According to the analysis, all proposed actions were found to be cost-effective. Three actions plus the No-Action were also designated as Best Buys. Based on the results of the IWR Planning Suite analysis, it was determined that all of the proposed actions within the final array of alternatives could be considered for selection as the TSP and that no alternatives were eliminated from consideration. The justification for the selection of the TSP/ Recommended Plan is provided in Section 3.7.11.1.

Table 3.13. IWR-PLAN Results

Alternative	Annualized Cost	Output (AAHUs)	Cost Effective?
No Action Plan	$0	0	Best Buy
35	$61,000	334	Best Buy
34	$174,000	589	Yes
33	$197,000	679	Yes
37	$217,000	922	Yes
38	$236,000	1013	Best Buy
36	$351,000	1268	Yes
39	$394,000	1602	Best Buy

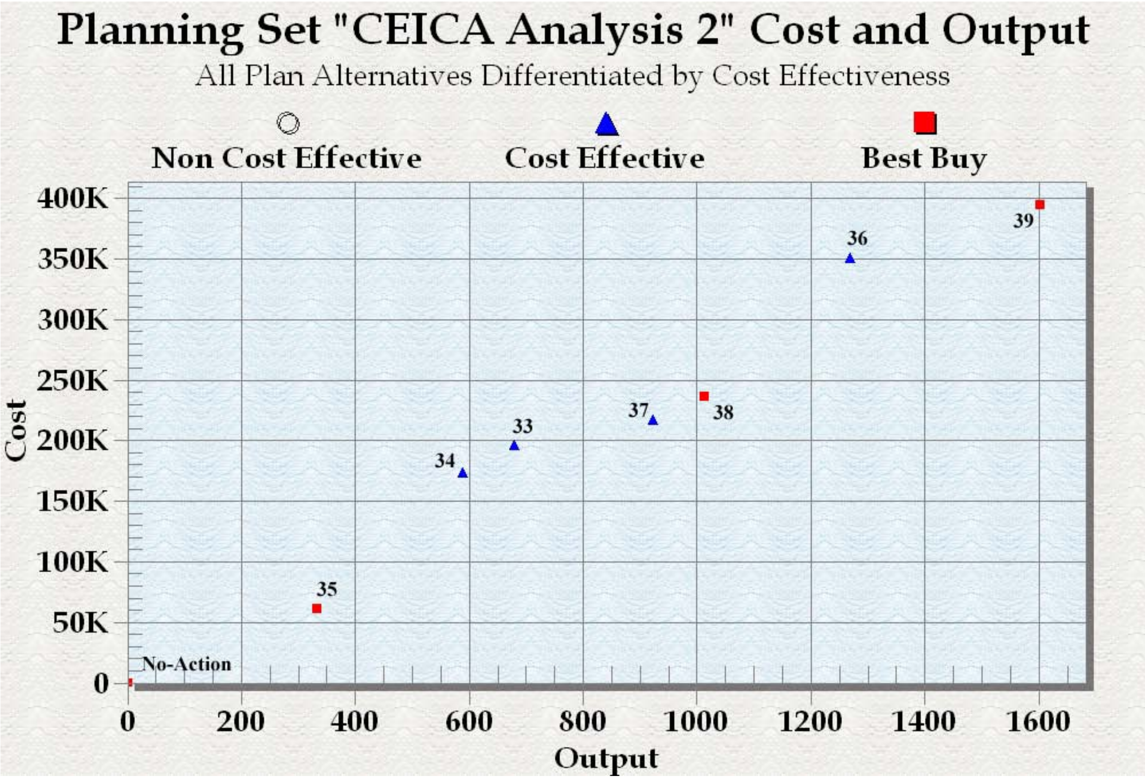

Figure 3.25. Cost versus Output

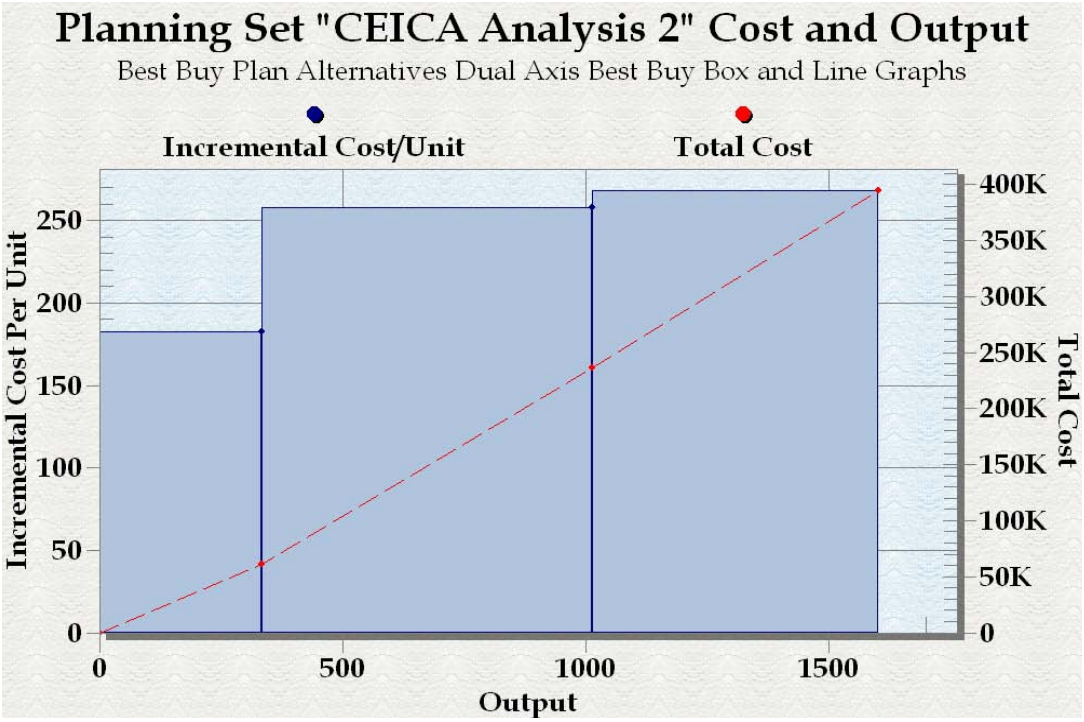

Figure 3.26. IWR Best Buy Comparison

3.5.4 Summary Comparison of Final Array of Alternatives

The conversion of acreages to freshwater marsh and open water for the final array, as previously depicted in Figure 2.2, is summarized in Table 3.14. In addition, a summary comparison of impacts to significant resources for the final array of alternatives is found in Table 3.15. The information presented in both tables, along with each plan's contribution to planning objectives, constraints, and evaluation criteria was used when selecting the National Ecosystem Restoration (NER) plan, along with the Recommended Plan. Table 3.15 represents a summary of the costs, impacts, and quantities associated with the final array of alternatives. Further information regarding these proposed actions and the corresponding impacts may be found throughout Sections 4 and 5 of this report.

Table 3.14. Conversion of Habitat Types (Years to Marsh) for each Alternative

Years to Marsh	Study Area Degradation (Acres)	Benefits Achieved from Final Array (Acres)						
	No-Action	33	34	35	36	37	38	39
Existing Marsh	300	144	146	0	290	146	144	290
10 Years to Marsh	1,723	241	775	0	1,016	775	241	1,016
20 - 3- Years to Marsh	7,979	975	299	542	1,274	841	1,518	1,816
30 - 50 Years to Marsh	8,202	242	239	278	481	517	519	759
Total Acres	**18,204**	**1,602**	**1,459**	**820**	**3,061**	**2,279**	**2,422**	**3,881**
***Benefits (AAHUs)**	**0**	**679**	**589**	**334**	**1,268**	**922**	**1,013**	**1,602**
*** AAHUs calculated for year 50 (2061)**								

3.6 NATIONAL ECOSYSTEM RESTORATION PLAN

The following is the criteria for selecting the NER Plan.

For ecosystem restoration projects, a plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective, shall be selected. The selected plan must be shown to be cost-effective and justified to achieve the desired level of output. This plan shall be identified as the National Ecosystem Restoration (NER) Plan (ER 1105-2-100).

Based on the results of the WVA modeling, the IWR Planning Suite analysis, and the impacts of alternative plans, Alternative 39 was chosen to be the NER plan. This plan includes all the areas in the final array including the areas with the critical need of restoration (NE-2 and SE-2 have already begun converting to marsh) and additional areas that are expected to need restoration in the next 20 years (SE-1, NE-1). The non-Federal sponsor supports Alternative 39 as the NER plan and believes it represents the long term restoration need for the area. The non-Federal sponsor supports the NER plan; therefore, no separate locally preferred plan (LPP) is identified. The NER plan is also identified as the environmentally preferable plan (EPP) since it maximizes the environmental benefit

3.7 PLAN SELECTION – TENTATIVELY SELECTED PLAN (TSP)/ RECOMMENDED PLAN

The following is the criteria for selection of the TSP and Recommended Plan.

A single alternative plan would be selected for recommendation from among all those that have been considered. It must be shown to be preferable to taking no action (if the No-action alternative is not recommended) or implementing any of the other alternatives considered during the planning process (ER 1105-2-100).

Alternative 33, which addresses the most-highly degraded portion of the study area (NE-2) and provides benefits within NE-1, was chosen as the TSP and was later confirmed as the Recommended Plan. Alternative 33 was chosen based on the WVA modeling results (Tables 3.11 and 3.12), IWR Planning Suite analysis (Table 3.13 and Figures 3.17 and 3.18), and the impacts on significant resources found within the study area (Table 3.15). Alternative 33 is an implementable increment of the NER plan, is within the cost and scope of the WRDA 2007 authorization, has stand-alone utility, and can be justified based on ecosystem restoration benefits. This alternative provides sustainable benefits for the areas of impact with 679 AAHUs. The non-Federal sponsor supports Alternative 33 as the Recommended Plan under the current WRDA 2007 authorization.

A comparison of the NER and the Recommended Plan is shown in Figure 3.27. Development of additional restoration activities within the most highly-degraded areas not currently evaluated as part of the Recommended Plan (Alternative 33) should receive priority. More specifically, primary consideration should be given to improving degradation within SE-2, then SE-1. It should be noted that there are other potential sources for restoration within the study area that may be able to provide an opportunity to build the remaining portions of the NER plan and/or build additional restoration features above the Recommended Plan. The Livingston Parish CIAP project, Hydrologic Restoration in Swamps West of Lake Maurepas, located within the study area received study funding in September 2010 to begin design but has not yet been awarded construction funding. Based on the aforementioned coordination, once the CIAP project is authorized for construction funding, the actions proposed by this project will represent a separate effort from the actions recommended by the LCA ARDC Modification project. To date, no formal request for the use of CIAP funds as a cost share for this project has been made.

A comparison of the costs for the NER plan and the Recommended Plan is shown in Table 3.16. Additionally, the details behind the authorized costs are located in Table 3.17.

3.7.1 Components

Features of the Recommended Plan (Figure 3.4) include:

- Three dredged material bank openings and three bifurcated conveyance channels in the north bank of the ARDC in NE-2 with the westernmost channel in the north bank of the ARDC also extending through the railroad grade into NE-1 to add connectivity between NE-1, NE-2, and the ARDC.

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Table 3.15. Summary Comparison of Final Array of Alternatives

		No-Action	Alternative 33 (Recommended Plan)	Alternative 34	Alternative 35	Alternative 36	Alternative 37	Alternative 38	Alternative 39
1. PLAN DESCRIPTION		No-Action/Without Project Condition	NE-2, NE-1, 3 cuts ARDC dredged material berm, 1 railroad grade cut, 1 conveyance channel cut, vegetative plantings	SE-2, SE-1, 1 cut ARDC dredged material berm, 2 railroad grade cuts, 1 conveyance channel cut, vegetative plantings	SE-1, 1 cut ARDC dredged material berm	NE-2, SE-2, NE-1, SE-1, 4 cuts ARDC dredged material berm, 3 railroad grade cuts, 2 conveyance channel cuts, vegetative plantings	SE-2, SE-1, 2 cuts ARDC dredged material berm, 2 railroad grade cuts, 1 conveyance channel cut, vegetative plantings	NE-2. SE-1, NE-1, 4 cuts ARDC dredged material berm, 1 railroad grade cut, 1 conveyance channel cut, vegetative plantings	NE-2, SE-2, NE-1, SE-1, 5 cuts ARDC, dredged material berm, 3 railroad grade cuts, 2 conveyance channel cuts, vegetative plantings
2. IMPACT ASSESSMENT									
	A. NER								
	1) Total Project Cost: *preliminary cost- planning only*	$0	$3,780,000	$3,370,000	$1,090,000	$6,870,000	$4,210,000	$4,550,000	$7,700,000
	2) Annual Cost (not fully funded)	$0	$196,686	$173,671	$60,956	$351,365	$217,220	$236,293	$394,171
	3) Total Benefits (CHU)	0	33,937	29,429	16,680	63,402	46,109	50,653	80,082
	4) Annual Net Benefits (AAHU)	0	679	589	334	1,268	922	1,013	1,602
	5) Cost Effective (yes/no/best buy)	Best Buy	Yes	Yes	Best Buy	Yes	Yes	Best Buy	Best Buy
	B. Environmental Resources								
	1) Soils and Water Bottoms: Soils	Conversion of 18,204 acres of Barbary, Fausse, and Maurepas swamp soils experience nearly continuous waterlogging, subsidence and reduction in organic components.	Net total of 1,602 acres of wetland soils restored and nourished; 2.6 acres ARDC berm soils and 28.6 acres existing swamp soils removed to construct bottomland hardwood "islands."	Net total of 1,459 acres of wetland soils restored and nourished; 3.4 acres ARDC berm soils and 15.4 acres existing swamp soils removed to construct bottomland hardwood "islands."	Net total of 820 acres of wetland soils restored and nourished; 2.4 acres ARDC berm soils and 10.9 acres existing swamp soils removed to construct bottomland hardwood "islands."	Net total of 3,061 acres of wetland soils restored and nourished; 6.0 acres ARDC berm soils and 44.0 acres existing swamp soils removed to construct bottomland hardwood "islands."	Net total of 2,279 acres of wetland soils restored and nourished; 5.8 acres ARDC berm soils and 26.3 acres existing swamp soils removed to construct bottomland hardwood "islands."	Net total of 2,422 acres of wetland soils restored and nourished; 5.0 acres ARDC berm soils and 39.5 acres existing swamp soils removed to construct bottomland hardwood "islands."	Net total of 3,881 acres of wetland soils restored and nourished; 8.4 acres ARDC berm soils and 54.9 acres existing swamp soils removed to construct bottomland hardwood "islands."
	2) Soils and Water Bottoms: Water Bottoms	Swamp water bottoms remain isolated from hydrologic connections; swamp water bottoms convert to open water; decreased nutrients and detritus from decomposing swamp vegetation	18.6 acres existing swamp water bottoms dredged to create drainage channels; increased hydrologic connections and tree plantings result in increased detritus and healthier benthic substrates.	10.5 acres existing swamp water bottoms dredged to create drainage channels; increased hydrologic connections and tree plantings result in increased detritus and healthier benthic substrates	7.2 acres existing swamp water bottoms dredged to create drainage channels; increased hydrologic connections result in increased detritus and healthier benthic substrates	29.1 acres existing swamp water bottoms dredged to create drainage channels; increased hydrologic connections and tree plantings result in increased detritus and healthier benthic substrates	17.7 acres existing swamp water bottoms dredged to create drainage channels; increased hydrologic connections and tree plantings result in increased detritus and healthier benthic substrates	25.8 acres existing swamp water bottoms dredged to create drainage channels; increased hydrologic connections and tree plantings result in increased detritus and healthier benthic substrates	36.3 acres existing swamp water bottoms dredged to create drainage channels; increased hydrologic connections and tree plantings result in increased detritus and healthier benthic substrates

		No-Action	Alternative 33 (Recommended Plan)	Alternative 34	Alternative 35	Alternative 36	Alternative 37	Alternative 38	Alternative 39
	3) Hydrology: Flow and Water Levels	Continued hydrologic isolation and impoundment resulting in reduced flows into and out of the SA; water levels static but steadily increase due to continued hydrologic barriers and projected sea level rise.	Connected hydrology increases flows into and out of 1,602 acres swamp; water levels fluctuate in response to ARDC and sea level rises.	Connected hydrology increases flows into and out of 1,459 acres swamp; water levels fluctuate in response to ARDC and sea level rises.	Connected hydrology increases flows into and out of 820 acres swamp; water levels fluctuate in response to ARDC and sea level rises.	Connected hydrology increases flows into and out of 3,061 acres swamp; water levels fluctuate in response to ARDC and sea level rises.	Connected hydrology increases flows into and out of 2,279 acres swamp; water levels fluctuate in response to ARDC and sea level rises.	Connected hydrology increases flows into and out of 2,422 acres swamp; water levels fluctuate in response to ARDC and sea level rises.	Connected hydrology increases flows into and out of 3,881 acres swamp; water levels fluctuate in response to ARDC and sea level rises.
	4) Hydrology: Sediment	Continued lack of sediment inputs into SA due to hydrologic isolation and impoundment.	Connected hydrology increases potential for sediment inputs into 1,602 acres swamp.	Connected hydrology increases potential for sediment inputs into 1,459 acres swamp.	Connected hydrology increases potential for sediment inputs into 820 acres swamp.	Connected hydrology increases potential for sediment inputs into 3,061 acres swamp.	Connected hydrology increases potential for sediment inputs into 2,279 acres swamp.	Connected hydrology increases potential for sediment inputs into 2,422 acres swamp.	Connected hydrology increases potential for sediment inputs into 3,881 acres
	5) Hydrology: Water Use and Supply	Continued increase in water use and supply demands; conversion of swamp habitat to open water reduces water purification function of wetlands.	Continued increase in water use and supply demands; connected hydrology improves water purification function over 1,602 acres swamp.	Continued increase in water use and supply demands; connected hydrology improves water purification function over 1,459 acres swamp.	Continued increase in water use and supply demands; connected hydrology improves water purification function over 820 acres swamp.	Continued increase in water use and supply demands; connected hydrology improves water purification function over 3,061 acres swamp.	Continued increase in water use and supply demands; connected hydrology improves water purification function over 2,279 acres swamp.	Continued increase in water use and supply demands; connected hydrology improves water purification function over 2,422 acres swamp.	Continued increase in water use and supply demands; connected hydrology improves water purification function over 3,881 acres swamp.
	6) Hydrology: Groundwater	Nearby human populations and industry continue to increase resulting in increased groundwater demands and decreased groundwater resources. Continually degrading swamp habitat no longer functions as an effective natural water quality filtration system to shallow aquifers.	Restoration of 1,602 acres swamp acts as natural water quality filtration system to the shallow aquifers.	Restoration of 1,459 acres swamp acts as natural water quality filtration system to the shallow aquifers.	Restoration of 820 acres swamp acts as natural water quality filtration system to the shallow aquifers.	Restoration of 3,061 swamp acts as natural water quality filtration system to the shallow aquifers.	Restoration of 2,279 acres swamp acts as natural water quality filtration system to the shallow aquifers.	Restoration of 2,422 acres swamp acts as natural water quality filtration system to the shallow aquifers.	Restoration of 3,881 acres swamp acts as natural water quality filtration system to the shallow aquifers.
	7) Water Quality	Conversion of 18,204 acres of swamp vegetation to fresh marsh and open water reduces natural water quality. Continued discharge of untreated stormwater runoff from nearby populated areas into the SA.	Temporary negative impacts (e.g., increased turbidity, decreased dissolved oxygen) during construction. Water quality improves over 1,602 acres of swamp habitat due to increased connectivity as well as absorption and filtering of the untreated stormwater runoff.	Temporary negative impacts (e.g., increased turbidity, decreased dissolved oxygen) during construction. Water quality improves over 1,459 acres of swamp habitat due to increased connectivity as well as absorption and filtering of the untreated stormwater runoff.	Temporary negative impacts (e.g., increased turbidity, decreased dissolved oxygen) during construction. Water quality improves over 820 acres of swamp habitat due to increased connectivity as well as absorption and filtering of the untreated stormwater runoff.	Temporary negative impacts (e.g., increased turbidity, decreased dissolved oxygen) during construction. Water quality improves over 3,061 acres of swamp habitat due to increased connectivity as well as absorption and filtering of the untreated stormwater runoff.	Temporary negative impacts (e.g., increased turbidity, decreased dissolved oxygen) during construction. Water quality improves over 2,279 acres of swamp habitat due to increased connectivity as well as absorption and filtering of the untreated stormwater runoff.	Temporary negative impacts (e.g., increased turbidity, decreased dissolved oxygen) during construction. Water quality improves over 2,422 acres of swamp habitat due to increased connectivity as well as absorption and filtering of the untreated stormwater runoff.	Temporary negative impacts (e.g., increased turbidity, decreased dissolved oxygen) during construction. Water quality improves over 3,881 acres of swamp habitat due to increased connectivity as well as absorption and filtering of the untreated stormwater runoff.

		No-Action	Alternative 33 (Recommended Plan)	Alternative 34	Alternative 35	Alternative 36	Alternative 37	Alternative 38	Alternative 39
	8) Water Quality: Salinity	Continued impoundment results in longer residence time of higher-salinity water. This results in absorption of salinity into swamp soils, continuing the degradation of freshwater swamp and bottomland hardwood vegetation. Salinities may also increase due to projected relative sea level rise.	Restored hydrologic connectivity to 1,602 acres reduces impoundment of higher salinity waters; salinities would have temporary spikes, but flushing would lower salinity overall. At the same time, salinities may also increase due to projected relative sea level rise.	Restored hydrologic connectivity to 1,459 acres reduces impoundment of higher salinity waters; salinities would have temporary spikes, but flushing would lower salinity overall. At the same time, salinities may also increase due to projected relative sea level rise.	Restored hydrologic connectivity to 820 acres reduces impoundment of higher salinity waters; salinities would have temporary spikes, but flushing would lower salinity overall. At the same time, salinities may also increase due to projected relative sea level rise.	Restored hydrologic connectivity to 3,061 acres reduces impoundment of higher salinity waters; salinities would have temporary spikes, but flushing would lower salinity overall. At the same time, salinities may also increase due to projected relative sea level rise.	Restored hydrologic connectivity to 2,279 acres reduces impoundment of higher salinity waters; salinities would have temporary spikes, but flushing would lower salinity overall. At the same time, salinities may also increase due to projected relative sea level rise.	Restored hydrologic connectivity to 2,422 acres reduces impoundment of higher salinity waters; salinities would have temporary spikes, but flushing would lower salinity overall. At the same time, salinities may also increase due to projected relative sea level rise.	Restored hydrologic connectivity to 3,881 acres reduces impoundment of higher salinity waters; salinities would have temporary spikes, but flushing would lower salinity overall. At the same time, salinities may also increase due to projected relative sea level rise.
	9) Air Quality	Conversion of 18,204 acres of swamp vegetation to fresh marsh and open water habitat over 50- year period of analysis reduces function of swamp vegetation to act as natural filter for air pollutants.	Restoration of 1,602 acres of freshwater swamp/bottomland hardwood habitat may act as natural filters for air pollutants.	Restoration of 1,459 acres of freshwater swamp/bottomland hardwood habitat may act as natural filters for air pollutants.	Restoration of 820 acres of freshwater swamp/bottomland hardwood habitat may act as natural filters for air pollutants.	Restoration of 3,061 acres of freshwater swamp/bottomland hardwood habitat may act as natural filters for air pollutants.	Restoration of 2,279 acres of freshwater swamp/bottomland hardwood habitat may act as natural filters for air pollutants.	Restoration of 2,422 acres of freshwater swamp/bottomland hardwood habitat may act as natural filters for air pollutants.	Restoration of 3,881 acres of freshwater swamp/bottomland hardwood habitat may act as natural filters for air pollutants.
	10) Noise	Increased human activities within the study area may increase noise levels.	Short term, localized and temporary increased noise due to construction. Long term, impacts similar to No-Action Alternative.	Short term, localized and temporary increased noise due to construction. Long term, impacts similar to No-Action Alternative.	Short term, localized and temporary increased noise due to construction. Long term, impacts similar to No-Action Alternative.	Short term, localized and temporary increased noise due to construction. Long term, impacts similar to No-Action Alternative.	Short term, localized and temporary increased noise due to construction. Long term, impacts similar to No-Action Alternative.	Short term, localized and temporary increased noise due to construction. Long term, impacts similar to No-Action Alternative.	Short term, localized and temporary increased noise due to construction. Long term, impacts similar to No-Action Alternative.
	11) Vegetation Resources: Riparian Vegetation	Degradation of riparian vegetation would continue as swamp converts to open water.	There would be creation of riparian habitat along new conveyance channels. Riparian vegetation on dredged material berms impacted by construction.	There would be creation of riparian habitat along new conveyance channels. Riparian vegetation on dredged material berms impacted by construction.	There would be creation of riparian habitat along new conveyance channels. Riparian vegetation on dredged material berms impacted by construction.	There would be creation of riparian habitat along new conveyance channels. Riparian vegetation on dredged material berms impacted by construction.	There would be creation of riparian habitat along new conveyance channels. Riparian vegetation on dredged material berms impacted by construction.	There would be creation of riparian habitat along new conveyance channels. Riparian vegetation on dredged material berms impacted by construction.	There would be creation of riparian habitat along new conveyance channels. Riparian vegetation on dredged material berms impacted by construction.
	12) Vegetation Resources: Wetland Vegetation	Degradation of wetland vegetation would continue with conversion of 18,204 acres of existing swamp to fresh marsh and open water over 50-year period of analysis.	A net total of 1,602 acres of baldcypress-tupelo swamp habitat hydrologically restored.	A net total of 1,459 acres of baldcypress-tupelo swamp habitat hydrologically restored.	A net total of 820 acres of baldcypress-tupelo swamp habitat hydrologically restored.	A net total of 3,061 acres of baldcypress-tupelo swamp habitat hydrologically restored.	A net total of 2,279 acres of baldcypress-tupelo swamp habitat hydrologically restored.	A net total of 2,422 acres of baldcypress-tupelo swamp habitat hydrologically restored.	A net total of 3,881 acres of baldcypress-tupelo swamp habitat hydrologically restored.

		No-Action	Alternative 33 (Recommended Plan)	Alternative 34	Alternative 35	Alternative 36	Alternative 37	Alternative 38	Alternative 39
	13) Vegetation Resources: Upland Vegetation	Upland vegetation along ARDC berms likely unchanged over 50-year period of analysis	Upland vegetation on ARDC berms converted to conveyance channel.	Upland vegetation on ARDC berms converted to conveyance channel.	Upland vegetation on ARDC berms converted to conveyance channel.	Upland vegetation on ARDC berms converted to conveyance channel.	Upland vegetation on ARDC berms converted to conveyance channel.	Upland vegetation on ARDC berms converted to conveyance channel.	Upland vegetation on ARDC berms converted to conveyance channel.
	14) Vegetation Resources: Submerged Aquatic Vegetation (SAV)	Presently there is little to no habitat for SAV due to invasive species out-competing them. This would likely stay unchanged over 50-year period of analysis.	Creation of 18.6 acres of conveyance channels would create a healthy habitat for SAV.	Creation of 10.5 acres of conveyance channels would create a healthy habitat for SAV.	Creation of 7.2 acres of conveyance channels would create a healthy habitat for SAV.	Creation of 29.1 acres of conveyance channels would create a healthy habitat for SAV.	Creation of 17.7 acres of conveyance channels would create a healthy habitat for SAV.	Creation of 25.8 acres of conveyance channels would create a healthy habitat for SAV.	Creation of 36.3 acres of conveyance channels would create a healthy habitat for SAV.
	15) Vegetation Resources: Invasive Species	Invasive species would continue to spread throughout the study area.	Reconnecting hydrology to 1,602 acres of swamp makes conditions conducive for invasive species to continue spreading.	Reconnecting hydrology to 1,459 acres of swamp makes conditions conducive for invasive species to continue spreading.	Reconnecting hydrology to 820 acres of swamp makes conditions conducive for invasive species to continue spreading.	Reconnecting hydrology to 3,061 acres of swamp makes conditions conducive for invasive species to continue spreading.	Reconnecting hydrology to 2,279 acres of swamp makes conditions conducive for invasive species to continue spreading.	Reconnecting hydrology to 2,422 acres of swamp makes conditions conducive for invasive species to continue spreading.	Reconnecting hydrology to 3,881 acres of swamp makes conditions conducive for invasive species to continue spreading.
	16) Wildlife Resources	Continued conversion of 18,204 acres of bottomland swamp to fresh marsh and open water habitat.	Connected hydrology improves 1,602 acres of swamp habitat for wildlife use.	Connected hydrology improves 1,459 acres of swamp habitat for wildlife use.	Connected hydrology improves 820 acres of swamp habitat for wildlife use.	Connected hydrology improves 3,061 acres of swamp habitat for wildlife use.	Connected hydrology improves 2,279 acres of swamp habitat for wildlife use.	Connected hydrology improves 2,422 acres of swamp habitat for wildlife use.	Connected hydrology improves 3,881 acres of swamp habitat for wildlife use.
	17) Fishery Resources	Conversion of 18,204 acres of swamp vegetation to fresh marsh and open water habitat increases availability of open water habitat for fish and aquatic organisms. However, ARDC berms limit access; water quality decline makes environment suitable only for those aquatic organisms tolerant of low dissolved oxygen conditions.	Connected hydrology allows commercial and recreational fishery use in 1,602 acres of improved swamp habitat.	Connected hydrology allows commercial and recreational fishery use in 1,459 acres of improved swamp habitat.	Connected hydrology allows commercial and recreational fishery use in 820 acres of improved swamp habitat.	Connected hydrology allows commercial and recreational fishery use in 3,061 acres of improved swamp habitat.	Connected hydrology allows commercial and recreational fishery use in 2,279 acres of improved swamp habitat.	Connected hydrology allows commercial and recreational fishery use in 2,422 acres of improved swamp habitat.	Connected hydrology allows commercial and recreational fishery use in 3,881 acres of improved swamp habitat.

		No-Action	Alternative 33 (Recommended Plan)	Alternative 34	Alternative 35	Alternative 36	Alternative 37	Alternative 38	Alternative 39
	19) Aquatic Resources: Plankton	Plankton resources would not be able to filter nutrients from the watershed due to the lack of connectivity.	There would be temporary and localized impacts (e.g., decreased dissolved oxygen, increased turbidity) to plankton communities during construction. Long term, creation of conveyance channels in concert with marsh creation and nourishment would result in greater productivity.	There would be temporary and localized impacts (e.g., decreased dissolved oxygen, increased turbidity) to plankton communities during construction. Long term, creation of conveyance channels in concert with marsh creation and nourishment would result in greater productivity.	There would be temporary and localized impacts (e.g., decreased dissolved oxygen, increased turbidity) to plankton communities during construction. Long term, creation of conveyance channels in concert with marsh creation and nourishment would result in greater productivity.	There would be temporary and localized impacts (e.g., decreased dissolved oxygen, increased turbidity) to plankton communities during construction. Long term, creation of conveyance channels in concert with marsh creation and nourishment would result in greater productivity.	There would be temporary and localized impacts (e.g., decreased dissolved oxygen, increased turbidity) to plankton communities during construction. Long term, creation of conveyance channels in concert with marsh creation and nourishment would result in greater productivity.	There would be temporary and localized impacts (e.g., decreased dissolved oxygen, increased turbidity) to plankton communities during construction. Long term, creation of conveyance channels in concert with marsh creation and nourishment would result in greater productivity.	There would be temporary and localized impacts (e.g., decreased dissolved oxygen, increased turbidity) to plankton communities during construction. Long term, creation of conveyance channels in concert with marsh creation and nourishment would result in greater productivity.
	20) Aquatic Resources: Benthic	The amount of habitat available for benthos assemblages that utilize swamp or marsh edge habitats would likely decrease. The availability of nutrients and detritus from the decomposing swamp vegetation would initially increase and then decrease, causing the decline in habitat availability.	Wetland restoration and reconnecting hydrology of 1,602 acres would result in a greater export of dissolved organic compounds and detritus from the wetlands creating a healthier benthic habitat.	Wetland restoration and reconnecting hydrology of 1,459acres would result in a greater export of dissolved organic compounds and detritus from the wetlands creating a healthier benthic habitat.	Wetland restoration and reconnecting hydrology of 822 acres would result in a greater export of dissolved organic compounds and detritus from the wetlands creating a healthier benthic habitat.	Wetland restoration and reconnecting hydrology of 3,061 acres would result in a greater export of dissolved organic compounds and detritus from the wetlands creating a healthier benthic habitat.	Wetland restoration and reconnecting hydrology of 2,279 acres would result in a greater export of dissolved organic compounds and detritus from the wetlands creating a healthier benthic habitat.	Wetland restoration and reconnecting hydrology of 2,422 acres would result in a greater export of dissolved organic compounds and detritus from the wetlands creating a healthier benthic habitat.	Wetland restoration and reconnecting hydrology of 3,881 acres would result in a greater export of dissolved organic compounds and detritus from the wetlands creating a healthier benthic habitat.
	21) Essential Fish and Habitat (EFH)	No EFH identified within SA. This designation would likely not change over the 50-year period of analysis.	Proposed action would not likely result in changes to EFH.	Proposed action would not likely result in changes to EFH.	Proposed action would not likely result in changes to EFH.	Proposed action would not likely result in changes to EFH.	Proposed action would not likely result in changes to EFH.	Proposed action would not likely result in changes to EFH.	Proposed action would not likely result in changes to EFH.
	22) Threatened and Endangered Species	Converted 18,204 acres of swamp habitat to fresh marsh and open water habitats would likely not be utilized by listed species.	Restored 1,602 acres of Maurepas Swamp would likely not be utilized by listed species.	Restored 1,459 acres of Maurepas Swamp would likely not be utilized by listed species.	Restored 820 acres of Maurepas Swamp would likely not be utilized by listed species.	Restored 3,061 acres of Maurepas Swamp would likely not be utilized by listed species.	Restored 2,279 acres of Maurepas Swamp would likely not be utilized by listed species.	Restored 2,422 acres of Maurepas Swamp would likely not be utilized by listed species.	Restored 3,881 acres of Maurepas Swamp would likely not be utilized by listed species.
	23) Cultural and Historic Resources	The land loss within the study area threatens the integrity of these resources.	Ecosystem restoration would prevent further land loss and have positive effects on these resources.	Ecosystem restoration would prevent further land loss and have positive effects on these resources.	Ecosystem restoration would prevent further land loss and have positive effects on these resources.	Ecosystem restoration would prevent further land loss and have positive effects on these resources.	Ecosystem restoration would prevent further land loss and have positive effects on these resources.	Ecosystem restoration would prevent further land loss and have positive effects on these resources.	Ecosystem restoration would prevent further land loss and have positive effects on these resources.
	24) Aesthetics	Conversion of 18,204 acres of swamp vegetation to fresh marsh or open water habitat could reduce aesthetics.	Restoration of 1,602 acres of bottomland swamp would improve aesthetics.	Restoration of 1,459 acres of bottomland swamp would improve aesthetics.	Restoration of 820 acres of bottomland swamp would improve aesthetics.	Restoration of 3,061 acres of bottomland swamp would improve aesthetics.	Restoration of 2,279 acres of bottomland swamp would improve aesthetics.	Restoration of 2,422 acres of bottomland swamp would improve aesthetics.	Restoration of 3,881 acres of bottomland swamp would improve aesthetics.

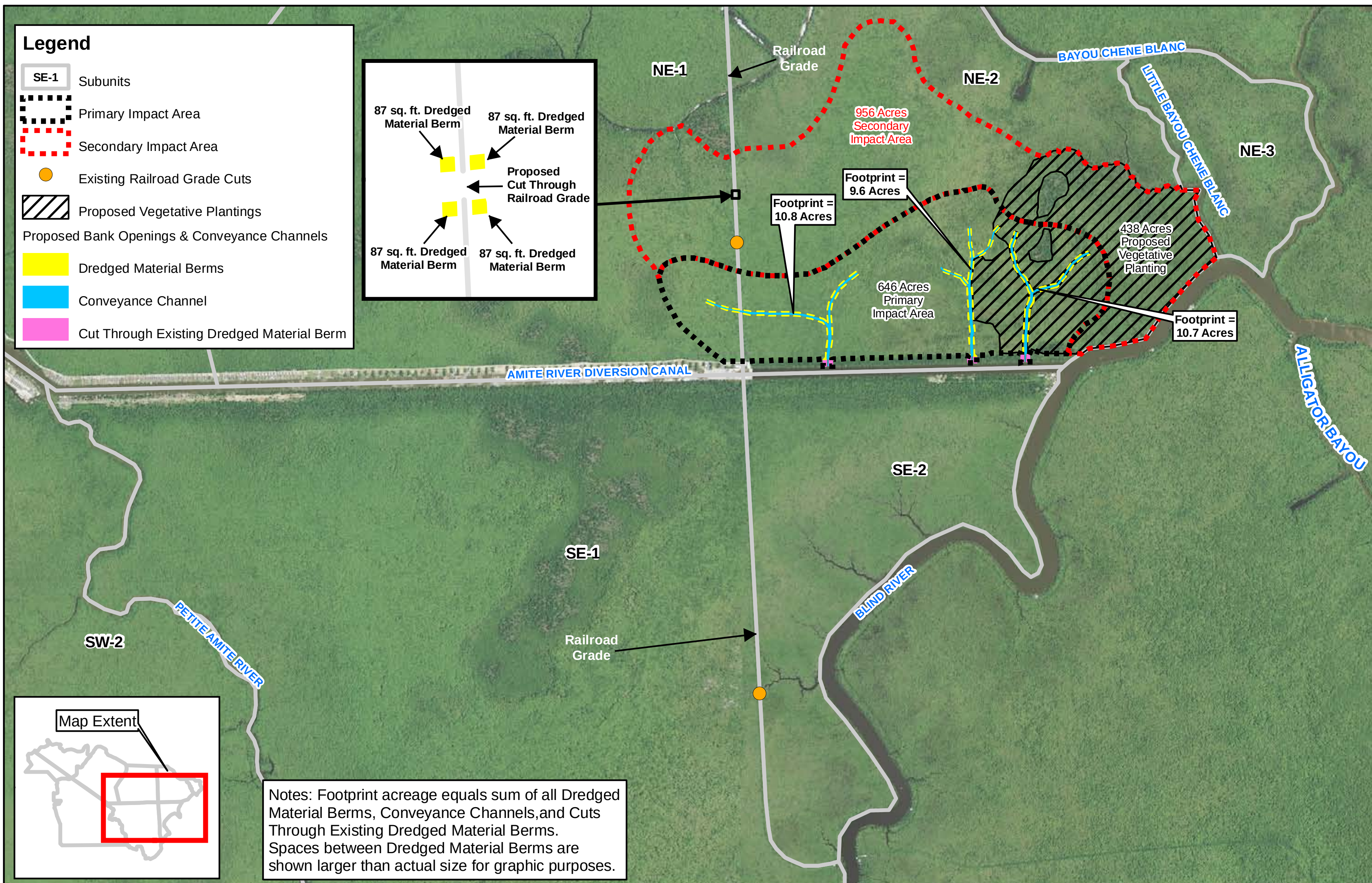
		No-Action	Alternative 33 (Recommended Plan)	Alternative 34	Alternative 35	Alternative 36	Alternative 37	Alternative 38	Alternative 39
	25) Recreational Resources	Support and sustainability of bottomland swamp recreational opportunities would decline over time with conversion to an open water system.	The proposed action would lead to improvements in swamp habitat, resulting in a higher number of recreational opportunities.	The proposed action would lead to improvements in swamp habitat, resulting in a higher number of recreational opportunities.	The proposed action would lead to improvements in swamp habitat, resulting in a higher number of recreational opportunities.	The proposed action would lead to improvements in swamp habitat, resulting in a higher number of recreational opportunities.	The proposed action would lead to improvements in swamp habitat, resulting in a higher number of recreational opportunities.	The proposed action would lead to improvements in swamp habitat, resulting in a higher number of recreational opportunities.	The proposed action would lead to improvements in swamp habitat, resulting in a higher number of recreational opportunities.
	26) Socioeconomic and Human Resources: Population and Housing	No impacts to population and housing would occur.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.
	27) Socioeconomic and Human Resources: Employment and Income	The employment and income of the residents would follow regional trends. Presently, close to 35% of the 477 study area residents are retired, and the unemployment rate is 7.2% in the parish.	Minor positive effects in temporary and permanent labor would occur as a result of ecosystem restoration.	Minor positive effects in temporary and permanent labor would occur as a result of ecosystem restoration	Minor positive effects in temporary and permanent labor would occur as a result of ecosystem restoration	Minor positive effects in temporary and permanent labor would occur as a result of ecosystem restoration	Minor positive effects in temporary and permanent labor would occur as a result of ecosystem restoration	Minor positive effects in temporary and permanent labor would occur as a result of ecosystem restoration	Minor positive effects in temporary and permanent labor would occur as a result of ecosystem restoration
	28) Socioeconomic and Human Resources: Community Cohesion	Several of the current subdivisions would expand. A proposed bridge over the ARDC would improve community cohesion.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.
	29) Socioeconomics and Human Resources: Environmental Justice	No disproportionate impacts on minority and/or low-income communities would occur.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.
	30) Socioeconomic and Human Resources: Infrastructure	Conversion of 18,204 acres of swamp vegetation to fresh marsh or open water habitat may affect relocations and maintenance of infrastructure within the study area.	Restoration could provide protection by reducing inundation, wave action, and erosion.	Restoration could provide protection by reducing inundation, wave action, and erosion.	Restoration could provide protection by reducing inundation, wave action, and erosion.	Restoration could provide protection by reducing inundation, wave action, and erosion.	Restoration could provide protection by reducing inundation, wave action, and erosion.	Restoration could provide protection by reducing inundation, wave action, and erosion.	Restoration could provide protection by reducing inundation, wave action, and erosion.
	31) Socioeconomic and Human Resources: Business and Industry	Wetland land loss potentially threatens businesses in the study area.	Improvements and nourishment of swamp habitat would sustain business and industry.	Improvements and nourishment of swamp habitat would sustain business and industry.	Improvements and nourishment of swamp habitat would sustain business and industry.	Improvements and nourishment of swamp habitat would sustain business and industry.	Improvements and nourishment of swamp habitat would sustain business and industry.	Improvements and nourishment of swamp habitat would sustain business and industry.	Improvements and nourishment of swamp habitat would sustain business and industry.
	32) Socioeconomic and Human Resources: Traffic and Transportation	Wetland land loss threatens the stability of roads passing through area, resulting in increased maintenance. Several of the current subdivisions would expand, creating additional roads, bridges, and traffic.	This alternative would reduce the amount of road damages and relocations needed compared to the no-action alternative.	This alternative would reduce the amount of road damages and relocations needed compared to the no-action alternative.	This alternative would reduce the amount of road damages and relocations needed compared to the no-action alternative.	This alternative would reduce the amount of road damages and relocations needed compared to the no-action alternative.	This alternative would reduce the amount of road damages and relocations needed compared to the no-action alternative.	This alternative would reduce the amount of road damages and relocations needed compared to the no-action alternative.	This alternative would reduce the amount of road damages and relocations needed compared to the no-action alternative.

		No-Action	Alternative 33 (Recommended Plan)	Alternative 34	Alternative 35	Alternative 36	Alternative 37	Alternative 38	Alternative 39
	33) Socioeconomic and Human Resources: Public Facilities and Services	Wetland land loss threatens public facilities and services and increases maintenance. Several of the current subdivisions would expand, creating additional needs for public facilities and services.	This alternative would reduce the amount of maintenance and relocations needed compared to the no-action alternative.	This alternative would reduce the amount of maintenance and relocations needed compared to the no-action alternative.	This alternative would reduce the amount of maintenance and relocations needed compared to the no-action alternative.	This alternative would reduce the amount of maintenance and relocations needed compared to the no-action alternative.	This alternative would reduce the amount of maintenance and relocations needed compared to the no-action alternative.	This alternative would reduce the amount of maintenance and relocations needed compared to the no-action alternative.	This alternative would reduce the amount of maintenance and relocations needed compared to the no-action alternative.
	34) Socioeconomic and Human Resources: Local Government Finances	Increasing population growth increases local government finances.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.
	35) Socioeconomic and Human Resources: Tax Revenue and Property Values	Additional increases in property values and tax revenues would be sustained through the filling of lots in the existing and proposed subdivisions. At the same time, property values may drop from lowering aesthetics due to swamp degradation.	Property values may increase with improved aesthetics.	Property values may increase with improved aesthetics.	Property values may increase with improved aesthetics.	Property values may increase with improved aesthetics.	Property values may increase with improved aesthetics.	Property values may increase with improved aesthetics.	Property values may increase with improved aesthetics.
	36) Socioeconomic and Human Resources: Community and Regional Growth	Additional increases in community and regional growth would be sustained through the filling of lots in the existing and proposed subdivisions.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.
	37) Socioeconomic and Human Resources: Land Use Socioeconomics – Agriculture	Agricultural lands, primarily livestock pastures, would continue to be used.	There would be no impacts to agriculture as a result of the proposed alternative as there are no agricultural lands in the area impacted by this alternative.	There would be no impacts to agriculture as a result of the proposed alternative as there are no agricultural lands in the area impacted by this alternative.	There would be no impacts to agriculture as a result of the proposed alternative as there are no agricultural lands in the area impacted by this alternative.	There would be no impacts to agriculture as a result of the proposed alternative as there are no agricultural lands in the area impacted by this alternative.	There would be no impacts to agriculture as a result of the proposed alternative as there are no agricultural lands in the area impacted by this alternative.	There would be no impacts to agriculture as a result of the proposed alternative as there are no agricultural lands in the area impacted by this alternative.	There would be no impacts to agriculture as a result of the proposed alternative as there are no agricultural lands in the area impacted by this alternative.
	38) Socioeconomic and Human Resources: Land Use Socioeconomics – Forestry	Little timber harvesting would take place in the future due to a lack of quality timber.	There would be restoration easements as a result of the proposed alternative, limiting forestry activities.	There would be restoration easements as a result of the proposed alternative, limiting forestry activities.	There would be restoration easements as a result of the proposed alternative, limiting forestry activities.	There would be restoration easements as a result of the proposed alternative, limiting forestry activities.	There would be restoration easements as a result of the proposed alternative, limiting forestry activities.	There would be restoration easements as a result of the proposed alternative, limiting forestry activities.	There would be restoration easements as a result of the proposed alternative, limiting forestry activities.
	39) Socioeconomic and Human Resources: Land Use Socioeconomics – Public Lands	A portion of the Maurepas WMA is the only public lands present in the study area. These lands may be adversely affected by future sea level rise.	Minor beneficial impacts to public lands in study area.	Minor beneficial impacts to public lands in study area.	Minor beneficial impacts to public lands in study area.	Minor beneficial impacts to public lands in study area.	Minor beneficial impacts to public lands in study area.	Minor beneficial impacts to public lands in study area.	Minor beneficial impacts to public lands in study area.

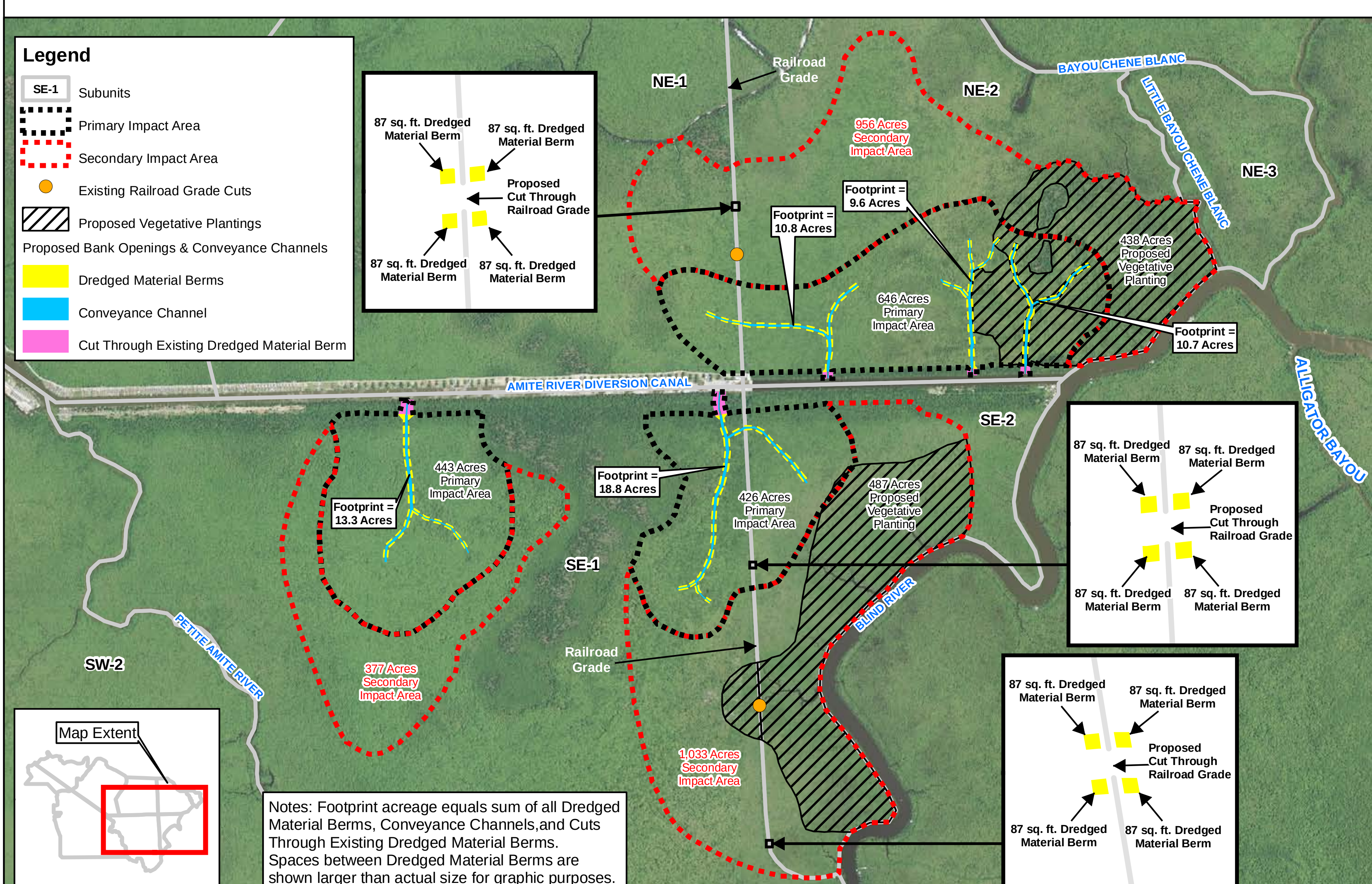
		No-Action	**Alternative 33 (Recommended Plan)**	**Alternative 34**	**Alternative 35**	**Alternative 36**	**Alternative 37**	**Alternative 38**	**Alternative 39**
	40) Socioeconomic and Human Resources: Water Use and Supply	There would continue to be little significant public use of surface waters (other than for recreation) in the study area.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.
	41) Socioeconomic and Human Resources: Navigation	Blind River, ARDC, Bayou Manchac, and Amite River are likely to continue to be used primarily for recreational navigation; continued degradation could result in increased maintenance issues.	Wetland restoration would continue to give protection to navigational waterways from marine conditions.	Wetland restoration would continue to give protection to navigational waterways from marine conditions.	Wetland restoration would continue to give protection to navigational waterways from marine conditions.	Wetland restoration would continue to give protection to navigational waterways from marine conditions.	Wetland restoration would continue to give protection to navigational waterways from marine conditions.	Wetland restoration would continue to give protection to navigational waterways from marine conditions.	Wetland restoration would continue to give protection to navigational waterways from marine conditions.
	42) Socioeconomic and Human Resources: Man-Made Resources – Oil, Gas, and Utilities	Pipelines serving wells may need to be relocated and/or re-buried due to the conversion of 18,204 acres of swamp vegetation to fresh marsh or open water habitat.	Reduction in relocations and re-burying needed compared to the no-action alternative.	Reduction in relocations and re-burying needed compared to the no-action alternative.	Reduction in relocations and re-burying needed compared to the no-action alternative.	Reduction in relocations and re-burying needed compared to the no-action alternative.	Reduction in relocations and re-burying needed compared to the no-action alternative.	Reduction in relocations and re-burying needed compared to the no-action alternative.	Reduction in relocations and re-burying needed compared to the no-action alternative.
	43) Socioeconomic and Human Resources: Man-Made Resources – Oil, Gas, and Utilities – Pipelines	Relocations and/or re-burying of pipelines due to the conversion of 18,204 acres of swamp vegetation to fresh marsh or open water habitat would likely occur.	Reduction in relocations and re-burying needed compared to the no-action alternative.	Reduction in relocations and re-burying needed compared to the no-action alternative.	Reduction in relocations and re-burying needed compared to the no-action alternative.	Reduction in relocations and re-burying needed compared to the no-action alternative.	Reduction in relocations and re-burying needed compared to the no-action alternative.	Reduction in relocations and re-burying needed compared to the no-action alternative.	Reduction in relocations and re-burying needed compared to the no-action alternative.
	44) Socioeconomic and Human Resources: Man-Made Resources – Flood Control and Hurricane Protection Levees	Continued degradation of wetlands would result in an increase in localized storm surge and storm wave damages. The Amite River and Tributaries (AR&T) Federal flood control project is in the study area. Municipal and parish flood control measures, including drainage canals and control structures, are present in the study area.	There would be a minor decrease in storm surge and risk of flooding due to coastal land retention.	There would be a minor decrease in storm surge and risk of flooding due to coastal land retention.	There would be a minor decrease in storm surge and risk of flooding due to coastal land retention.	There would be a minor decrease in storm surge and risk of flooding due to coastal land retention.	There would be a minor decrease in storm surge and risk of flooding due to coastal land retention.	There would be a minor decrease in storm surge and risk of flooding due to coastal land retention.	There would be a minor decrease in storm surge and risk of flooding due to coastal land retention.
	45) Socioeconomic and Human Resources: Natural Resources – Commercial Fisheries	There are limited commercial fisheries present at this time. Production would not be affected.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.
	46) Socioeconomic and Human Resources: Natural Resources – Oyster Leases	SA provides no habitat suitable for oysters or oyster leases. Unlikely oyster habitat or leases would develop over 50-year period of analysis.	Proposed action would provide no habitat suitable for oysters or oyster leases.	Proposed action would provide no habitat suitable for oysters or oyster leases.	Proposed action would provide no habitat suitable for oysters or oyster leases.	Proposed action would provide no habitat suitable for oysters or oyster leases.	Proposed action would provide no habitat suitable for oysters or oyster leases.	Proposed action would provide no habitat suitable for oysters or oyster leases.	Proposed action would provide no habitat suitable for oysters or oyster leases.

		No-Action	Alternative 33 (Recommended Plan)	Alternative 34	Alternative 35	Alternative 36	Alternative 37	Alternative 38	Alternative 39
	47) HTRW	An HTRW Phase I ESA was performed 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.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.	Impacts would be similar to the No-Action Alternative.
3. Plan Evaluation	**A. Contribution to Planning Objectives**								
	1) Increase hydrologic connectivity between the degraded swamp and bottomland hardwood habitats and the ARDC by increasing the exchange of freshwater, sediments, and nutrients over the 50-year period of analysis.	0	2	2	2	2	2	2	2
	2) Reduce habitat conversion of swamp to open water over the 50-year period of analysis.	0	2	2	2	2	2	2	2
	3) Facilitate natural hydrologic cycles over the 50-year period of analysis by reducing impoundment in degraded swamp and bottomland hardwood habitats adjacent to the ARDC to improve tree productivity and seedling germination.	0	2	2	2	2	2	2	2
	4) Improve fish and wildlife habitat over the 50-year period of analysis.	0	2	2	2	2	2	2	2
0=Does not meet									
1=Partially meets									
2=Meets									

		No-Action	Alternative 33 (Recommended Plan)	Alternative 34	Alternative 35	Alternative 36	Alternative 37	Alternative 38	Alternative 39
	B. Planning Constraints								
	1) Flood control	2	2	2	2	2	2	2	2
	2) Designated Scenic Rivers	2	2	2	2	2	2	2	2
	3) Hydroperiod	0	2	2	2	2	2	2	2
	C. Response to Evaluation Criteria								
	1) Completeness	0	2	2	2	2	2	2	2
	2) Effectiveness	0	2	2	2	2	2	2	2
	3) Efficiency	0	2	2	2	2	2	2	2
	4) Acceptability	0	2	2	2	2	2	2	2
0=Does not meet									
1=Partially meets									
2=Meets									



ALTERNATIVE 33 (TSP)



ALTERNATIVE 39 (NER)

N

0 2,000 4,000 6,000 Feet

ALTERNATIVE 33 AND ALTERNATIVE 39 COMPARISON

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 3.27
Date: July 2010
Scale: 1:40,000
Source: USGS/GEC
Map ID: 27850108-1874

Table 3.16 Comparison of the NER and Recommended Plan

	Alternative 39 (NER)	Alternative 33 (Recommended Plan)
MCACES Costs		
Channels & Canals	$9,210,000	$4,450,000
Monitoring	$3,660,000	$2,970,000
Construction Estimate Total	$12,870,000	$7,420,000
Federal Share Construction Estimate	$8,370,000	$4,820,000
Non-Federal Share Construction Estimate	$4,500,000	$2,600,000
Lands & Damages	$390,000	$180,000
Planning, Engineering & Design	$1,110,000	$534,000
Construction Management	$829,000	$401,000
Project Cost Total	$15,200,000	$8,540,000
Federal Share Cost Total	$9,880,000	$5,550,000
Non-Federal Share Cost Total	$5,320,000	$2,990,000
Benefits		
Benefits (AAHUs)	1,602	679
Annualized Cost/AAHU	$480	$660

Notes: Costs represent the "fully funded" project estimate including interest during construction. Discount Rate of 4.375 percent Utilized for Annualized Costs.

Table 3.17 Maximum Cost Including Inflation through Construction

Authorized cost in WRDA 2007 Title VII, Section 7006 (e)(3)(A):	$5,600,000
* Cost Index Used EM 1110-2-1304 (Revised 31 Mar 2010)	CWBS Feature Code 09 – Channels and Canals
Cost Index Ratio 1Q FY07 to 3Q FY15	1.20
** Current Project Cost Estimate (Inflation applied from 10/2006 to 4/2015)	$6,711,849
20% of Authorized Cost:	$1,120,000
*** Monitoring & Adaptive Management: (per WRDA 2007 Section 2039)	$2,971,200- $45,000 = $2,926,200
Maximum Cost Limited by Section 902:	$6,711,849+ $1,120,000 +2,926,200 = **$10,760,000**
****Recommended Plan cost	**$8,540,000**

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 October 2006 price levels to the midpoint 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 Worksheet - October 2004 Price Levels modified study cost Dec 20 2004. Figures in calculations are actual and not rounded. Final numbers in bold are rounded.****Represents fully funded cost estimate including interest during construction.

- Dredged material (5.0 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps will be left in the disposal berms so sheet flow is not reduced.
- One cut would be created in the railroad grade approximately 0.9 miles north of the ARDC to improve sheet flow.
- Vegetative plantings of bottomland hardwood/freshwater swamp tree species on 5.0 acres of dredged material berms.
- Vegetative plantings of freshwater swamp tree species within 438 acres of the swamp floor.
- Installation of nutria guards on all newly planted trees to protect against tree loss.
- Environmental easements on 1,633 acres of land

Three natural low areas or relict channels have been identified as potential bank opening and conveyance channel sites. Openings would enable impounded water to be drained from the swamp and provide hydrologic connectivity between the swamp and the ARDC. Additionally, the placement of a cut in the railroad grade would provide further hydrologic connectivity between NE-1 and NE-2. Openings would promote the introduction of freshwater, sediments, and nutrients into the swamp and allow the oxidation of sediments and removal of toxic metabolites. This alternative is anticipated to improve the degraded swamp and decrease the transition to marsh and ultimately, open water. This alternative represents the minimum effort that would meet the goals and objectives of the project.

Alternative 33 would benefit approximately 1,602 acres of existing freshwater swamp, recreate 144 acres of freshwater swamp from freshwater marsh, and create 5.0 acres of upland habitat from dredged material placement.

All excavation through the dredged material berms, as well as the conveyance channels through the swamp, would be based on four design cross-sections (Figures 3.5 through 3.8). These cross-sections were developed in an effort to mimic natural, existing cuts within the study area, which have been determined to be self-maintaining. The cross-sections include a 70-foot wide cut section with benches through dredged material berm, a 70-foot wide cut section, a 50-foot wide cut section and a 30-foot wide cut section. The benches are 25-foot wide flat areas, located above the average water level, on both sides of the conveyance channel. These benches will be included in the portions of the conveyance channel to be cut through the existing dredged material berms. The 70-foot cut section with benches was designed to allow increased amounts of flow to pass beyond the existing dredged material berm during high-water events. The material dredged from the existing berms would be placed along the swamp-side of the excavated cut as new bottomland hardwood habitat. All material dredged during construction of the conveyance channels would be placed along the channels, with gaps included, to allow sufficient sheet flow to be conveyed from the swamp. The quantities associated with each alternative are found in Table 3.5. Table 3.6 summarizes the features associated with each alternative within the final array. A typical depiction of the conveyance channels is found in Figure 3.9.

The Recommended Plan would provide environmental benefits as follows:

- Restoring and benefitting 1,602 acres of freshwater swamp habitat; freshwater swamp habitat has been identified nationally as institutional, public, and technical significance. This significance is due to the ecosystem functions that include fish and wildlife habitat, water quality benefits, pollutant filtration, groundwater charge and recharge, habitat for threatened and endangered species, carbon sequestration, aesthetics, and recreations;
- Creating a net of 679 Average AAHUs; AAHUs are a measure of ecological benefits as output from the WVA. An AAHU is the equivalent of improving one acre from a totally non-functioning habitat (0 percent functioning) to a fully functional one (100 percent), as well has to take two acres from a 50 percent functional level to a 100 percent functional level. More AAHU and WVA detail are presented in 3.5.2. The benefits of this project would be to essentially restore the equivalent on 679 acres of a 100 percent functioning freshwater swamp from a 679 acres of a completely non-functioning habitat;
- Creating 5.0 acres of bottomland hardwood habitat;
- Establishing hydrologic connectivity between the ARDC and the western Maurepas Swamp allowing the swamp to drain during seasonal low-flow conditions in the Amite River and allowing nutrients and sediments to be introduced from the ARDC into the swamp during flood events and from runoff during localized rainfall events;
- Reducing the likelihood of the swamp being converted to marsh or open water;
- Promoting the germination and survival of the seedlings of bald cypress and other trees;
- Improving biological productivity and reducing further habitat deterioration.

3.7.2 Design, Environmental, and Construction Considerations

Design Considerations. Alternative 33 (Recommended Plan) utilizes the addition of cuts in the north dredged material berms along with bifurcated conveyance channels to reduce impoundment and increase hydrologic connectivity between the ARDC and subunits NE-1 and NE-2. All cut locations were placed to maximize the potential for flow into and out of the impounded swamp habitat. Additionally, one cut is placed in the existing railroad grade to further reduce impoundment and improve flow within these areas. All material dredged during construction of the conveyance channels would be placed along the channels, with gaps included, to allow sufficient sheet flow to be conveyed from the swamp.

The cross-sectional dimensions of the conveyance channels were designed to mimic natural cuts found within the southern portion of SE-2 and along Blind River. These natural cuts facilitate drainage for an area similar in size to those required in NE-2 and are considered to be in a state on hydrologic equilibrium. The surveys of the existing channels are presented in Appendix L. These cuts represent natural equilibrium dimensions which have formed based on drainage requirements similar to the hydrologic subunits involved in this restoration study. Additional cross-sectional area was provided for the cut portion within the existing dredged material berms so as to allow high-water flows through this portion of proposed conveyance system. Additional geotechnical data will be collected during PED and will be used to verify the channel design (Appendix L).

Vegetative plantings are added to the most highly-degraded areas within NE-2 to increase the potential for reversing habitat conversion and to provide a seed source, thereby increasing vegetative regeneration within this portion of the study area. These plantings will be implemented in two phases. A primary planting will be implemented in the designated areas one year after the earthmoving phase of construction is completed. The period of time between excavation and the primary plantings will allow the disturbed material to compact into a more suitable substrate. This time will also allow for the determination of an appropriate planting scheme. Sixteen months after the primary plantings are completed; a mortality analysis will be conducted to establish the quantity of plantings required for the secondary planting. It is assumed that 50 percent of the initial plantings will perish. Four months after this determination is made a secondary planting will be implemented. Both the primary and secondary plantings will consist of 173 trees per acre. Each acre planted will be composed of 75 percent bare-root, 15 percent one-gallon potted, and 10 percent three-gallon potted plants. These plantings are considered an important component of the restoration design, due to the native regeneration they would provide for the highly degraded areas of impact. The planting should only occur during the non-growing season (November to March) and it is recommended that at least one year elapse after construction before planting such that soils in the impounded areas could recover and the dredged material berms reach a stable elevation. The plant list for the dredged material areas would be developed based upon this final elevation.

3.7.3 Real Estate Requirements

Construction of Alternative 33 (Recommended Plan) would require the acquisition of required easements to allow for the construction of the project and to ensure that all project benefits are protected. These real estate acquisitions include flowage, wetland, and channel easements for the appropriate portions of the construction footprint. The real estate cost required for implementation of Alternative 33 (Recommended Plan) is estimated at approximately $180,000 (Appendix J).

3.7.4 OMRR&R Considerations

OMRR&R requirements for Alternative 33 (Recommended Plan) include a yearly inspection of the bank opening locations and conveyance channels to ensure that there are no flow interruptions, such as from debris or fallen trees. Upon inspection it would be determined if blockage removal or some other appropriate remedial operation is required. Since the channel designs were based on stable, existing channel that require no maintenance, no blockage is anticipated. However, some maintenance is being planned for in the event that high water soon after construction could move some debris and block the channel. Once these areas stabilize, little to no maintenance would be required.

The conveyance channels would be naturally altered over time, eventually reaching a state of hydrologic equilibrium similar to the relict channels that the conveyance channels were designed to mimic. These changes would most possibly result in changes to the geomorphology of the channel along with a transition to a more meandering channel makeup and would not reduce the expected benefits of Alternative 33 (Recommended Plan). Therefore, it is anticipated that little to no attempt to maintain the depth or shoreline geometry of the conveyance channels would be necessary. The non-Federal sponsor would be required to enforce any restrictions as identified in the easements to ensure that the benefits of Alternative 33 (Recommended Plan) are retained.

3.7.5 Monitoring Plan and Adaptive Management

3.7.5.1 Description of Monitoring Activity and Adaptive Management

Monitoring is critical to understanding how effective a project is with respect to meeting its goals and objectives. Project and system level objectives must be identified to determine appropriate indicators to monitor. In order to be effective, monitoring designs must be able to discern ecosystem responses due to project implementation (i.e., management actions) from natural variability. In coastal Louisiana, there are many existing restoration and protection projects constructed, and many more planned under a multitude of different authorizations and programs, which will ultimately influence much of coastal Louisiana. Monitoring must therefore be conducted at project and system-wide scales, and nested to support long-term, large-scale status and trends and short-term performance assessments.

When possible, specific monitoring and large scale information needs should be integrated with monitoring efforts that are underway in coastal Louisiana. The Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) produced a program that has been monitoring restoration and protection projects in coastal

Louisiana since 1990 (Steyer and Stewart 1992, Steyer *et al.* 1995). The monitoring program incorporates a system-level wetland assessment component called the Coast-wide Reference Monitoring System (CRMS-Wetlands, Steyer *et al.* 2003). CRMS-Wetlands provide system-wide performance measures that are evaluated to help determine the cumulative effects of restoration and protection projects in coastal Louisiana. LCA monitoring plans should benefit from existing monitoring networks to the extent practicable and participate in the implementation of CRMS-Wetlands. The CRMS stations, which are capable of monitoring RSLR, could also be utilized in the future as a means of adaptive management for RSLR. Consideration could be given to additional monitoring efforts as well. Such participation can maintain the data consistencies necessary to conduct project assessment and programmatic adaptive management.

A feasibility level monitoring and adaptive management (AM) plan has been developed for the project (Appendix I). The monitoring and AM plan was developed to include the proposed monitoring and to consider and identify any necessary AM activities. The plan also estimates the costs and duration of the monitoring and applicable AM components.

The primary incentive for implementing an adaptive management program is to increase the likelihood of achieving desired project outcomes in the face of uncertainty. Adaptive management provides an organized, coherent and documented process that defines management actions in relation to measured project performance compared to desired project outcomes.

Principal sources of uncertainty common to management and restoration projects include (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.

In the case of the LCA-ARDC Modification project, the following questions were considered to determine if adaptive management should be applied to the project. A “NO” answer to questions 1 through 3 and a “YES” answer to question 4 indentifies the project as a candidate that could benefit from adaptive management.

(1) Are the ecosystems to be restored sufficiently understood in terms of hydrology and ecology, and can project outcomes be accurately predicted given recognized natural and anthropogenic stressors?

(2) Can the most effective project design and operation to achieve project goals and objectives be readily identified?

(3) Are the measures of this restoration project’s performance well understood and agreed upon by all parties?

(4) Can project management actions be adjusted in relation to monitoring results?

Answers to questions 1 through 3 were "NO." However, the Adaptive Management Framework Team determined that the Amite River Diversion Canal Modification project was not a good candidate for adaptive management because there are no actions that could be taken in response to monitoring results that the USACE would define as adaptive management actions. That is, the answer to question 4 is "NO." Although some activities could be conducted to adjust project performance, these actions would not be considered adaptive management activities. O&M for the selected plan includes a yearly inspection of the bank opening locations and conveyance channels to ensure that there are no flow interruptions, such as from debris or fallen trees, which could improve project performance. However if monitoring data indicate that actions beyond yearly O&M (i.e changing the shape, size, branching, or number of conveyances channels or gaps) would be needed these would be considered structural changes and are beyond the adaptive management authority. The USACE and State of Louisiana can initiate the process for developing a new water resources project or pursue a design deficiency under the constructed project. The Framework Team also considered opportunities for active adaptive management by designing the project as a management experiment. The Team determined there were minimal active adaptive management opportunities for the project and that any lessons learned would be limited and would not likely apply to other coastal Louisiana restoration projects. While there are currently no apparent adaptive management opportunities, the Adaptive Management Planning Team can examine the performance of the project in the future. If it is determined during PED that adaptive management could help achieve any unfulfilled project objectives, the Team can recommend adaptive management for the project at that time.

Independent of adaptive management, an effective monitoring program will be 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 properly assessing the effects of the Amite River Diversion Canal Modification project.

3.7.5.2 Performance Measures for Monitoring

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: Increase hydrologic connectivity between the degraded swamp and bottomland hardwood habitats within the study area and the ARDC by increasing the exchange of freshwater, sediments, and nutrients.
Performance Measure 1: Freshwater distribution during operational events

Desired Outcome: Increase hydrologic connectivity and area of extent of freshwater movement into project area above pre-project conditions.

Monitoring Design: Synoptic hydrologic surveys, using salinity, temperature, dissolved oxygen, and velocity as tracers, will be conducted during selected low flow and high flow operational events to track distribution of freshwater. Sampling will be conducted twice annually in the first three years and as required thereafter.

Objective 2: Facilitate natural hydrologic cycles within the study area by reducing impoundment in degraded swamp and bottomland hardwood habitats adjacent to the ARDC which would improve tree productivity and seedling germination.

Performance Measure 2a: Swamp vegetation production and extent.

Desired Outcome: Increase in basal area increment of baldcypress and tupelo in the swamp from existing conditions (existing conditions defined from pre-construction measurements from CRMS-Wetlands stations and Southeastern Louisiana University historical monitoring).

Monitoring Design: Diameter at breast height (dbh) and overstory tree cover will be measured in the fall in two pre-construction years and four post-construction years (within the first 10 years).

Performance Measure 2b: Number of baldcypress and tupelo saplings.

Desired Outcome: A 25 percent increase in the number of naturally recruited baldcypress and tupelo saplings per acre from pre-project conditions 10 years after project implementation. Performance of this measure is most dependent on achieving extended dry periods in the swamp.

Monitoring Design: Understory vegetation (herbaceous, seedling, and sapling) will be measured in the fall in two pre-construction and four post-construction years (within the first 10 years) to assess regeneration and changes in cover classes.

Performance Measure 2c: Depth, duration and frequency of flooding in the swamp.

Desired Outcome: Increase or decrease from pre-project conditions average flood durations (existing conditions defined from pre-construction measurements from CRMS-Wetlands stations).

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: Water-level recorders will be deployed in six key areas to measure water depths at the needed frequencies. Recorders will be established three years prior to construction to determine existing conditions and will be monitored for 10 years post-construction or until desired outcomes are achieved.

Supporting Information Need: A deep rod-surface elevation table (RSET) rod will be installed where hydrologic measurements are taken to establish an elevation benchmark.

Objective 3: Reduce habitat conversion from swamp to marsh and open water within the study area.

Performance Measure 3: Habitat and land:water classification
Desired Outcome: Maintaining immediate pre-construction acreage of baldcypress-tupelo swamp acreage after 10 years.

Monitoring Design: Habitats will be classified using Landsat Thematic Mapper (TM) scenes and Digital Orthophoto Quarter Quadrangles (DOQQs) for one pre- and four post-project years in the study area to assess trends in conversion between swamp, herbaceous marsh, and open water.

Supporting Information Need: Salinity data will be collected in order to characterize potential salinity stress associated with low water conditions in the fall, droughts, and intrusions associated with tropical cyclone events.

Objective 4: Improve fish and wildlife habitat within the study area.

Performance Measure 4: No applicable performance measure.

Desired Outcome: Swamp production and hydroperiod 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.

3.7.5.3 Cost and Duration of Monitoring and Adaptive Management

The costs associated with implementing the monitoring and adaptive management plans was estimated based on currently available data and information developed during plan formulation as part of the feasibility study. Because uncertainties remain as to the exact project features, monitoring elements, and adaptive management opportunities, the costs estimated will be need to be refined in PED during the development of the detailed monitoring and adaptive management plans. The estimated cost for the monitoring program is $2,970,000 over 10 years, following the completion of project construction. These costs are budgeted as construction costs.

In accordance with WRDA 2007 Section 2039 the monitoring costs presented in the report are for the full allowable 10-year period and represent conservative and comprehensive cost. Section 2039 guidance does allow for the monitoring to end prior to the 10-year period if the Secretary determines that the success criteria have been met. The costs presented in the report are for the full 10-year period but may end much sooner than 10 years. The monitoring plans and costs were developed by the interagency LCA Adaptive Management Planning Team in conjunction with stakeholders and have been determined to be a reasonable plan and estimate for what is needed and necessary to be able to determine project success.

3.7.6 Effectiveness of Recommended Plan in Meeting Goals and Objectives

The proposed action selected as the Recommended Plan, meets all of the goals and objectives listed in Section 2.4 of this study and has been determined to have minimal impacts on significant resources, as described in Table 3.15. The manner in which each objective and goal is achieved is listed below.

***Objective 1*:** *Increase hydrologic connectivity between the degraded swamp and bottomland hardwood habitats within the study area and the ARDC by increasing the exchange of freshwater, sediments, and nutrients over the 50-year period of analysis.*

With the addition of cuts and conveyance channels, H&H modeling has shown that hydrologic connectivity would be increased within the designated areas of impacts for the subunits determined to be in the most need of restoration. This connectivity would add to the seasonal flows needed to maintain healthy swamp habitat and would increase the exchange of sediments and nutrients between the ARDC and the interior swamp areas.

***Objective 2*:** *Reduce habitat conversion of swamp to open water within the study area over the 50-year period of analysis.*

With implementation of Alternative 33 (Recommended Plan), added conveyance, reduced impoundment, and implementation of vegetative plantings, would result in a reduction of habitat conversion to freshwater marsh for 1,602 acres of degraded cypress-tupelo swamp. It is also anticipated that the regeneration of native swamp vegetation would be increased with the implementation of this proposed action, thereby creating a self-sustaining swamp habitat.

***Objective 3*:** *Facilitate natural hydrologic cycles within the study area over the 50-year period of analysis by reducing impoundment in degraded swamp and bottomland hardwood habitats adjacent to the ARDC to improve tree productivity and seedling germination.*

The cuts placed within the existing dredged material berm, along with the conveyance channels, would allow the swamp habitat adjacent to the ARDC to drain high-salinity waters introduced by tropical storm events and allow for seasonal hydrologic flow to occur within the areas of impact. The increased conveyance observed from seasonal hydrology would produce increased sheet flow, resulting in nutrient and sediment input as well as a flushing action for the areas of impact within Alternative 33 (Recommended Plan). This would produce the type of hydrologic cycles required to maintain and promote healthy swamp habitat. The resulting reduction in impoundment will increase the number of dry days occurring within the areas of impact, in turn increasing seed germination and promoting natural succession.

***Objective 4*:** *Improve fish and wildlife habitat within the study area over the 50-year period of analysis.*

The implementation of Alternative 33 (Recommended Plan) would improve the ecosystem by creating a net gain of 679 AAHUs within the areas of impacts. These benefits quantify habitat improvements for fish and wildlife that thrive in cypress-tupelo swamp habitat. The placement of the dredged material along the proposed conveyance channels, existing railroad grade, and existing dredged material berms would also provide areas of bottomland hardwood habitat for wildlife to use during high-water periods. The vegetative plantings on the placed dredged material and within the degraded swamp also provide habitat diversity and sustainability within the areas of impact.

3.7.7 Effectiveness of Recommended Plan in Meeting Environmental Operating Principals

Alternative 33 (Recommended Plan) would benefit 1,602 acres of cypress-tupelo swamp habitat, resulting in a net gain of 679 AAHUs with little to no negative environmental impacts. This would reverse the trend of conversion from swamp to freshwater marsh habitat within the areas of impact, while adding habitat sustainability and diversity. The Recommended Plan provides a significant amount of benefits and has been agreed upon by the PDT, including Federal and state agencies, as being the most beneficial plan within the authorized cost for the study area.

3.7.8 Compensatory Mitigation Measures

Implementation of Alternative 33 (Recommended Plan) would result in a net gain in wetland habitat; therefore, compensatory mitigation, as stipulated in the Clean Water Act, is not required. In order to offset the loss of habitat resulting from the placement of dredged material within the areas of impact, 5.0 acres of vegetative plantings of additional tree species, such as sweet gum and live oaks, would be implemented on the placed material to create bottomland hardwood habitat. This habitat could be utilized by some wildlife for available land and food during high-water periods. The addition of these areas also provides habitat diversity within the areas of impact. The Recommended Plan would result in a net gain in habitat units; therefore, no compensatory mitigation for construction of this project is required.

3.7.9 Micro-Computer Aided Cost Estimating System

In order to obtain a more thorough analysis of the costs associated with the recommended plan (Alternative 33), a Micro-Computer Aided Cost Estimating System (MCACES) cost estimate was conducted on the recommended plan. This estimate included all items listed in Section 3.5.1 of this report, with the addition of various project-specific considerations such as contingencies and localized cost items such as sales tax and labor rates. The contingency costs were determined based on a risk analysis as shown in Section 3.8 of this report. The overall cost of the recommended plan was estimated to be $8,540,000 (fully funded). The full MCACES estimate report may be found in Appendix L of this report.

3.7.10 Construction Considerations

It is estimated that construction of the earthmoving portion of the recommended plan (Alternative 33) would take approximately six months. This duration includes the mobilization and demobilization of the required equipment and laborers and the construction of all three gaps and conveyance channels. The first implementation of vegetative plantings within the appropriate swamp and bottomland hardwood habitat would commence approximately 12 months after completion of earthmoving construction. This period of time is required to allow the impounded soils to recover and to allow the dredged material berms to settle. The final elevation of the dredged material berms is a critical component of determining the correct tree species to plant. Supplementary plantings would likely be required at a later date, depending on the mortality rate of the first plantings. It is estimated that the secondary plantings would commence approximately 28 months after the initial plantings are completed. A chart depicting the construction schedule as well as the planting contract schedule can be found in Appendix L.

Once the appropriate equipment is mobilized to the project site via trucks and barges, construction of the gaps would commence by clearing and grubbing the designated footprints of construction on both sides of the ARDC. Stumps are to be removed from the portions of excavation within the proposed channels, but only trees would be cleared along the benches, 10-foot gaps and material placement areas. Cleared trees would be placed in the same area with the stumps and dredged material in a manner that does not impede hydrologic connectivity. Once clearing is completed at one cut location, the equipment would be mobilized to another cut location so excavation could begin.

Excavation of the cuts within the existing dredged material berms and the proposed conveyance channels would be carried out by a short-reach, hydraulic excavator mounted on flexi-float mats or amphibious equipment. As the equipment cuts its way into the cut locations, the dredged material would be placed along the cuts and conveyance channels as shown in Figure 3.9. The excavated cuts and channels would serve as the area in which equipment would move in and out of the construction area. Some amphibious equipment would most likely be needed to accomplish the incremental movement of the mats.

Upon completion of the excavation, vegetative plantings would be carried within the predetermined areas of the swamp and material placement. Approximately 173 trees per acre would be planted. Each area planted would consist of approximately 25 percent potted seedlings and 75 percent bare-root seedlings. Cypress and tupelo gum would be planted within the swamp floor areas and hardwoods such as live oaks and sweet gum would be planted on both the newly created and existing dredged material berms. The final species list would have to be determined after the dredged material berms settle to ensure the correct trees are planted. Nutria guards would be required on every tree planted in order to ensure a reasonable success rate. It is expected that the replanting of 50 percent of these areas would be necessary within a few years of the conclusion of cut and channel construction. The monitoring activities required for this project, such as the mortality of vegetative plantings, are found in Appendix I. No relocations of infrastructure or utilities would be required during construction of the Alternative 33 (Recommended Plan). The estimated schedule for project implementation is shown in Table 3.18.

3.7.11 Significance

Ecosystem restoration is one of the primary missions of the USACE Civil Works program. The USACE's objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER). Contributions to 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 is expressed quantitatively in physical units or indexes. These net changes are measured in the planning area and in the rest of the Nation.

Louisiana contains one of the largest expanses of coastal wetlands in the contiguous United States and accounts for 90 percent of the total coastal wetland loss occurring in the Nation. The Maurepas Swamp complex is the second largest continuous coastal forest in Louisiana, comprising over 190,000 acres of freshwater swamp habitat. The LCA ARDC study area is an essential ecosystem since it includes wetland habitats and provides high fish and wildlife value as well as habitat for migratory birds and other aquatic organisms including threatened or endangered species.

The swamp habitat surrounding the ARDC has been historically used for hunting, fishing, bird watching, and trapping. The restoration of the freshwater swamp habitat surrounding the ARDC would protect these national assets from further degradation. The restoration and protection of this swamp system will further protect the human infrastructure from the damages of storm surges and would protect the habitat for many species, including neotropical migrants.

3.7.11.1 Rationale for the Recommended Plan

The Recommended Plan meets both 2004 and current planning objectives. The Recommended Plan is an implementable increment of the NER plan, has been determined to be cost effective, is within the cost and scope of the authorization, has stand-alone utility, is supported by the non-Federal sponsor, and can be justified based on ecosystem restoration benefits, and addresses problem stipulated by the CEM. The Recommended Plan will restore 1,602 acres of cypress-tupelo swamp habitat and will create five acres of bottomland hardwood habitat for the 50 year period of analysis. Freshwater swamp habitat for essential fish and wildlife species will be restored, mimicking as closely as possible, conditions which occur naturally in the area. The alternatives were designed to work with the natural, fluid, soft environment of coastal Louisiana.

Table 3.18 Recommended Plan (Alternative 33) Construction Schedule

ARDC Alternative 33 Earthmoving Construction Schedule												
		Dredged Material Berm			**Swamp**		**Equipment Utilized (Hours)**					
Week*	Mob	Clear Trees	Land-Based Earthwork	Marsh Backhoe Work	Clear Trees	Marsh Backhoe Work	Log Skidder	D6 Dozer	Marsh Backhoe	Barge	Tug Boat 900hp	Crew Boat**
NTP												
2	MOB											40
3							40	40	80	40	40	40
4		Cut 1					40	40	80	40		40
5				Cut 1			40	40	80	40		40
6			Cut 1		Cut 1		40	40	80	40	20	40
7		Cut 2					40	40	80	40		40
8							40	40	80	40		40
9			Cut 2		Cut 2		40	40	80	40	20	40
10		Cut 3				Cut 1	40	40	80	40		40
11				Cut 2			40	40	80	40		40
12			Cut 3		Cut 3		40	40	80	40	20	40
13									80	40		40
14									80	40		40
15									80	40		40
16						Cut 2			80	40	20	40
17				Cut 3					80	40		40
18									80	40		40
19									80	40		40
20									80	40		40
21									80	40		40
22						Cut 3			80	40		40
23	Demob								80	40	40	40
						Totals	**400**	**400**	**1,680**	**840**	**160**	**880**

* Cells are completion by end of specific week
** Contingency Hours Added for Repairs Etc.

The project will restore natural hydrologic connectivity to the interior swamp surrounding the ARDC, while also reducing impoundment. The increased connectivity will result in increased sediment and nutrient input, which will facilitate seed germination and increase tree growth and canopy within the areas of impact. This increase in vegetative productivity will allow the restored area to continue to function and provide habitat with minimum continuing intervention. Without this project, the LCA ARDC study area will continue to degrade, with the eventual conversion of 18,204 acres of freshwater swamp habitat to marsh and open water. By reducing the impoundment of storm surge and restoring overland flow to the swamp habitat surrounding the ARDC, the Recommended Plan would allow the ecosystem to "self-regulate," by letting natural hydrologic and ecosystem processes to take over. Per ER 1105-2-100 Section E-30, "The objective of Civil Works ecosystem restoration is to restore degraded significant ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. However, partial restoration may be possible, with significant and valuable improvement made to degraded ecological resources." The Maurepas swamp provides important hydrologic and habitat functions within the wetlands of coastal Louisiana. Loss of these functions would have impacts beyond the project study area.

Problems discussed in Section 1.5 of the November 2004 Louisiana Coastal Area (LCA) Ecosystem Restoration Study, as well as how they are addressed by the ARDC Modification study, are listed below:

- **Subsidence** is caused by a lack of sediment replenishing the soil that is removed from an area due to natural erosion or other forces. The Recommended Plan will address this problem by allowing hydrologic connectivity which will introduce sediments to the study area. Additionally, increases in canopy will result in increased biomass accretion, thereby reducing the impacts of subsidence.

- **Habitat switching**, occurs when one habitat converts to another habitat through succession. In Louisiana, this process is frequently due to changes in salinity levels or inundation. Examples of habitat switching may be a forested system converting to a freshwater marsh or a freshwater marsh converting to a saline marsh. The changes in habitat structure and/or composition result in a loss of one group of ecosystem services and may result in local rarity of a habitat type. More specifically, the study area is in danger of switching from a freshwater swamp to a marsh, and then potentially to open water. Through increased hydrologic connectivity, the Recommended Plan allows for nutrient and sediments to be introduced to the area to nourish the swamp and encourage indigenous flora and fauna to remain, thereby keeping the habitat intact. Vegetative plantings will help accelerate and sustain the restoration of the swamp habitat by providing a seed source for vegetative regeneration.

- **Erosion of wetlands** is a result of stormwater runoff carrying sediment away that will not be replenished. The hydrologic connectivity created by the Recommended Plan would lead to the improvement of freshwater swamp habitat, increased basal width, and increased canopy. These improvements will prevent the further conversion of the native habitat.

- **Isolation from sediment and nutrients** has occurred as a result of the construction of the ARDC. This problem will be corrected by the proposed cuts in the dredged material berm, leading to hydrologic connectivity.

- **Saltwater intrusion** occurs when salt water brought in by high tide, storm events or some other method is not able to drain effectively from an area. Improving hydrologic connectivity to the study area would allow for impounded salinity to be flushed out more effectively.

- **Human-built infrastructure has modified the hydrology in the area.** This is the root cause of many of the problems identified in the ARDC study area. This will be addressed by making cuts in the ARDC dredged material berm and allowing for hydrologic connectivity between the ARDC and the surrounding study area.

- **The Mississippi River sediment load is deposited in deeper Gulf of Mexico** due to the controlling of the route of the Mississippi River. This marginally contributes to the problems in the ARDC study area, but measures to address this issue are outside the scope of this project.

- **A decline in sediment load from the Mississippi River** also contributes to the issues in the ARDC study area, but measures to address this issue are outside the scope of this project.

The project objectives addressed through implementation of the Recommended Plan are described in Section 3.7.6 of the report.

The significance of the ecosystem outputs plays an important role in ecosystem restoration evaluation per section E-37 of ER 1105-2-100. The outputs are institutionally recognized. The western Maurepas swamp serves as stopping ground for neotropical migratory bird species and provides habitat for bald eagles, Gulf sturgeon, and the West Indian Manatee. This project is listed in the Louisiana State Master Plan, and 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 ARDC and the surrounding swamp habitat are utilized for camping, fishing, and holiday celebrations. Commercial and recreational fishing are culturally significant to many south Louisiana residents. The wetlands provided by the western Maurepas swamp are nurseries for many fish species.

3.7.11.2 Significance of Recommended Plan

The outputs provided by the Recommended Plan are technically recognized. Examples of technical significance are:

- Scarcity: Louisiana's coastline represents 90 percent 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 interior swamp habitat by restoring natural flow regimes and using plantings of tree species native to the surrounding area.

- Status and Trends: The study area is exhibiting a decline in habitat. While the project cannot stop the natural processes of sea level rise and subsidence, the project can greatly slow down the disappearance of these landforms by decreasing impoundment and increasing hydrologic connectivity and flushing, as well as sediment and nutrient input within the areas of impact.

- Connectivity: The Maurepas swamp complex is the second largest continuous coastal forest in Louisiana. With the continued conversion of this habitat to marsh and open water, 18,204 acres of freshwater swamp habitat would be converted to marsh and open water. The swamp is also a valuable stopover habitat for neotropical migratory birds.

- Limiting Habitat: The LCA ARDC study area is considered habitat for bald eagles, Gulf sturgeon, and Western Indian manatee.

The Recommended Plan meets the four evaluation criteria specified in the USACE Planning and Guidance.

3.7.11.3 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.

3.7.11.4 Completeness

The plan provides and accounts for all necessary investments and actions to ensure the planned restoration outputs specified in the Recommended Plan. The plan prevents the continued degradation of 1,602 acres of freshwater swamp habitat to marsh and open water over the 50-year period of analysis. Consequently, the project improves the potential for long term survival of the wetland habitat within the areas of impact.

3.7.11.5 Efficiency

The Recommended Plan was identified as cost effective by the IWR Planning Suite analysis.

3.7.11.6 Effectiveness

The plan makes a significant contribution to addressing the specific restoration problems for the swamp habitat surrounding the ARDC. Restoring hydrologic connectivity for the ecosystem will facilitate an increase in sediment and nutrient introduction to the degraded habitat and reduce impoundment. The added connectivity will also increase the flushing action, thereby reducing salinity levels. The Recommended Plan will result in an improved and sustainable ecosystem that provides benefits throughout the 50-year period of analysis of the project.

The LCA 2004 report states that, "Gapping the ARDC will 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 feature would provide nutrients and sediment to facilitate organic deposition in the swamp, improve biological productivity, and prevent further swamp deterioration." While the project will not stop the natural force of sea level rise and subsidence, the project will return hydrologic flow throughout the swamp habitat to its natural state, allowing for the sustainable restoration and regeneration of wetlands within the western Maurepas swamp.

3.7.12 Sustainability

Among the planning criteria utilized in the evaluation of proposed actions in ecosystem restoration projects, the significance and sustainability of ecosystem outputs achieved over the period of analysis are among the most critical. While some solutions provide immediate solutions to problems found within the project study area, the sustainability of benefits achieved leads to a continued solution to natural and man-made causes of habitat degradation. Additionally, a sustainable solution increases the significance of the proposed action as it pertains to significant resources and local and nationwide restoration efforts. Within the LCA ARDC study area, issues such as subsidence and sea level rise provide the potential for long-term reductions in any benefits derived from a proposed action.

As stated in Section 2.3.3.3 of this report, over the 50-year period of analysis, RSLR could potentially reduce the long-term functionality and quality of the freshwater swamp habitat found within the LCA ARDC areas of impact. In order to fully ascertain the impacts of the proposed actions found in the final array of alternatives, an analysis of the sustainability of benefits within each action is required. For planning purposes, the expected benefits for the final array were calculated by the WVA model in the form of AAHUs. A full breakdown of the AAHUs achieved for the final array is found in Section 3.5.2. These benefits represent the average annual benefits observed over the period of analysis at year 50. For the low estimate of RSLR, Alternative 33 (Recommended Plan) is expected to achieve 679 AAHUs by year 50. As shown in Section 3.8, benefits in habitat units will decrease by 7 percent and 10 percent for the intermediate and high RSLR estimates, respectively. Benefits provided by the WVA model for the No-Action alternative and the Recommended Plan, in terms of non-annualized habitat units (HUs) over the 50-year period of analysis are shown in Figures 3.28 and 3.29 and Table 3.19. The net HUs achieved for each RSLR estimate are also shown.

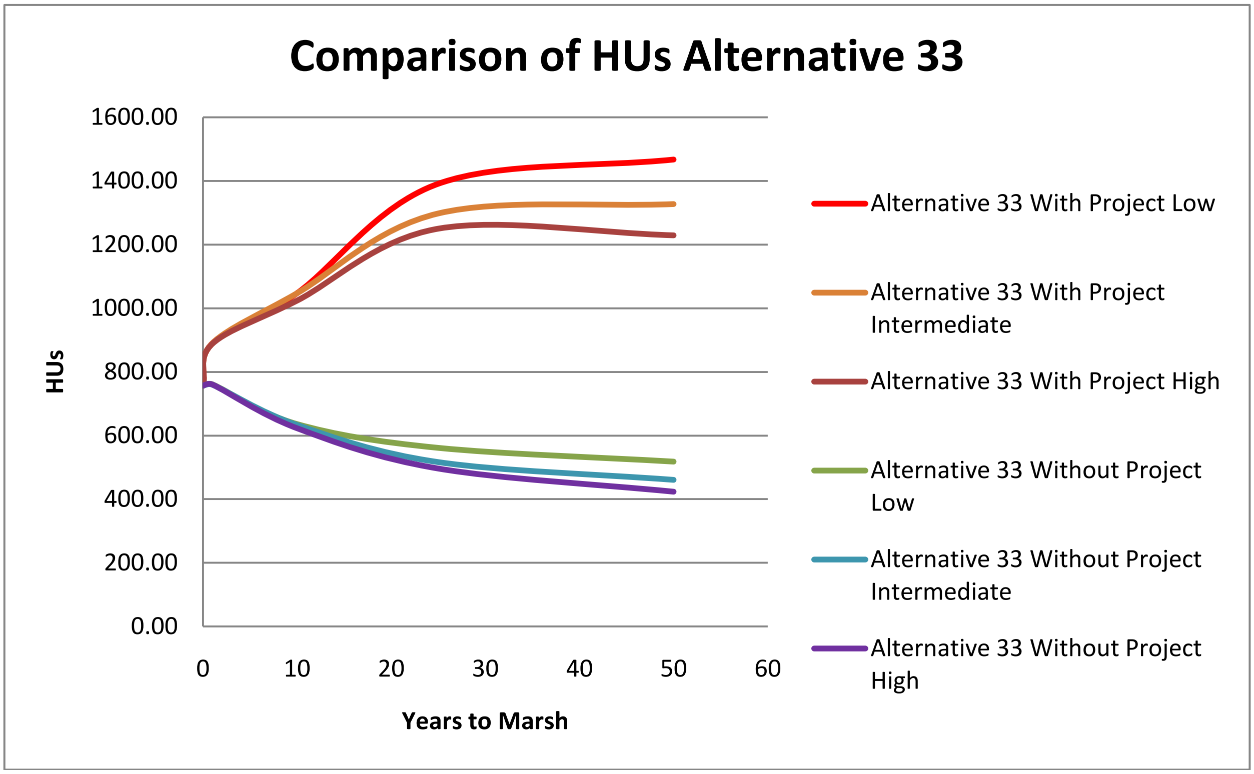


Figure 3.28. Comparison of Habitat Units over the Period of Analysis

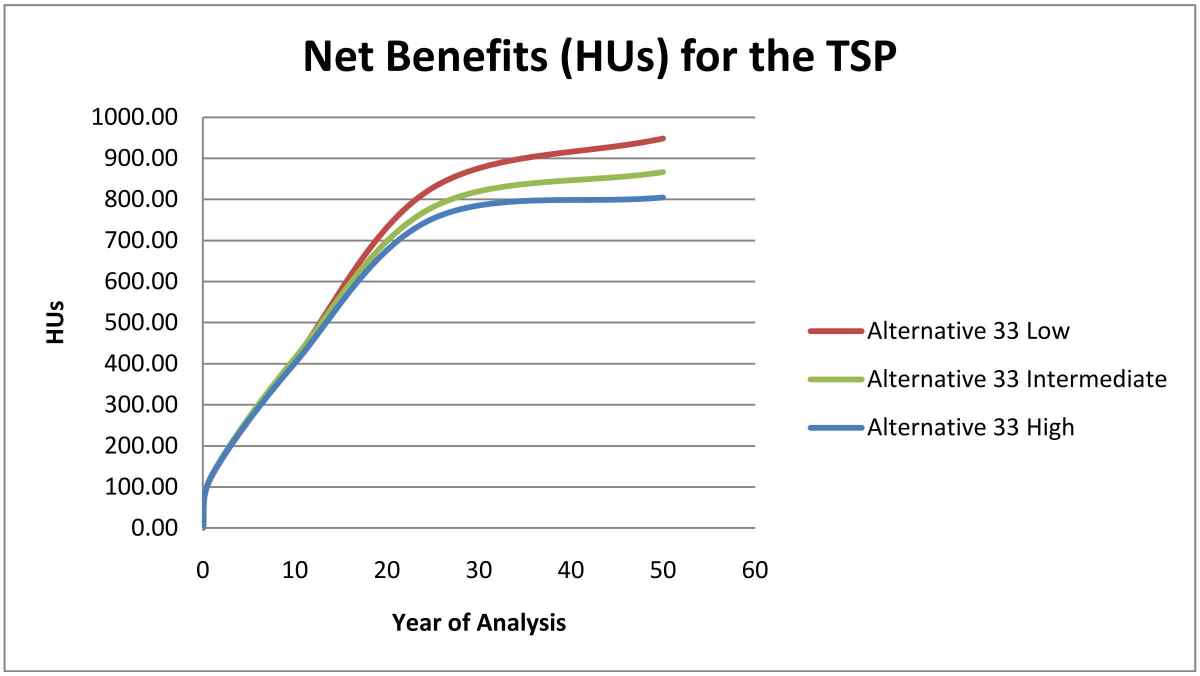


Figure 3.29. Net Benefits Obtained Over Period of Analysis

Table 3.19. Comparison of Habitat Units Obtained from the Recommended Plan Over Period of Analysis

Habitat Units Over Time for the Recommended Plan					
Alternative/RSLR Estimate	**Year of Analysis**				
	0	**1**	**10**	**25**	**50**
No-Action - Low RSLR	757	762	636	562	518
No-Action - Intermediate RSLR	757	761	634	517	461
No-Action - High RSLR	757	761	624	497	425
Alternative 33 - Low RSLR	757	889	1047	1390	1466
Alternative 33 - Intermediate RSLR	757	889	1047	1297	1327
Alternative 33 - High RSLR	757	888	1023	1249	1228
Net Benefits Achieved - Low RSLR	0	127	410	828	948
Net Benefits Achieved - Intermediate RSLR	0	128	413	780	866
Net Benefits Achieved - High RSLR	0	127	400	752	804

The results show that the impacts resulting from RSLR in general are fairly consistent for all estimates of RSLR and appear to begin near year 20 of the period of analysis. Furthermore, for all three estimates of RSLR, the amount of benefits observed appear to stabilize near year 25, with a continued, but gradual increase in benefits over the next 25 years. This is an indicator that the proposed action achieves sustainability for the remainder of the period of analysis, with no reduction in benefits present regardless of the sea level rise scenario realized. It should also be pointed out that after 10 years, the areas of impact will achieve a net of approximately 400 HUs; this substantiates the short-term benefits resulting from the Recommended Plan as well.

The data presented in the above table and figures is representative of a freshwater swamp habitat with restored hydrologic connectivity and increased sediment and nutrient input. This results in increased seed germination, regeneration of native vegetation, and a more sustained and stable freshwater swamp. As shown in Table 3.14 vegetative, hydrologic, wildlife, and fishery resources are benefited by the implementation of the Recommended Plan. Even though RSLR could potentially impact the area over the 50-year period of analysis, benefits are observed in the short-term and maintained in the long-term frames of analysis. It should also be pointed out that accretion, which would increase with added tree growth and canopy, was not included in the analysis of RSLR. It is estimated that the net accretion rate would be 8mm/year, within the healthiest portions of the LCA ARDC study area (Bernard Wood, unpublished data, 2005 through 2009). These net accretion rates account for subsidence, but not eustatic sea level rise. Based on these estimates, accretion rates could reduce the potential impacts of sea level rise within the healthiest portions of the LCA ARDC study area, thereby adding to sustainability.

Approximately 90 percent of the total coastal wetland loss occurring in the Nation is found within Louisiana. The Maurepas Swamp complex is the second largest continuous coastal forest in Louisiana, comprising over 190,000 acres of freshwater swamp habitat. The LCA ARDC study area is an essential ecosystem since it includes wetland habitats and provides high fish and wildlife value as well as habitat for migratory birds and other aquatic organisms including threatened or endangered species. The significance of the ecosystem output plays an important role in ecosystem restoration evaluation according to section E-37 of ER 1105-2-100. The resulting ecosystem sustainability reinforces that all project objectives are achieved and maintained by implementation of the Recommended Plan. This, along with the significance of the resources benefited by this action, adds to the local and national importance of this restoration activity.

3.8 RISK AND UNCERTAINTY

Identification of all risks and uncertainties involved with development and implementation of Alternative 33 (Recommended Plan) help to develop risk management techniques and quantify cost estimate contingencies. The following risks and uncertainties are involved with development, selection, and construction of the Recommended Plan. Regardless of the associated risks, this project has been developed to feasibility-level standards. The risks associated with the project will not impact plan selection or significantly alter the analysis of project benefits and impacts. All risk items associated with the LCA ARDC Modification project may be found in Appendix L.

Modeling Uncertainty. Models such as the WVA allow for the prediction of environmental benefits over periods of time and a range of conditions. However, they are highly dependent on input from existing data and the use of best professional judgment. The uncertainties inherent to the natural processes quantified by these models could affect the results. Relative sea level rise was determined to be the variable with the most uncertainty and therefore, could pose the greatest impact to the modeling results. In an effort to quantify these impacts, the WVA was run for all three levels of RSLR provided by EC 1165-2-211. When compared to the low sea level rise estimate, the results showed a decrease in benefits of 7 percent and 10 percent for the intermediate and high estimates, respectively. Additionally, RSLR and accretion estimates were utilized when developing the input variables for the WVA model as described in Appendix K. While the basis for RSLR and accretion are described in Section 5.2, any inaccuracies inherent to these natural processes would impact the results of the WVA model.

Cost and Schedule Risks. Cost estimates are a key component for the IWR Planning Suite analysis and in choosing a plan. Cost contingencies are included in estimations of cost to help minimize these risks. Cost contingencies are typically determined by a full Cost and Scheduling Risk Analysis (CSRA). Preliminary cost estimates for the Recommended Plan were below $40 million; therefore, a full CSRA is not required for the Recommended Plan, as stipulated in the *USACE Cost and Scheduling Risk Analysis Guidance* (ER 1110-2-1302). However, in an effort to identify the applicable cost and schedule risks inherent with implementation of the Recommended Plan, much of the process found within the USACE guidance was utilized. Once all potential areas of risk were agreed upon by the evaluation team, a Risk Register was created to help qualify and quantify the potential impacts of these risks. A Monte Carlo simulation (random occurrence generator) was run on the registry, which yielded the applicable cost contingency to use for estimating construction costs for Alternative 33 (Recommended Plan). For this study it was determined that the appropriate contingency to use is 59 percent. This cost contingency was applied to all cost accounts associated with the project except monitoring costs, which already contains a contingency cost. The application of the 59 percent contingency to the applicable accounts results in an overall project contingency of 31 percent. Due to the fact that all alternatives within the final array are composed of similar management measures and within areas similar in size and characteristics, it was determined that all risk items formulated in the CSRA would not vary for each proposed action. Additional details on the Cost Risk Analysis are found in Appendix L, Section 10.

Subsidence. Based on guidance provided in EC-1165-2-211, subsidence occurs within the LCA ARDC study area at a rate of 7.5 mm/yr. Subsidence plays a role in the occurrence of RSLR and could increase the impacts of storm surge and salinity spikes, thereby reducing any potential benefits associated with the proposed action. As shown in Section 3.7.12, upon permanent inundation, benefits would be observed throughout the 50-year period of analysis for the Recommended Plan. However, subsidence may limit benefits provided by the proposed action. Biomass accretion associated with healthy freshwater swamp habitat may offset the negative impacts resulting from subsidence and RSLR. Additional discussions on subsidence are located in Sections 2.3.3.2 and 5.2 of this report.

Sea Level Rise. Sea level rise has the ability to affect the coastal regions of the United States and Louisiana in varying degrees. The result of these potential impacts may include losses in project effectiveness, failure to achieve project objectives, and escalating operations, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs. Guidance provided from EC-1165-2-211 estimates these impacts as stipulated in Section 5. Specifically, within the LCA ARDC study area, sea level rise is predicted to increase from 1.5 ft (0.46 m) to 3.2 ft (0.97 m) over the 50-year period of analysis but is not expected to negate project performance or benefits. The risks associated with RSLR were considered in the formulation of all risk items during the CSRA performed for this project. The risk items in which RSLR was considered pertinent include vegetative plantings mortality and inaccuracies in the project scope (i.e., effects of RSLR may inhibit restoration opportunities available to this project).

In order to gauge the effects of RSLR on the recommended plan, the WVA model was run for Alternative 33 (Recommended Plan) and Alternative 39 (NER) over the 50-year period of analysis of the project. The impacts of the intermediate and high sea level rise estimates were added to the analysis in addition to the low estimate, which was run as the base-line condition. The results showed a decrease in benefits (AAHUs) from the low estimate of approximately seven percent when the intermediate estimate was modeled and a decrease of approximately 10 percent with the high estimate. Both alternatives displayed similar results. The results of this analysis may be seen in Table 3.20. More details on sea level rise are found in Appendix L.

Table 3.20. Effect of Relative Sea Level Rise on Alternatives

Effect of Relative Sea Level Rise on Alternatives			
Alternative	**Low SLR (AAHUs)**	**Intermediate SLR (AAHUs)**	**High SLR (AAHUs)**
33	679	640	610
34	589		
35	334		
36	1,268		
37	922		
38	1,013		
39	1,602	1,516	1,452

Additionally, the Hydrologic Engineering Centers River Analysis System (HEC-RAS) model was run with all three estimates of RSLR for the No-Action alternative and the Future With Project conditions (conditions are nearly the same for both swamp areas). The results of these model runs are shown in Table 3.21. Results show that without the project the area will be inundated much sooner than with project conditions. The project is still expected to produce benefits even if it is inundated refer to Section 3.5.2. Additional discussions on sea level rise are located in Sections 2.3.3.3 and 4.2.2.1 of this report.

Table 3.21. Years to Permanent Inundation

RSLR Case	RSLR Year 50	No Action	With Project
Low Rate	1.5 feet	14 years	40 years
Intermediate Rate	1.9 feet	12.5 years	31 years
High Rate	3.2 feet	8 years	17 years

Accretion. Healthy freshwater swamps with an established canopy produce organic buildup, also known as biomass accretion. Accretion produces a net increase in the substrate, effectively raising the elevation of the swamp floor. It is estimated that with a healthy freshwater swamp habitat, the study area could produce 8 mm/yr of biomass accretion (Bernard Wood, unpublished data, 2005 through 2009). Accretion could help offset the effects of subsidence and RSLR, thereby reducing negative impacts and increasing the benefits associated with the proposed action. Additional discussion on biomass accretion is located in Section 5.2 of this report.

Risk of Flooding. According to the H&H modeling it was determined that all proposed actions would have an insignificant reduction in the stage on the Amite River and on the ARDC. The modeling also showed an insignificant increase in stage height within the swamp area, near the proposed openings in the ARDC dredged material berms. It has also been noted that under existing conditions, the interior swamp areas tend to flood during high stage events. The proposed plan features will not restrict flow in the ARDC or in the swamps adjacent to the ARDC. Therefore there would not be an increase in the risk of flooding within the study area. Additionally, increased flood risks would not occur for any nearby businesses and residences as a result of all proposed actions.

Geotechnical Uncertainties. Until a full geotechnical investigation is performed in the PED phase of the project, uncertainties will exist with the assumptions made regarding material placement and slope stability. It is assumed that when material from excavation is placed within the project area, it will be stable enough to create habitat at an elevation sufficient to sustain bottomland hardwood tree species. However, if the material does not maintain the required elevations, a shift in the tree species to be utilized for these plantings will be made to those suitable for a freshwater swamp. Additionally, the stability of channel and placement area slopes will not be known until the full results of a slope stability analysis are completed.

Assumptions. The following assumptions are key to the success of the project:

- The rainfall-driven conditions of the Amite River watershed will remain unchanged; therefore, the hydrologic cycles within the ARDC will also remain unchanged. The current trend suggests conditions will remain unchanged.
- The net effects of local subsidence and sea level rise will not deviate significantly from the numbers estimated for this study. This is based on hydraulic and habitat conditions.
- The conveyance channels would be naturally altered over time but would remain functional, eventually reaching a state of hydrologic stability. This is based on existing natural channels in the study area which have formed under similar conditions.

3.9 IMPLEMENTATION REQUIREMENTS

3.9.1 Schedule

The approximate LCA ARDC milestone schedule for project implementation is shown in Table 3.22. A favorable signed Chief's Report is required by December 31, 2010 to obtain authorized construction funding.

Table 3.22. LCA ARDC Milestone Schedule

Milestone	Baseline Date
Final Report	August 2010
Division Engineers Notice	August 2010
Washington Level Reviews	August 2010
State and Agency Review	October 2010
Sign Chief's Report	December 2010
ASA(CW) and OMB Review	2011
ASA(CW) Reports to Congress	2011

The remaining requirements for the LCA ARDC FS/SEIS, and modification project implementation schedule are shown in Table 3.23. Design Considerations were previously discussed in Section 3.7.2.

Table 3.23. LCA ARDC Modification Project Implementation Schedule

Milestone	Baseline Date
Begin Pre Construction Engineering and Design	2010
Initiation of Monitoring Program	2010
USACE and non-Federal sponsor negotiate PPA	2012
Complete Plans and Specifications	2012
Real Estate Acquisition	2012
Award Contract	2012
Construction Start	2012
Complete Construction- Earthwork	2012
Complete 1st Vegetation Planting	2015
Complete 2nd Vegetation Planting	2018
Turnover Project to Local Sponsor	2018
Complete Monitoring Program	2023

3.9.2 Implementation Responsibilities

This project was authorized for construction by the Water Resources Development Act of 2007, contingent upon a signed Chief of Engineers Report by December 31, 2010. After a signed Chief's report, this project would be eligible for construction funding. 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, amount of local public support, willingness of the non-Federal sponsor to fund 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). This PPA would define the Federal and non-Federal responsibilities for implementing, operating, and maintaining the project. The project is expected to begin Pre construction Engineering and Design in late 2010 and begin construction in 2012 (see Table 3.22).

The Corps would officially request the sponsor to acquire the necessary real estate immediately after signing the PPA. The advertisement of the construction contract would follow the certification of the real estate. 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. The estimated schedule for project construction is shown in Table 3.23.

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 Amite River Diversion Canal Modification 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 percent Federal and 50 percent 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 percent Federal and 35 percent 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 percent CPRA responsibility.

Table 3.24 shows the cost apportionment for the Recommended Plan.

Table 3.24. Cost Apportionment for the Recommended Plan

Item	Federal	Non-Federal	Total
Construction	$3,070,000	$1,380,000	$4,450,000
S&A	$261,000	$140,000	$401,000
PED	$347,000	$187,000	$534,000
LERDDs	$0	$180,000	$180,000
Monitoring	$1,930,000	$1,040,000	$2,970,000
Total*	$5,610,000	$2,930,000	$8,540,000

S&A – Supervision and Administration (Construction Management).
PED – Planning, Engineering, and Design.
LERRD – Lands, Easements, Rights-of-Way, Relocations, and Disposal Areas.
* Fully funded cost estimate includes interest during construction.

Additionally, project monitoring and any Adaptive Management deemed necessary will be cost shared at 65/35 for the first 10 years of the period of analysis.

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.

3.9.4 Environmental Commitments

The USACE, non-Federal sponsor, and all contractors would commit to following all laws and executive order, and to avoid and minimize adverse impacts to the environment by the following:

- Employ necessary Best Management Practices (BMPs) to reduce erosion and sedimentation during construction. The Plans and Specifications would include such BMPs and erosion control measures as necessary. The Contractor would be required to develop a Storm Water Pollution Prevention Plan (SWPPP) that would be coordinated through the Louisiana Department of Environmental Quality (LDEQ).
- The Contractor would be made aware of any practices or measures need to be compliant with the Endangered Species Act (ESA).
- The Contractor would be made aware of any practices or measures to protect cultural resources.
- The USACE and the non-Federal Sponsor agree to maintain coordination with the U.S. Fish and Wildlife Service (USFWS) and the LDEQ to ensure compliance with all laws and executive orders.

The Contractor would be prohibited from dumping oil, fuel, or other hazardous substances and would require that all appropriate sanitation measures are followed. The Contractor would be to develop a Spill Prevention Control and Countermeasure plan (SPCC).

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 financial analysis will be conducted to assess the CPRA's capability to financially participate in the Recommended Plan. A standard cost share percentage of 65 percent Federal and 35 percent non-Federal would be applied to the total first cost of the project. The 35 percent share of the project cost includes the State of Louisiana’s responsibility for providing all LERRDs.

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 ARDC 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 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 LCA6, (Attachment 1) CPRA, the non-federal sponsor, has expressed the desire for implementing the LCA Amite River Diversion Canal Modification project and sponsoring the project construction in accordance with the items of local cooperation that are set forth in the recommendations chapter of this report. In addition, CPRA supports the NER plan (Alternative 39) since this plan includes all of the most critical areas within the Maurepas Swamp basin, establishes the greatest amount of hydrologic connectivity of all of the alternatives, is cost-effective while providing the most benefits, and is a best-buy plan. However, due to authorized cost limitations in WRDA 2007, CPRA supports Alternative 33 as the Recommended Plan. CPRA believes the project warrants additional Congressional authorization to increase funding and allow the implementation of the NER plan (Alternative 39) to fully address the Maurepas Swamp's ecosystem needs identified in this report.

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.

4.0 AFFECTED ENVIRONMENT

4.1 ENVIRONMENTAL SETTING OF THE STUDY AREA

This section describes the climate, geomorphic and physiographic setting, and the historic and existing conditions for the following important resources: soils and waterbottoms, coastal vegetation, wildlife, fisheries, plankton, benthos, essential fish habitat (EFH), threatened and endangered species (T&E), hydrology (including flow and water levels, and sedimentation), water quality, recreation, cultural and historic resources, aesthetics, air quality, socioeconomic and human resources (including population, infrastructure, employment and income, navigation, oil and gas resources, utilities, pipelines, commercial fisheries, oyster leases, flood control, and hurricane protection), noise and Hazardous and Toxic and Radioactive Wastes (HTRW).

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 Louisiana Coastal Area Amite River Diversion Canal (LCA ARDC) study area.

4.1.1 Location

The LCA ARDC study area (Figures 1.2 and 1.3) is located along the ARDC in Ascension and Livingston Parishes, in the vicinity of Head of Island, Louisiana. The study area is bounded to the north by the old channel of the Amite River, Old River, Chinquapin Canal and Bayou Chene Blanc; to the east by the Blind River; to the south by the Petite Amite River and the New River Canal; and to the west by the Sevario Canal, Ascension Parish flood protection levees, and the Laurel Ridge Canal.

4.1.2 Climate

The climate of the study area is subtropical marine with long humid summers and short moderate winters. The climate is strongly influenced by the water surface of many sounds, bays, lakes and the Gulf of Mexico and seasonal changes in atmospheric circulation. During the fall and winter, the study area experiences cold continental air masses which produce frontal passages with temperature drops. During the spring and summer, the study area experiences tropical air masses which produce a warm, moist airflow conducive to thunderstorm development (LACPR, 2009). The study area is also subject to periods of both drought and flood, and the climate rarely seems to truly exhibit “average” conditions.

The study area is susceptible to tropical waves, tropical depressions, tropical storms, and hurricanes. These weather systems can cause considerable property and environmental damage and loss of human life. Historical data from 1899 to 2007 indicate that 30 hurricanes and 41 tropical storms have made landfall along the Louisiana coastline (NOAA, 2009). The largest recent hurricanes were Katrina and Rita in 2005, which caused extensive devastation in south Louisiana and some damage in the study area. Hurricane Gustav, while much smaller and less intense, caused additional damage in the study area in 2008. Hurricane Ike, which made landfall in Galveston, Texas in 2008, caused flooding and wind damage in coastal areas as it passed the LA Coast.

The 1955 USACE *Survey of Amite River and Tributaries, Louisiana* provides historical climate and meteorological data for the lower Amite River Basin, which includes the study area. Average minimum and maximum temperatures and rainfall, over the period of record (POR), is provided in the survey. The minimum and maximum temperatures from 1901 through 1953 for Reserve, Louisiana, located 10 miles from the study area, are 15 and 100 degrees Fahrenheit, respectively. The average temperature for the same POR is 70 degrees Fahrenheit. The survey also identified 10 rainfall stations in the lower Amite River Basin (a subset of the temperature stations with approximately the same PORs), also ranging from 10 to 70 miles from the study area. Minimum and maximum annual rainfall values for Reserve were reported as 34.1 and 84.3 inches, respectively. The average rainfall for Reserve during the same POR was 61.6 inches.

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, or location of the proposed action, as well as determine the impacts that the proposed action would have on other important resources.

The study area is located in the Maurepas Basin, a component of the Lake Pontchartrain Basin, which is located near the southern terminus of the Mississippi Alluvial Plain physical province. The most significant geologic features in the basin are Lakes Maurepas and Pontchartrain. These lakes occupy a portion of the St. Bernard Delta complex, one of the oldest deltaic complexes within the Mississippi Deltaic Plain Region. The St. Bernard Delta complex formed in what was then Pontchartrain Bay, enclosing a portion of the bay to form Lake Pontchartrain. The Open-File Report 98-36 (1998) describes the St. Bernard Delta complex as a distinct physiographic unit, formed by Mississippi River deposits between 700 and 4,700 years ago. The majority of the remaining surface features within the St. Bernard Delta complex 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.

Holocene deposits in the St. Bernard Delta complex typically overlay Pleistocene alluvial terrace deposits of fine grained sands and silts derived from alluvium deposited by the proto-Mississippi and other coastal river systems during recent sea level lowstand intervals. Holocene and Pleistocene deposits are underlain by approximately 34,000 feet (ft) of sediment and sedimentary rock. Sandstone, siltstone, and claystone account for virtually all the sedimentary rocks. These sediments record the outward progression of the Gulf Coastal Plain, and in the case of Pleistocene sediments, the outward building of the Mississippi and proto-Mississippi River Complex.

Construction of the Amite River and Tributaries (1956) flood control project, which includes the ARDC, has impacted the natural geomorphology and hydrology of the St. Bernard Delta complex. Hydrologic analyses within the study area indicate that the ARDC and its associated dredged material berms have hydrologically isolated the study area, thereby preventing the adjacent bald cypress-tupelo swamp habitat from receiving nutrient and sediment-laden floodwaters during high channel flow events and have prevented the adjacent swamps from draining during low channel flow events in the lower Amite River system. Further details behind the geomorphic setting related to the LCA ARDC project are located in Appendix L of the report. Additionally, biomass accretion rates are discussed in Sections 2.3.3.2 and 5.2 of the report.

4.2 SIGNIFICANT RESOURCES

4.2.1 Soils and Waterbottoms

Soils are institutionally significant because of the Center for Environmental Quality memorandum of August 11, 1980, entitled "Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act (NEPA);" EO 11990 – Protection of Wetlands; and Agriculture and Food Act of 1981 (Public Law 97-98) containing the Farmland Protection Policy Act (FPPA) (Public Law 97-98; United States Code [U.S.C.] 4201 *et seq*.). This resource is technically significant because it is a critical element of coastal habitats, supports vegetation growth and benthic productivity, and influences the types of land use within a given area. This resource is publicly significant because of the high value the public places on wildlife and fisheries supported by the soils in the area.

Soils and waterbottoms are institutionally significant because of the NEPA of 1969; the Coastal Zone Management Act; and the Estuary Protection Act. They are technically significant because the bottom of an estuary regulates or modifies most physical, chemical, geological, and biological processes throughout the entire estuarine system via what is called a "benthic effect." Benthic animals are directly or indirectly involved in most physical and chemical processes that occur in estuaries (Day *et al*., 1989). Waterbottoms are publicly significant because of their habitat value to members of the epibenthic community (e.g., oysters, mussels, etc.) that utilize estuarine waterbottoms and provide commercial and recreational fisheries.

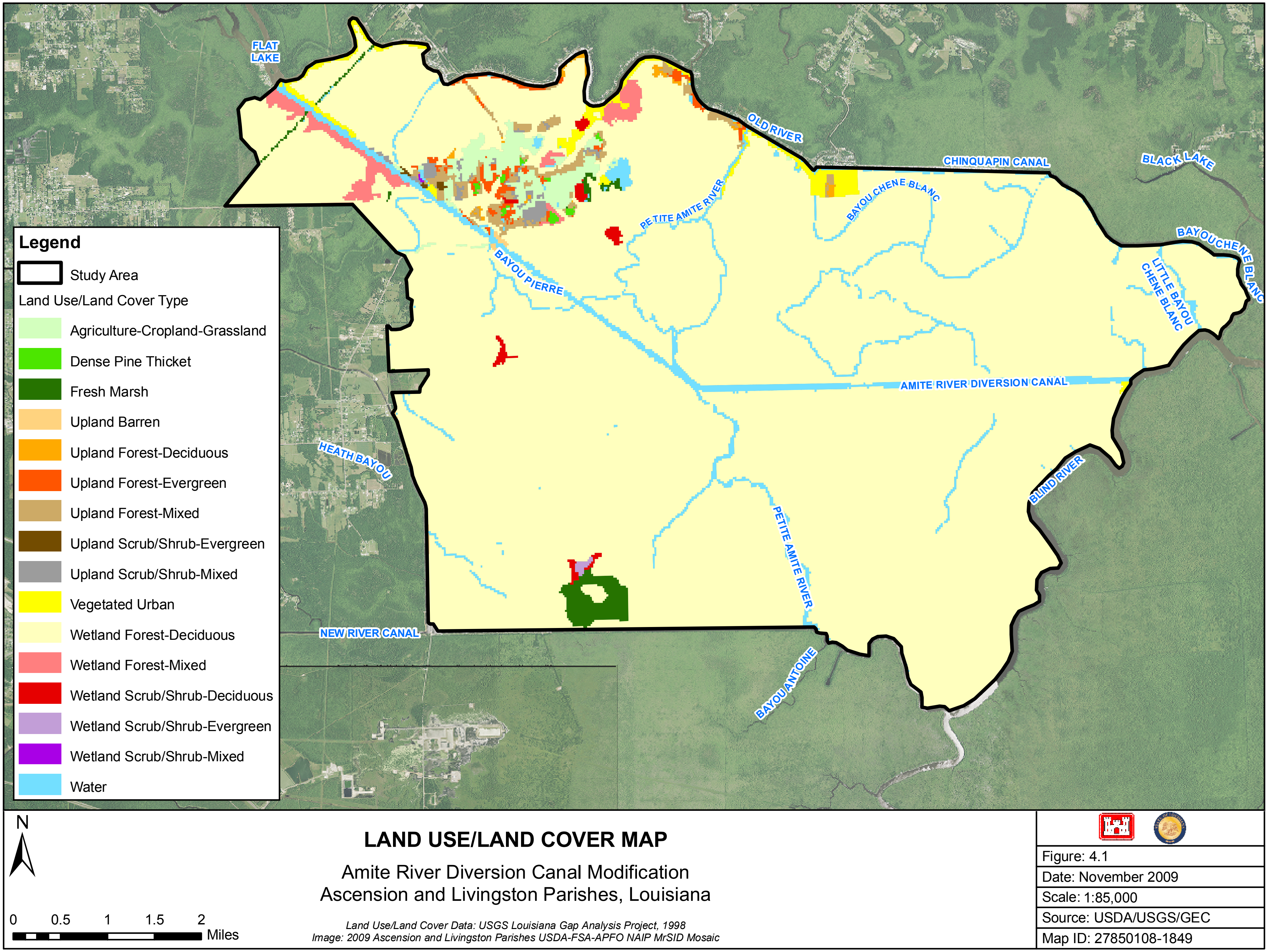
4.2.1.1 Soils

Deltaic processes have played a significant role in the types of soil present in the LCA ARDC study area. The dynamic and episodic deltaic building processes alternate between periods of seaward progradation of deltas (regressive deposition) and the subsequent landward retreat of deltaic headlands as deltas are abandoned, reworked, and submerged by marine waters (transgressive deposition). The types of soils present today in much of the LCA ARDC study area are characterized by the depositional environments associated with both phases of the deltaic cycle.

Historic Conditions. There has been a conversion of 1,600 acres of freshwater swamp habitat to marsh and open water in the Amite and Blind River mapping units between 1932 and 1990 (Louisiana Coastal Wetlands Conservation and Restoration Task Force [LCWCRTF] and Wetland Conservation and Restoration Authority [WCRA], 1999).

Existing Conditions. National Resource Council (NRC) data indicate that 19 soil types are found within the LCA ARDC study area (Figures 4.1 and 4.2, Natural Resources Conservation Service [NRCS], 1976, 1991). Soils within the LCA ARDC study area are typically hydric clays or mucks that are frequently or continuously flooded (NRCS, 1976, 1971). Soils in the Barbary series comprise a majority (62 percent) within the LCA ARDC study area, and substantial quantities of soils within the Maurepas series (12 percent) are also present.

Soil loss is continuing due to natural and man-made causes, particularly in the Barbary, Fausse, and Maurepas soils. As a result, swamp and wetland forests have deteriorated and become increasingly stressed. Die back of the swamp vegetation has contributed to the conversion to freshwater marsh. As marsh fragments, small islands of floating marsh can develop. Floating marsh (flotant) is vulnerable to degradation and is considered the most fragile, with respect to catastrophic storm events, of all marsh types. Due to degradation and decreased productivity, soil accretion is insufficient to offset regional subsidence and the degraded swamp habitat is consequently susceptible to conversion to fresh marsh or

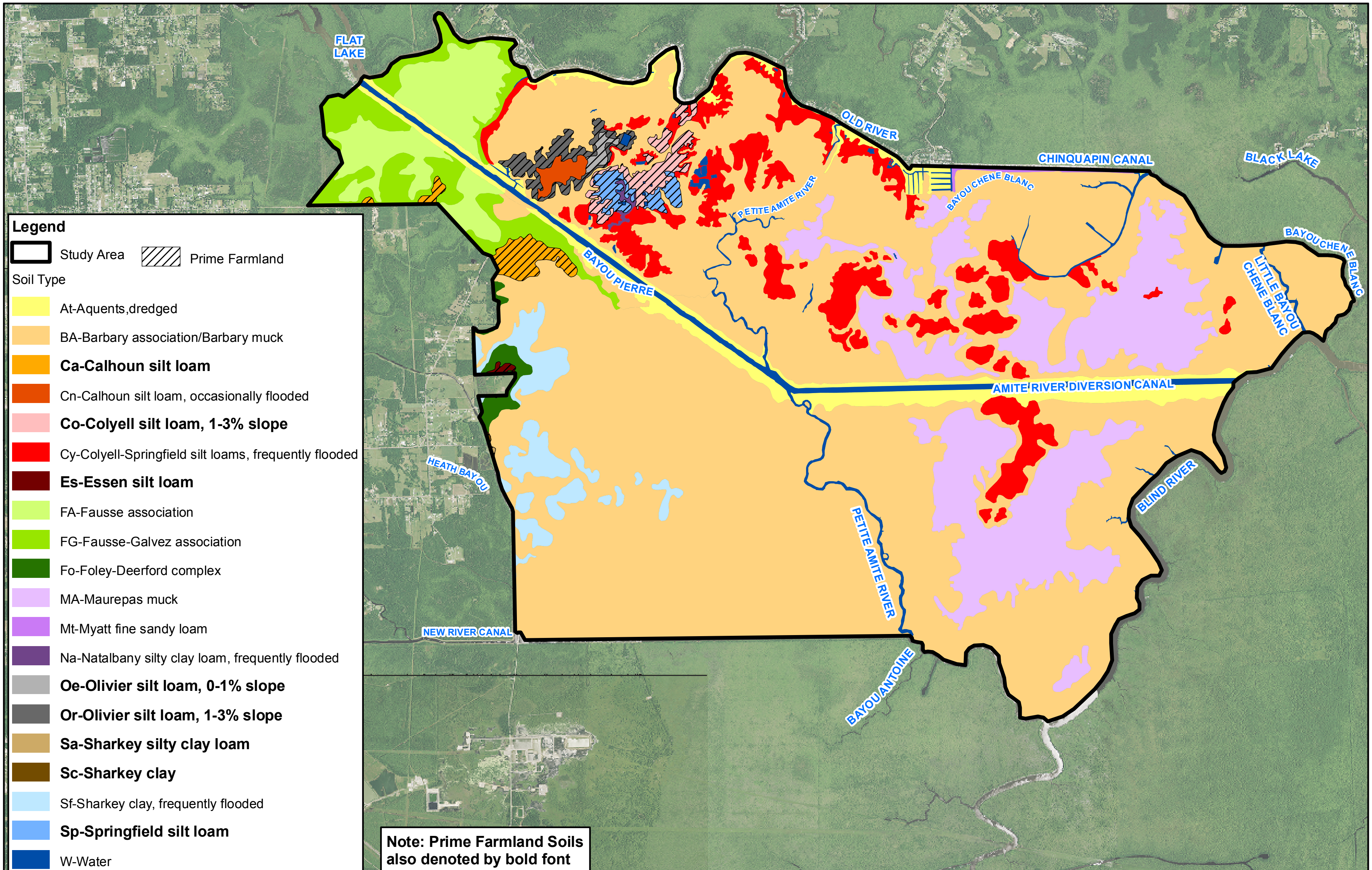


LAND USE/LAND COVER MAP

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Land Use/Land Cover Data: USGS Louisiana Gap Analysis Project, 1998
Image: 2009 Ascension and Livingston Parishes USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 4.1
Date: November 2009
Scale: 1:85,000
Source: USDA/USGS/GEC
Map ID: 27850108-1849



SOILS MAP

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Ascension and Livingston Parishes USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 4.2	
Date: November 2009	
Scale: 1:90,000	
Source: USDA/NRCS/GEC	
Map ID: 27850108-1848	

open water. According to guidance form EC-1165-2-211, the subsidence rate for the project area has been calculated to be 7.5 mm/yr (USACE 2009).

Prime and Unique Farmlands. In an effort to identify the extent and location of important farmlands, 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 United States Department of Agriculture (USDA) defines *prime farmland* soil as land with the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops that is available for these uses. Prime farmland generally has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks (USDA 2006). Some soils identified as prime farmland require measures that overcome hazards or limitations such as flooding or excess wetness or drought.

Unique farmland is land other than prime farmland that is used for the production of specific high-value food and fiber crops, such as citrus, tree nuts, olives, cranberries, and other fruits and vegetables (USDA NRCS, 1993). It has the special combination of soil quality, growing season, moisture supply, temperature, humidity, air drainage, elevation, and aspect needed for the soil to economically produce sustainable high yields of these crops when properly managed. The water supply is dependable and of adequate quality. Nearness to markets is an additional consideration. Unique farmland is not based on national criteria, and commonly occurs in areas where there is a special microclimate. *Additional Farmlands of statewide importance* nearly meet the criteria for prime farmland, and economically produce high crop yields when treated and managed according to acceptable farming methods.

A recent trend in land use in some areas has been the loss of prime farmland to industrial and urban areas. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, susceptible to drought, less productive, and cannot be easily cultivated. As a result of a substantial decrease in the amount of open farmland, the FPPA was put forth by Congress. In the statement of purpose, Federal programs which contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses would be minimized. It follows that Federal programs shall be administered in a manner that, as practicable, would be compatible with state, local government, and private programs and policies to protect farmland.

Eight soils within the LCA ARDC study area are classified as prime farmland. These soils (Calhoun silt loam; Colyell silt loam; Essen silt loam; Olivier silt loam, 0-1 percent slopes; Olivier silt loam, 1-3 percent slopes; Sharkey silty clay loam; Sharkey clay; Springfield silt loam) comprise a total of approximately 749 acres (three percent) of soils within the LCA ARDC study area (See Figure 4.2). Prime farmland soils within the LCA ARDC study area are generally confined to agricultural areas in the vicinity of LA Highway 22 (LA-22).

4.2.1.2 Waterbottoms

Historic Conditions. Historically, swamp waterbottoms in the LCA ARDC study area were typically subjected to flooding and drying events. Construction of the ARDC (1956) and the Chinquapin Canal (constructed in the early 1960s) increased the amount of available waterbottoms. However, sidecast of the dredged material from constructing the ARDC and Chinquapin canal has restricted hydrologic connectivity thereby impounding and permanently flooding large portions of the swamp habitats in the LCA ARDC study area.

Swamps have been shown at times to be both sources and sinks of nutrients, particularly nitrogen. Phosphorus, however, is typically the limiting nutrient which is attributed to excessive algal growth (blooms). Little phosphorus appears to be retained in swamp vegetation, but instead is retained in the sediments. As long as sediment mobilization remains low, phosphorus export should remain low (Mitsch and Gosselink, 2000). Nitrogen is largely reduced by denitrification, but can also undergo substantial reductions via burial in subsiding sediments (Lane *et al.*, 2003). According to Mitsch and Gosselink (2000), organic matter is utilized primarily through detrital pathways, but decomposition can be impeded by anaerobic conditions. Mitsch and Gosselink (2000) point out that little detritus material is exported from the still water or slow-flowing swamps. However, detritus export can be significant from lake edge and river swamps.

Existing Conditions. Waterbottoms in the LCA ARDC study area are associated with the existing waterways and channels, including the ARDC, bayous, canals, and creeks, and are also in open water areas within the swamp. Portions of the swamp are impounded by dredged material berms along the ARDC and maintain higher-than-normal water levels.

4.2.2 Hydrology

This resource is institutionally significant because of NEPA; Clean Water Act (CWA); 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 EO 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 LCA ARDC study area is located within the Pontchartrain Basin, a 9,700-square-mile drainage basin in southeastern LA. Three major estuarine lakes, Lakes Maurepas, Pontchartrain, and Borgne, each form a subbasin of the greater Pontchartrain Basin. The LCA ARDC study area is located within the Maurepas subbasin and the Amite River and Blind River watersheds. The combined Amite River and Blind River watersheds are approximately 2,200 square miles. Most of the LCA ARDC study area is in the Blind River watershed and most of this watershed is the Lake Maurepas swamp. Storm water runoff in the LCA ARDC study area is dominated by the Amite River. The Amite River watershed is approximately 1,842 square miles and a third of this watershed is in the State of Mississippi. Additionally, the LCA ARDC study area is hydrologically independent of the LCA Small Diversion at Convent/Blind River study area.

4.2.2.1 Flow and Water Levels

Historic Conditions. Historically, hydrology within the LCA ARDC study area was dominated by overbank flows from the Mississippi and Amite Rivers. The construction of flood control projects, most notably the AR&T (1956) project, which includes the ARDC, largely isolated bald cypress-tupelo swamp habitat within the LCA ARDC study area from natural waterbodies and effectively ended overbank flooding from the Mississippi and Amite Rivers. The LCA ARDC study area is a rural and relatively lightly inhabited coastal wetland forest area that contains potable water resources. Sources of fresh groundwater in the LCA ARDC study area and vicinity include the Chicot Equivalent Aquifer, the Evangeline Equivalent Aquifer, and the Jasper Equivalent Aquifer.

Historically, hydrologic conditions within the LCA ARDC study area were dominated in the north and west by the Amite River, in the south by overbank flow from the Mississippi River, and in the east by tidal influence from Lake Maurepas. Periodic flooding of the Amite River and/or Mississippi River resulted in the inundation of the LCA ARDC study area. Flooding occurred annually, with peak water elevations in the late spring or early summer. As floodwaters receded, surface waters in the LCA ARDC study area were conveyed eastward via sheet flow until they were received by Bayou Chene Blanc or the Blind River, by which they were conveyed to Lake Maurepas. Further hydrology and hydraulic information is provided in Appendix L.

Implementation of flood control projects, beginning in the early 19th century and culminating in the Mississippi River and Tributaries (MR&T) (1928) and AR&T (1956) Federal flood control projects disrupted the natural hydrologic regime within the LCA ARDC study area. River channelization and levee construction reduced overbank flooding in the LCA ARDC study area, which in turn reduced the influx of floodwaters bearing high volumes of nutrients and sediment that are essential for biomass production and soil accretion. Additionally, the placement of dredged material along either side of the ARDC disrupted sheet flow within the LCA ARDC study area and prevented the drainage of the swamp during intervals of low surface flow (Shaffer *et al.*, 2006). These dredged material berms, in conjunction with other constructed improvements, such as the relict railroad grade that crosses the eastern LCA ARDC study area from north to south, permanently impounded some of the swamps within the LCA ARDC study area.

Sea level Rise. Eustatic sea level refers to the global fluctuations in sea level primarily due to changes in the volume of major ice caps and glaciers, and expansion or contraction of seawater in response to temperature changes. Past studies based on worldwide tide gauges estimate the rate of eustatic sea level rise at 1.2 mm/yr (Gornitz *et al.*, 1982). Additional studies have estimated between 3 to 5 mm/yr (Penland *et al.*, 1990). More recent studies have predicted an increase in this rate to 1.7 mm/yr for the next 100 years due to climate change (EC 1165-2-211).

The entire Louisiana coastal zone is experiencing relative sea level rise, the net effect of eustatic sea level rise coupled with numerous processes that result in a downward movement of the land surface relative to sea level. Vertical land movement along the Louisiana coast is controlled by several major factors, including compaction and faulting. Past studies have indicated a relative sea level rise rate from 5 to 9 mm/yr within the Maurepas Swamp area (Penland *et al.*, 1990).

In addition to eustatic sea level rise, EC 1165-2-211 provides procedures for incorporating vertical land movement into the analysis. Relative sea level rise (RSLR) is obtained by incorporating the eustatic sea level rise with vertical land movement. A historic rate considered to be representative of the LCA ARDC study area is calculated using the West End at Lake Pontchartrain gage (85625). Daily stage data over the period 1959 to 2009 indicate a rate of 9.20 mm/yr (0.0302 ft/yr; see Figure 4.3). The standard error of the linear trend line is 0.65 ft.

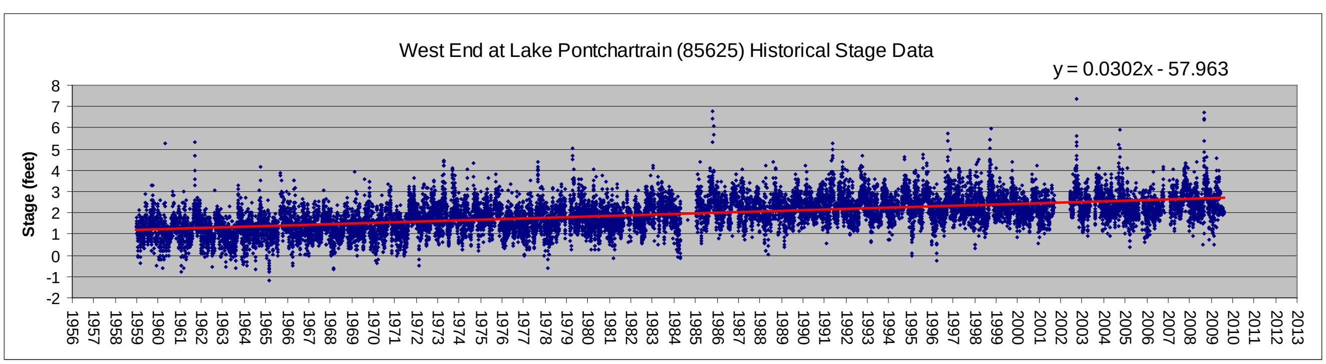


Figure 4.3. Plot of Historic Rate from Daily Stage Data

Existing Conditions. The LCA ARDC study area is located within the Lake Maurepas watershed of the Pontchartrain Basin. The principal hydrologic influence on the basin is that of Lake Maurepas. Surface water flow within the basin is generally from west to east to Lake Maurepas during most normal conditions. However, strong east winds can push water from Lakes Pontchartrain and Maurepas into the Lower Amite River system (Hsu *et al.,* 1997). Principal surface flow conduits in the LCA ARDC study area include the ARDC, the Amite and Petite Amite Rivers, and Blind River, into which the flow from other waterbodies is ultimately received and conveyed to Lake Maurepas. From Lake Maurepas surface waters are conveyed eastward through Pass Manchac, North Pass, or gaps in the Manchac Land Bridge to Lake Pontchartrain, from which they are conveyed eastward to the Gulf of Mexico via Chef Menteur Pass or the Rigolets and Lake Borgne.

Hydrologic flow patterns in the southwestern Maurepas Swamp were modeled in support of Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) Project PO-29, *Mississippi River Reintroduction into Maurepas Swamp* (Day *et al.*, 2004; URS, 2007). Physical hydraulic and hydrologic processes in the Maurepas Swamp, including channel flow, propagation of tidal signals, overbank flow, flow through bank gaps, and swamp circulation, were assessed under a variety of conditions during this modeling effort. The results of these investigations indicate that Lake Maurepas exerts a significant influence on stage levels within the lower Amite River and Blind River systems.

The swamp habitat along the left descending bank of the ARDC in subunits NE-1 and NE-2 is impounded (Shaffer *et al.*, 2006) (Figure 4.4). Figure 4.5 presents water surface elevation for a gages within NE-1, NE-2, along with three USGS gauges located within or near the study area. A map depicting the location of these gauges may be found in the H&H report in Appendix L, Section 2, Figure 2.2 of this report. During the study period, water levels within this area never receded below 2.2 ft above sea level; even during periods in which water levels within the canal receded below this level.

Within the eastern portion of the LCA ARDC study area, the swamps adjacent to the right descending bank of the ARDC exhibit a lack of hydrologic connectivity as well. The resulting lack of water flow between the ARDC and the adjacent swamp inhibits the exchange of sediments and nutrients within the swamp, which is vital to tree regeneration and growth.

Swamp impoundment does not appear to occur in the western portion of the LCA ARDC study area. Numerous drainage culverts were observed within the dredged material berms in these areas during field investigations, particularly in the portions of the LCA ARDC study area located in Ascension Parish. Additionally, several small gaps were constructed in the dredged material berms in this area, and the confluence of Bayou Pierre with the ARDC provides additional hydrologic exchange between the ARDC and the adjacent swamp. Most of these hydrologic conduits are located northwest of the LA Highway 22 Bridge.

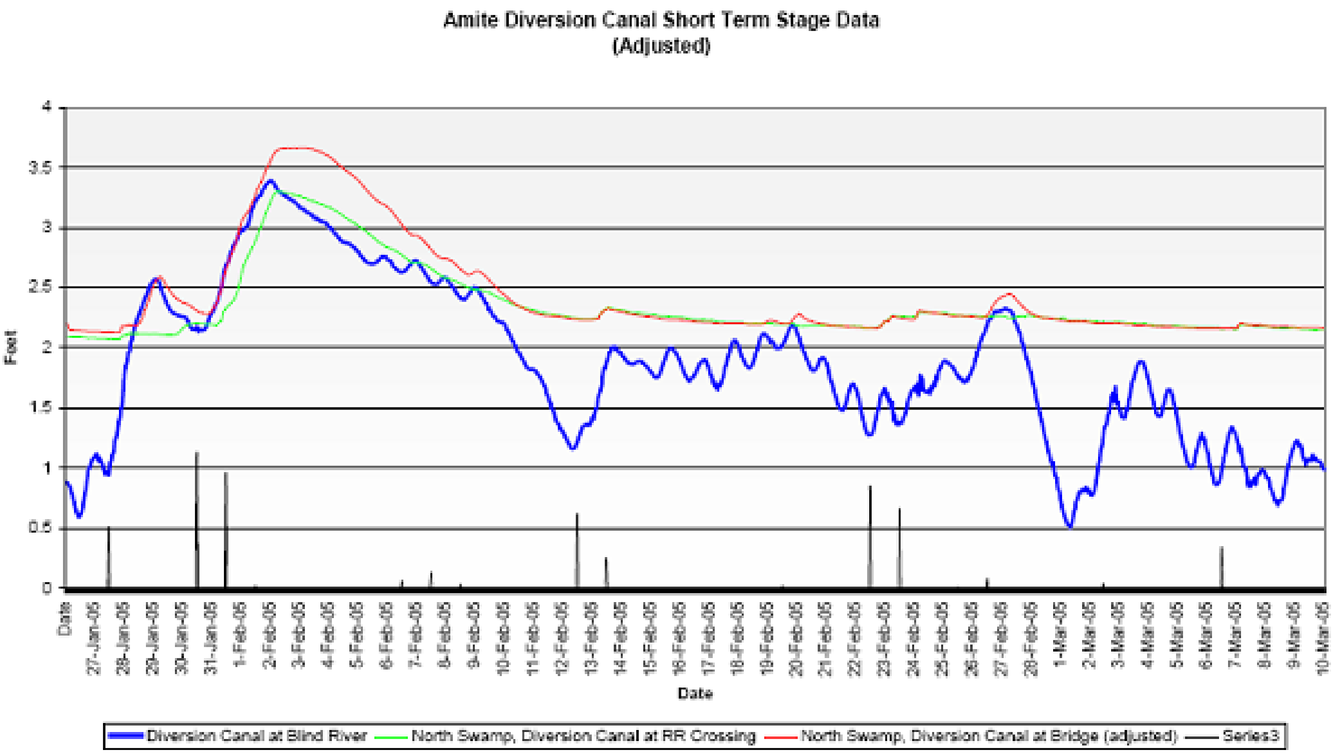


Figure 4.4. Hydrograph of Water Levels Obtained from Louisiana Department of Natural Resources (LDNR) Gauges in the LCA ARDC Study Area (Source: Shaffer *et al.,* [2006])

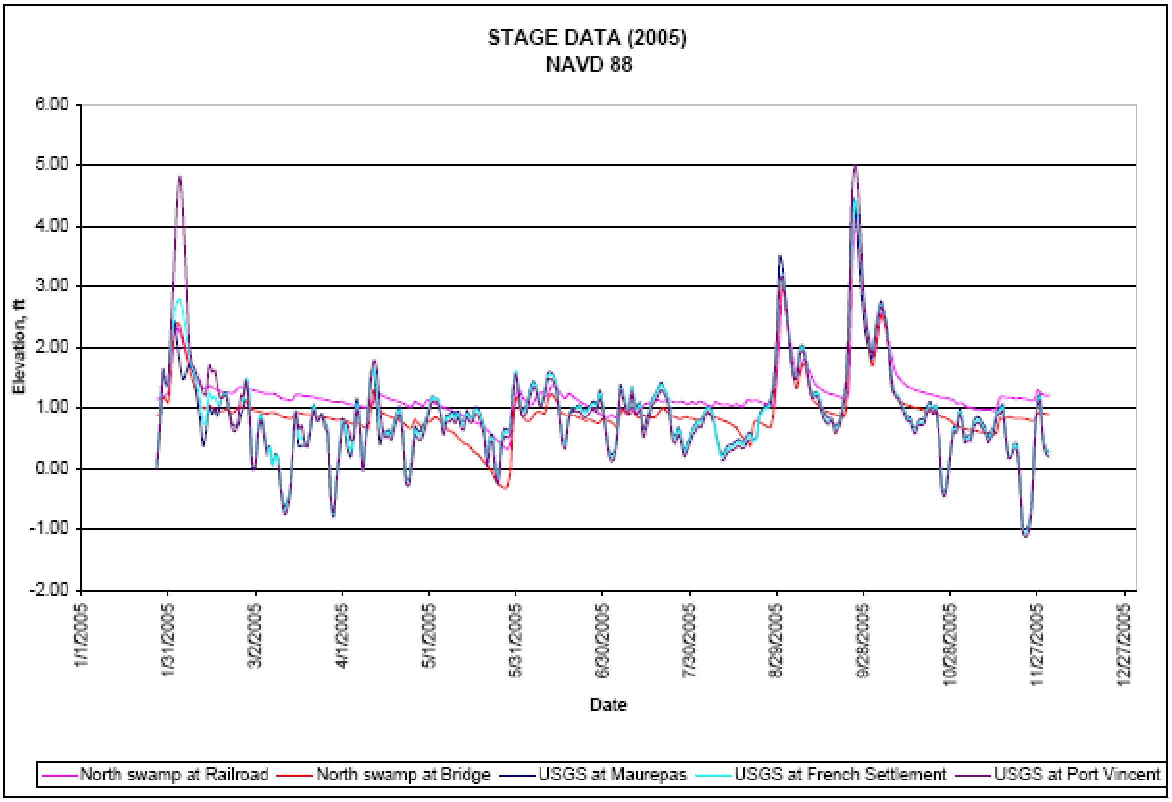


Figure 4.5. Water Surface Elevations at the North Swamp at the Railroad Grade and North Swamp at the Bridge in North American Vertical Datum (NAVD) 88(2006.81) and Three U.S. Geological Survey (USGS) Gauges

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 (Louisiana Department of Environmental Quality [LDEQ], 2007). Aquatic sediments are essential in maintaining the structure (assemblage of organisms) and function (processes) of aquatic ecosystems (LDEQ, 2007). Sediment quality is significant because sediments support community productivity (LDEQ, 2007). The productivity of green plants, algae, and bacteria build the foundation of food webs upon which higher aquatic organisms depend. Sediments provide essential 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 (LDEQ, 2007). Additionally, many fish and amphibian species utilize sediments at stages in their life cycles for the purposes of spawning, incubation, refuge, and over-wintering (LDEQ, 2007).

Historic Conditions. In addition to contributions from erosion and tropical storms, the Amite River is, and the Mississippi River and the Amite River were, the primary sources of sediment input into waterbodies within the LCA ARDC study area. The northern 30 miles of the Amite River in Louisiana, i.e., from the Mississippi state line to LA hwy 37 in Grangeville, is recognized as one of 15 waterbodies impaired by excess sediments in Louisiana (LDEQ, 2006). Fish and wildlife habitat has been directly degraded with significant loss of shoreline and aquatic habitat in this reach. This degradation is believed to have been caused by urbanization, sand and gravel mining, erosion, shallower water, faster flow, higher water temperature, increased turbidity, and agricultural/forestry practices over the last 50 years (LDEQ, 2006). This sediment impairment in the river has caused higher river stages downstream. The soil erosion rate for the Upper Amite River Basin has been calculated to be 5.42 ton/acre/year, producing a sediment load of 0.103 kg/m^3 to the Amite River (Mishra, 2005). There is a decreased redistribution of sediment into some of the swamps due to the dredged material berms of the ARDC.

Existing Conditions. The Blind River, which bounds the LCA ARDC study area to the southeast is the receiving water for the ARDC flow before discharging to Lake Maurepas, is listed on the 2006 303(d) list of impaired waterbodies as being impaired by excess sediments from the source to the outfall at Lake Maurepas (LDEQ, 2006). Sediment Total Maximum Daily Loads (TMDL), as well as a nutrient TMDL, is also required by the U.S. Environmental Protection Agency (USEPA) to be developed by 2011 for the Blind River.

To date, a limited amount of sediment samples within the ARDC and other waterbodies in the LCA ARDC study area (proximal upstream waterbodies) have been collected for analysis. The USGS is currently collecting data on both suspended sediments and bed sediments at five sites along the Amite River; however, this data will not be available until late 2010 (Dennis Demcheck, USGS, personal communication, April 10, 2009).

The USGS conducted a study in 1998 to examine the occurrence and distribution of trace elements and organic compounds in southern LA fishes and streambeds, including fine-grained samples and deep core sediment samples (bulk samples) (Skrobialowski, 2002). One of the sites at which sediment sampling was conducted for this study is located on the Amite River near Port Vincent, approximately 5.5 miles upstream of the ARDC.

While limited sediment sampling data is available at this time, LDEQ has an ongoing program (**http://www.deq.louisiana.gov/portal/default.aspx?tabid=2204**) to resample sediments of all waterbodies currently identified as impaired due to the presence of metals, using improved sampling methods to minimize sample contamination. In the most recent (2006) 303(d) list (**http://www.epa.gov/region6/water/npdes/tmdl/303d/la/epa-final-list_2006.pdf**) of impaired waterbodies, all reaches of the Amite River, the Blind River, and the ARDC are listed as impaired for the Fish and Wildlife Propagation designated use because of mercury. While this was originally determined by LDEQ using fish tissue sampling, LDEQ would likely conduct sediment sampling for confirmation of this data prior to the 2011 TMDL deadline.

4.2.2.3 Water Use and Supply

Historic Conditions. Water use within the LCA ARDC study area is primarily limited to public drinking water. The Louisiana Department of Transportation and Development (LA DOTD) online registry of water wells (**http://www.dotd.louisiana.gov/intermodal/wells/**) identifies nine registered water wells owned by Diversion Water Company, L.L.C. (DWC) in the vicinity of the ARDC within the LCA ARDC study area. The LA DOTD water well registry also identifies 33 privately owned water wells in the LCA ARDC study area (primarily in the vicinity of LA-16 and LA-22). Water provided to the LCA ARDC study area by French Settlement Water Company, Inc. (FSWC) is obtained from a well north of the LCA ARDC study area in Head of Island along LA-22. Department of Agriculture (DOA) Section 10/404 Permits for existing waterfront developments on the left descending bank of the ARDC identify the locations of two pump stations associated with water wells at approximately 1.0 and 3.3 miles east of the Petite Amite River. Proposed new development projects on the south ARDC bank east of the Petite Amite River would receive water service from DWC. No surface drinking water system intake locations were identified in the vicinity of the LCA ARDC study area. Further water use and supply information is provided in Appendix L.

Existing Conditions. Water supply in the LCA ARDC study area is primarily obtained from the local Gonzales-New Orleans aquifer (LDEQ, 2007). However, a small number of wells in the LCA ARDC study area have local aquifer sources (identified in the LA DOTD well registry) of the 600 foot sand of Baton Rouge aquifer, the shallow sand (less than 400 foot) of Baton Rouge aquifer, and the Norco (Geismar) aquifer. All of these local aquifers are part of the Chicot Equivalent aquifer system. Conversion of swamp to open water reduces the water purification function of forested wetlands.

4.2.2.4 Groundwater

Historic Conditions. Sources of fresh groundwater in the LCA ARDC study area and vicinity include the Chicot Equivalent Aquifer, the Evangeline Equivalent Aquifer, and the Jasper Equivalent Aquifer. Rivers and streams within the LCA ARDC study area exhibit a meandering regime rather than the entrenched or braided regimes observed in areas with higher gradients.

Common geomorphologic features in this regime include crevasse splays, point bars, floodplains, abandoned channels, abandoned courses, and backswamps/flood basins. Backswamp/flood basin features are predominant in the vicinity of the LCA ARDC study area. Further groundwater information is provided in Appendix L (Engineering Appendix). Generally, groundwater has not been a major concern in the LCA ARDC study area.

Existing Conditions. Groundwater is not a major issue of concern in the LCA ARDC study area. The LA DOTD online registry of water wells identifies five registered water wells within the LCA ARDC study area and four registered wells within the one-mile buffer of the LCA ARDC study area boundary. Four of the wells within the LCA ARDC study area are in the Chinquapin community; these four wells range in depth from 300 to 445 ft below ground surface (bgs). Two of the wells are owned by the FSWC and two are owned by private citizens. The fifth well within the LCA ARDC study area is a 500-foot bgs well owned by DWC; it is located on the left descending bank of the ARDC. A 440-foot bgs well is located within the one-mile buffer on the left-descending bank of the Chinquapin Canal. A 495-foot well owned by DWC, is located within the one-mile buffer on the right descending bank of the ARDC. Two wells are located on the right descending back of the Blind River near its confluence with the ARDC: one 719-foot well registered to LA Public Works, and one 240-foot well registered to Gulf Engineers.

4.2.3 Water Quality and Salinity

This resource is institutionally significant because of the NEPA; the CWA; the Coastal Zone Management Act; and the Estuary Protection Act. This resource is technically significant because water 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 fishery species for recreational and commercial use. Further water quality information is provided in Appendix L (Engineering Appendix).

The Clean Water Act of 1977 established a process for states to develop information on the quality of their water resources. Section 305(b) requires that each state develop a program to monitor the quality of its surface and groundwater and prepare a report describing the status of its water quality. Section 303(d) requires states to list impaired waterbodies where water quality standards are not met and designated uses are not fully supported, and to develop a TMDL for those waterbodies. Louisiana waterbody subsegments, their designated uses, and numerical water quality standards are identified in Louisiana Administrative Code Title 33, Part IX, Subpart 1, Chapter 11, Section 1123 (LAC 33:IX.1123). The LDEQ Water Quality Inventory Integrated Report is the current form of biennial reporting of the status of LA waters. The 2008 Final Draft Water Quality Inventory

Integrated Report summarizes the monitoring data that characterizes the quality of waters in the vicinity of the ARDC. The Final Draft has not yet been promulgated.

Section 303(d) of the Clean Water Act requires states to identify and list waterbody segments where water quality standards are not met and designated uses are not fully supported. The determination of the use support is based on specific guidance provided by the USEPA. A waterbody may fall within one of three use support categories depending on the percent of measurements for any one physical or chemical parameter that exceeds the state's numerical water quality standards. These categories include fully supporting, partially supporting, and not supporting. In the case where more than one parameter defines a designated use, support for each designated use is defined by the poorest performing parameter.

A draft Total Maximum Daily Load (TMDL) has been submitted by the Louisiana Department of Environmental Quality (LDEQ) and proposes a 60 percent reduction in non-point source (NPS) load within the ARDC in order to achieve current water quality standards. However, the LDEQ is in the process of conducting an ecoregional use attainability analysis that they suspect will modify the water quality standard such that the required NPS load reduction will be reduced to 25 percent.

4.2.3.1 Water Quality

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 LA Department of Health and Hospitals coordinates with the LDEQ, the Louisiana Department of Wildlife and Fisheries (LDWF), and the LA Department of Agriculture and Forestry to issue waterbody advisories aimed at protecting the public's health.

Human developments along the ARDC, Amite and Blind Rivers have begun to affect water quality. The ARDC northeast of Sorrento is listed as impaired for mercury (**http://www.epa.gov/region6/water/npdes/tmdl/303d/la/epa-final-list_2006.pdf**). The LCA ARDC study area falls within two LDEQ-defined waterbody subsegments. LDEQ waterbody subsegment 040402 is comprised of 10 square miles identified as the ARDC. The designated uses as assigned in LAC 33:IX.1123 for this subsegment are primary contact recreation (PCR), secondary contact recreation (SCR), and fish and wildlife propagation (FWP). LDEQ's 2004 Integrated Report listed subsegment 040402 as being fully supported for the PCR and SCR uses. The FWP use was identified as not supported because of nutrients and dissolved oxygen (DO) (**http://www.epa.gov/region6/water/npdes/tmdl/303d/la/epa-final-list_2006.pdf**). Suspected sources were unknown. LDEQ's 2006 Integrated Report listed subsegment 040402 as being fully supported for the PCR and SCR uses. The FWP use was identified as not supported (**http://www.epa.gov/region6/water/npdes/tmdl/303d/la/epa-final-list_2006.pdf**) because of chlorides and mercury. Suspected sources included atmospheric deposition for mercury, and site clearance (i.e., land development or redevelopment) and drought-related impacts for chloride. Data collected in 2001 were used for both the 2004 and 2006 assessments.

Existing Conditions. Human developments result in wastewater and polluted runoff from nearby urban areas. The continued conversion of swamp habitat to marsh and open water reduces natural filtration of water. LDEQ's 2008 Final Draft Integrated Report lists subsegment 040402 as being fully supported for the PCR and SCR uses. The FWP use is identified as not supported because of chlorides, total dissolved solids (TDS), and mercury. Suspected sources include atmospheric deposition for mercury, site clearance (i.e., land development or redevelopment) and drought-related impacts for chloride. The TMDL for the segment are scheduled to be completed by 2011 (**http://www.deq.state.la.us/portal/tabid/130/Default.aspx**).

The LDEQ 2008 Final Draft Integrated Report lists subsegment 040403 as being fully supported for the PCR, SCR, and Outstanding Natural Water Resource (ONWR) uses. Data collected from 2006 were used for the 2008 assessment.

4.2.3.2 Salinity Regimes

Historic Conditions. Recent studies have reported that mean monthly salinities in the Lake Maurepas Basin have increased 2-3 parts per thousand (ppt) in comparison to data collected between 1955 and 1981 (USACE, 2004). The ARDC and the Blind River are two of the three main sources of freshwater input into Lake Maurepas. Salinity data from these two rivers has only been collected on a regular basis since the year 2000; therefore, it is difficult to determine whether the river systems have been impacted by the saltwater influence observed in the lake.

The construction of the ARDC resulted in the impounding of higher saline waters, thus increasing soil salinities. The dredged material berms of the ARDC prevent the flushing of these saline waters by the normal headwater event that follows tropical storms. This lack of flushing and impoundment of saline water leads to the continued degradation of the swamp habitat.

Existing Conditions. Elevated salinities caused by impoundment of storm-driven higher-salinity waters and the subsequent absorption of salt into the substrate likely contribute to the degradation of the forested swamp and its eventual conversion to marsh and ultimately open water (Shaffer *et al*., 2006). Salinity data were collected at LDEQ stations 0268 on the ARDC and 0243 on the Blind River in 2006. Data at station 0243 were collected every month except August, September, and October. One salinity data point was collected in December 2001. Data were collected from 0268 in January, March, June, and November of 2006. LDEQ salinity data are summarized in Table 4.1.

Table 4.1. LDEQ Salinity in ppt

Date sampled	**Salinity by LDEQ Station**	
	0268 (ARDC)	**0243 (Blind River)**
12-11-01	---	0.1
1-10-06	0.1	0.1
2-7-06	---	0.1
3-7-06	0.2	---
3-21-06	---	1.1
4-18-06	---	0.2
5-2-06	---	0.1
6-13-06	0.3	1.9
7-31-06	---	0.1
11-16-06	0.1	---
12-19-06	---	0.1

Source: LDEQ, 2009.

Although the data are extremely limited, the salinity at the Blind River station (0243) was higher than at the ARDC station (0268) when sampled on the same day in June 2006 (LDEQ 2009). The mean salinity at Station 0268 in 2006 was 0.175 ppt; the mean salinity at Station 0243 in 2006 was 0.462 ppt, indicating that in 2006 the Blind River station was slightly more influenced by salt water than the ARDC station. Day *et al.* (2004) determined mean salinity in the Blind River study to be 0.144 ppt in the interval 2002-2003.

Salinity data from the Coastwide Reference Monitoring System (CRMS) stations are summarized in Table 4.2. The mean salinity of the Blind River stations is similar to that calculated from 2006 LDEQ data. Salinities at the Blind River surface water stations are nearly identical when plotted by monthly means (Figure 4.6). Although the mean concentration of the marsh well's salinity is similar to that in the Blind River, the range of data is much narrower than that recorded for the Blind River, and the monthly averages trend differently.

Table 4.2 CRMS Salinity Data Summary in ppt (http://dnr.louisiana.gov/crm/coastres/monitoring.asp)

Station	Salinity		
	Mean	Low	High
CRMS0061-H01	0.34	0	2.38
CRMS0038-H01	0.44	0	2.15
CRMS5845-H01	0.42	0	2.77
CRMS0008-W01	0.48	0.13	0.86

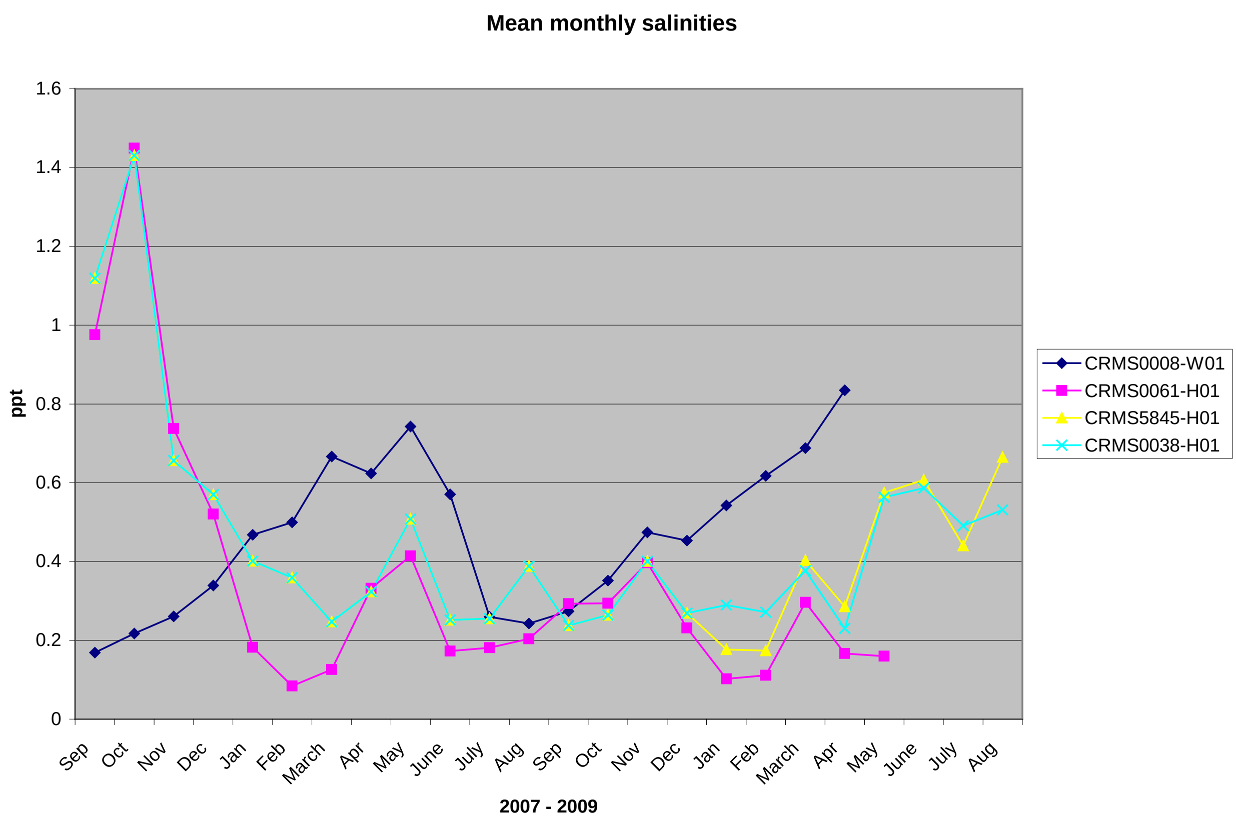


Figure 4.6. Mean Monthly Salinities from Four CRMS Stations in the Area (http://dnr.louisiana.gov/crm/coastres/monitoring.asp).

4.2.4 Air Quality

This resource is institutionally significant because of the Clean Air Act of 1963, as amended, and the LA 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.

The Clean Air Act Amendment of 1990 directed the USEPA to establish NAAQS for all regulated air pollutants. Federal air quality standards have been established for the following six pollutants that are considered as criteria air pollutants:

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

These pollutants are known as criteria air pollutants.

Historic Conditions. The LCA ARDC study area was in nonattainment for the interval 2004-2007 for ozone (8-hour average) (**http://www.epa.gov/oar/data**), EPA 2009). The measurements include both criteria air pollutants and hazardous air pollutants and are compared against the NAAQS specified by the USEPA. Each row of the table lists standards-related air pollution values for available criteria pollutants for one year. The values shown are the highest reported during the year by all monitoring sites in each parish. Air quality is not a major issue for the LCA ARDC study area.

Existing Conditions. Air quality in the LCA ARDC study area is generally good to moderate, with minimal periods in which air quality is classified as unhealthy for the general public or for sensitive groups (http://www.epa.gov/oar/data, EPA, 2009). Of the six criteria air pollutants, O_3 and $PM_{2.5}$ are most likely to occur within the Baton Rouge Metropolitan Statistical Area (MSA). However, the air quality did not exceed NAAQS limits for these parameters in the LCA ARDC study area for 2008 (**http://www.epa.gov/oar/data**). The area is in a non-attainment area for ozone.

4.2.5 Noise

Noise is institutionally significant because of the Noise Control Act of 1972 that declares the policy of the United States is 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 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 (Kryter, 1994). Noise is publicly significant because of the public's concern for the potential annoyance and adverse effects of noise on wildlife and humans.

Occupational noise exposure is regulated by 29 CFR Part 1910, subpart G. The U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) is the enforcing agency. OSHA has established noise exposure standards in order to protect the hearing of employees. Noise exposure for the construction industry is regulated by 29 CFR, Part 1926.52, and Occupational Noise Exposure.

Historic Conditions. Until development in the 1950s, noise pollution was of no concern. More recent historical sources of noise have been developments (1980s) and recreational boat traffic within the LCA ARDC study area.

Existing Conditions. Noise is typically associated with human activities and habitations, such as the operation of commercial and recreational boats, ships, air boats, and other recreational vehicles; operation of machinery and motors; and human residential-related noise (air conditioners, lawn mowers, etc.). However, the LCA ARDC study area is remote and uninhabited marsh. The noise from distant urban areas has little if any impacts on the area. As the population in the LCA ARDC study area continues to grow and develop, some noise pollution would occur. The ambient noise caused by boat traffic and human activity in the ARDC, Amite and Blind rivers may cause some minimal and temporary disturbances in the area.

4.2.6 Vegetation Resources

Coastal vegetation resources are institutionally significant because of the Coastal Barrier Resources Act of 1982; Coastal Zone Management Act (CZM) of 1972; Emergency Wetlands Resources Act of 1986; Estuary Protection Act of 1968; Fish and Wildlife Conservation Act of 1980; the Fish and Wildlife Coordination Act of 1958, as amended; Migratory Bird Conservation Act; Migratory Bird Treaty Act; Endangered Species Act of 1973 (ESA); the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended (Magnuson-Stevens Act); the Magnuson-Stevens Reauthorization Act of 2006; NEPA; the North American

Wetlands Conservation Act; the Water Resources Development Acts of 1976, 1986, 1990, and 1992; and EO 13186 Migratory Bird Habitat Protection. Coastal vegetation resources are technically significant because they are a critical element of the coastal habitats. Additionally, 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.
The LCA ARDC study area includes swamps, rivers, creeks, and bayous. Gulf Coast estuaries are among the most productive natural systems, producing more food per acre than the most productive Midwestern farmland and are second only to Alaska for domestic landings of commercial fish and shellfish (National Coastal Condition Report II) (**http://www.epa.gov/owow/oceans/nccr/2005/index.html**).

Habitat and historic land cover analysis for the LCA ARDC study area was performed by the USGS (USGS 2009 Map ID; USGS-National Wetlands Research Center [NWRC] 2010-11-007). The most recent land cover data identified by the habitat analysis was the 2000 Louisiana Coastal Area Habitat dataset. This dataset depicts information on the geographic distribution of land use/land cover for Louisiana. This dataset consists of digital data describing the land use/land cover (mainly vegetation, but including water and urban environments) for the State of Louisiana. Information is presented in the form of digital maps compiled using 1999 LandSat 7 Thematic Mapper classified land/water data, 1993 land cover classification for the Louisiana Gap Analysis Program, and 2001 Louisiana Coastal Marsh Vegetative Type map data. Attribute fields describe the different land cover types occurring within the polygon or associated with each pixel.

Approximately 27,984 acres are within the LCA ARDC study area. The geographic distribution of these land cover classifications is shown in Figure 4.7. The various land cover classifications, by acre, in the LCA ARDC study area, from the Louisiana Coastal Area Habitat dataset are presented in Table 4.3. The vegetation classification descriptions and acreage within the LCA ARDC study area are described in the following sections.

Approximately 25,634 acres (91.6 percent) of the LCA ARDC study area is comprised of wetland communities including forested and non-forested (scrub-shrub wetlands and fresh marsh - Table 4.3). Forested upland communities comprise approximately 441 acres (1.6 percent) of the LCA ARDC study area and consist primarily of pine thickets or upland forest communities. Approximately 1,142 acres (4.1 percent) of the LCA ARDC study area consist of open water, including rivers, streams, and canals. Open water areas within the LCA ARDC study area include the ARDC; the Amite, Petite Amite, and Blind Rivers; Bayous Pierre and Chene Blanc; and the Chinquapin Canal; and are distributed throughout the LCA ARDC study area. Developed land, which consists primarily of fringing suburbs and built-up areas of metropolitan communities containing sufficient coverage of woody and non-woody vegetation to include urban features, comprises approximately 281 acres (1.0 percent) of land within the LCA ARDC study area. Vegetated urban areas are primarily confined to the dredged material berms lining the ARDC residential areas adjacent to LA-22, and the right descending bank of the Amite River in the northwestern portion of the LCA ARDC study area. Barren land makes up a small percentage of the LCA ARDC study area and may include rangelands, strip mines, quarries, and gravel pits. Agricultural cropland or grassland makes up approximately 469 acres (1.6 percent) of the LCA ARDC study area and appears to be restricted to livestock pasture. These pastures are located in isolated pockets along the lower Amite River and LA-22 in the western LCA ARDC study area.

Table 4.3. Land Cover in the LCA ARDC Study Area by Acre (2000 Louisiana Coastal Area Habitat Analysis)

Land Cover Classification	Acres	Percent of LCA ARDC study area
Wetlands		
Wetland Forest	25,316	90.4%
Non-Forested Wetland		
Fresh marsh	226	0.8%
Wetland scrub/shrub	91	0.3%
Swamp	0	0.0%
Subtotal Wetlands	**25,633**	**91.6%**
Uplands		
Upland forest	441	1.6%
Upland scrub/shrub	0	0.0%
Subtotal Uplands	**441**	**1.6%**
Water: Streams and Canals	**1,142**	**4.1%**
Developed Land	**281**	**1.0%**
Barren Land	**18**	**0.1%**
Agriculture/Pasture	**469**	**1.6%**
TOTAL	**27,984**	**100%**

Note: The 2000 Louisiana Coastal Area habitat data composition is a hybrid dataset of the following:

- 1993 Land Cover Classification for the Louisiana Gap Analysis Project;
- November 18, 1999 Landsat 7 TM Classified Land/Water Data; and
- 2001 Louisiana Coastal Marsh Vegetation Type Map.

4.2.6.1 Riparian Vegetation

Historic Conditions. Construction of the ARDC in 1956 created riparian habitat along the sidecast dredged material berms; riparian habitat is also present on some of the banks of other waterbodies (Figure 4.7). Riparian zones within the LCA ARDC study area were historically confined to the natural banks of the Petite Amite and Blind Rivers as well as a myriad of smaller natural tributaries within the interior of the marsh.

Existing Conditions. Depending on the elevation, these corridors are forested with a myriad of tree species; the wettest areas are dominated by bald cypress/tupelo while the highest elevation areas are dominated by hardwood tree species such as oak, ash and elm. Riparian habitat along the ARDC is well defined; a steep geological gradient limits the influence of the ARDC and the spread of hydrophytes. This area as well, has remained relatively stable since the ARDC was completed.

4.2.6.2 Wetland Vegetation

Wetlands are defined as areas that are covered by water or that contain saturated soils for a minimum of five percent of the growing season, or approximately 14 days (33 CFR 328.3(b); 40 CFR 230.3(t)). Wetlands provide protection from wave action, erosion, and storm damage and provide various consumptive and non-consumptive recreational opportunities.

Historic Conditions. Prior to the early 20th century, the LCA ARDC study area was an unbroken expanse of wetlands interspersed with meandering bayous such as the Petite Amite and Amite Rivers. The LCA ARDC study area contains approximately 27,984 acres of primarily bald cypress-tupelo swamp habitat. The LCA ARDC study area is located within the Amite/Blind mapping unit (LCWCRTF, 1999). This mapping unit contains 190,036 acres in portions of St. James, Ascension, Livingston, and St. John the Baptist Parishes. Between 1932 and 1956, about 1,600 acres of wetlands were lost in the Amite/Blind mapping unit mainly to shoreline erosion and direct removal (LCWCRTF, 1999). Although there were no significant shifts in habitat type within this mapping unit from 1956 to 1990, the swamp vegetation is becoming increasingly stressed.

Existing Conditions. Wetland coverage data within the LCA ARDC study area were obtained from the National Wetlands Inventory (NWI) (www.fws.gov/wetlands). The NWI is maintained by the U.S. Fish and Wildlife Service (USFWS) and provides general wetland occurrence data for coastal regions in the United States. NWI data does not constitute geospatially precise wetland delineations, but rather provide basic occurrence data regarding the classification and approximate areal extent of wetland coverage within a given area. NWI wetland types are described according to the regimes devised in the USFWS Publication *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin *et al.*, 1979).

Wetland habitat types within the LCA ARDC study area are characterized into four major categories: palustrine forested (92.77 percent); palustrine emergent, scrub-shrub, unconsolidated bottom, and aquatic bed (1.2 percent); uplands (4.4 percent), and riverine (lacustrine). Figure 4.8 presents a map of the wetland types in the LCA ARDC study area.

The most common wetland regime in the LCA ARDC study area is wetland forest (Figure 4.7). About 18,204 acres of primarily bald cypress-tupelo swamp habitat are presently impounded at different levels within the LCA ARDC study area. Existing swamp habitats are converting to marsh and shallow open water habitats. Saltwater intrusion from storm events has additionally stressed the swamp habitat along the Blind River. The other dominant habitat types include water (1,123 acres), upland forest (406 acres), agriculture/pasture (375 acres), developed (251 acres), and fresh marsh (249 acres) (Figure 4.7).

Functions lost include habitat for wildlife and aquatic species, recreational opportunities, aesthetics, and storm surge protection. Upon severe degradation; the swamp will convert to freshwater marsh, then to open water. The freshwater marsh does offer some of the functions of the freshwater swamp, but certain functions are lost, such as habitat for avian species and storm surge protection. It is a national priority to preserve and protect freshwater swamps.

Vegetation Communities. Common plant species in the LCA ARDC study area are presented in Table 4.4 by habitat type. Many species occur in more than one habitat. Highly flood-tolerant bald cypress (*Taxodium distichum*) and water tupelo or tulepo-gum (*Nyssa aquatica*) dominate the overstory of much of the Maurepas Swamp, including the LCA ARDC study area (Conner and Day, 1976). This dominance is due in part to their ability to produce secondary roots with the capacity to oxidize the area surrounding their roots in flooded, anaerobic soils.

In addition to bald cypress and water tupelo, swamp red maple (*Acer rubrum* var. *drummondii*), green ash (*Fraxinus pennsylvanica*), swamp tupelo (*Nyssa sylvatica* var. *biflora*), and various oak species (*Quercus* spp.) are also found in bald cypress-tupelo swamp habitat within the LCA ARDC study area, with swamp red maple and green ash comprising sub-dominant midstory species (Conner and Day, 1976; Hoeppner, 2008; Shaffer *et al.*, 2003). Scrub species, including black willow (*Salix nigra*), wax myrtle (*Morella cerifera*), and buttonbush (*Cephalanthus occidentalis*) are sporadically present, particularly in areas with diminished canopy cover caused by impaired health or mortality of overstory species.

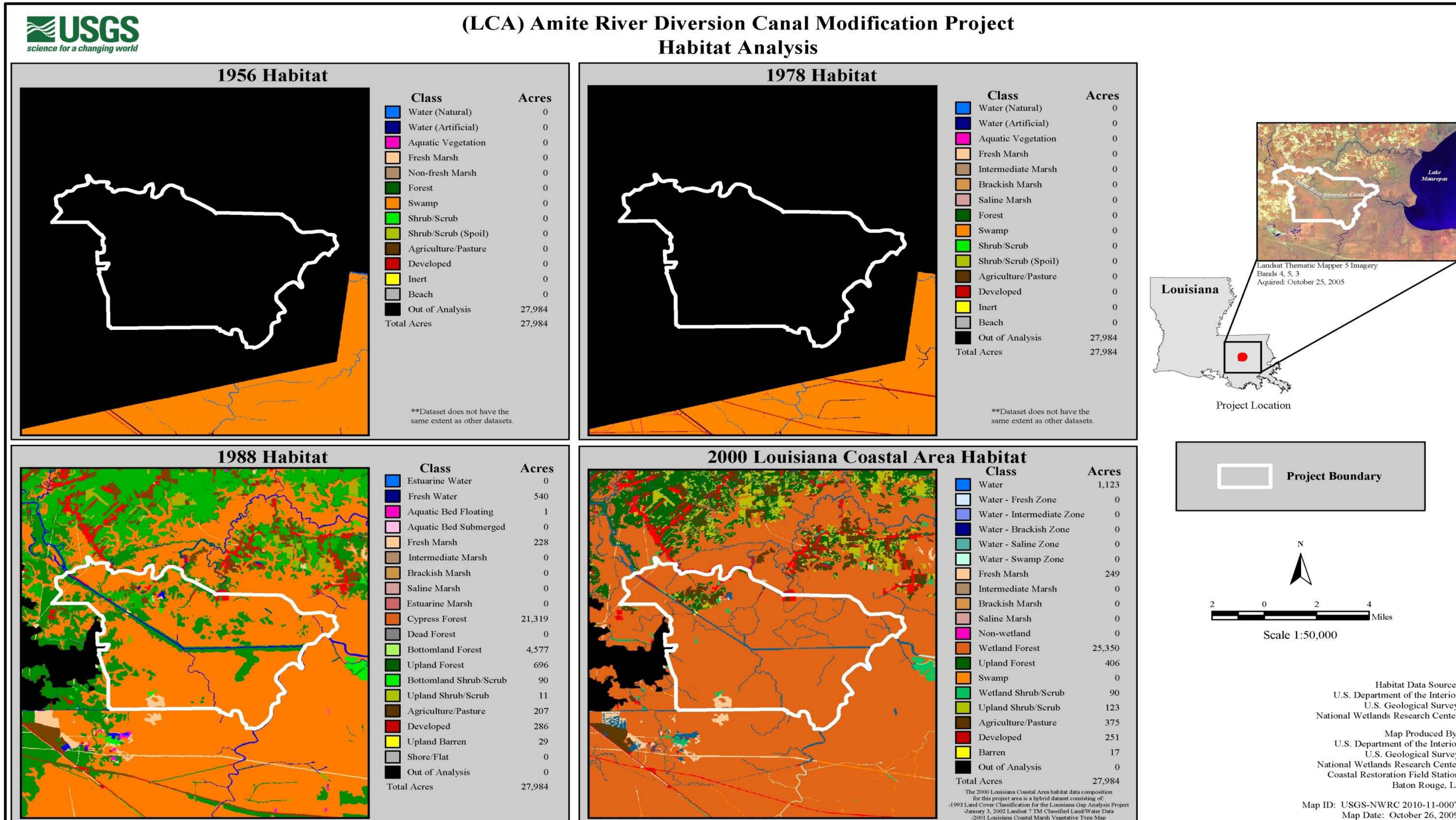


Figure 4.7. Land Cover within the LCA ARDC Study Area (USGS, 2009)

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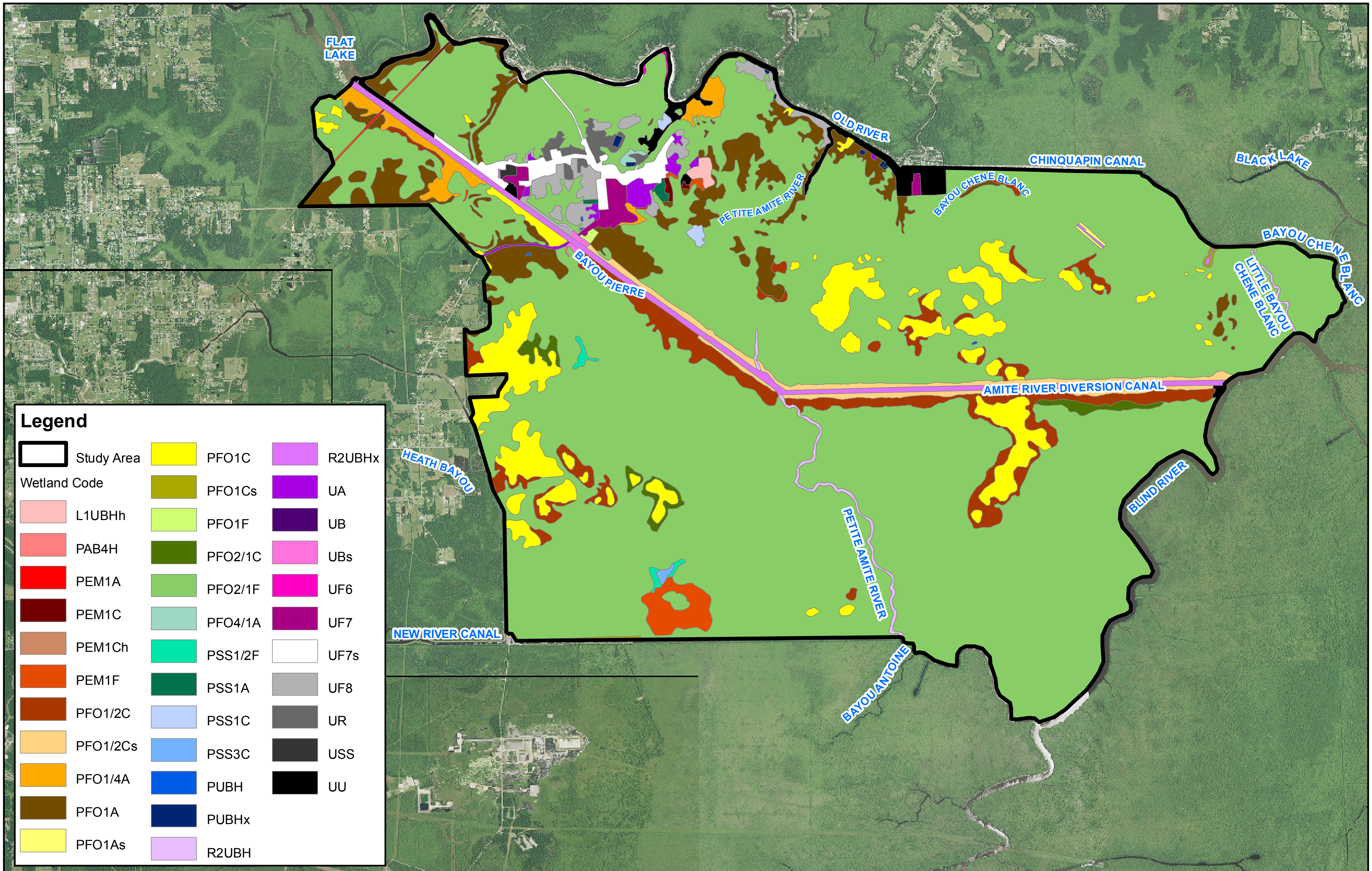


N

0 0.5 1 1.5 2 Miles

WETLAND TYPE MAP

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Wetland Data: National Wetlands Research Center Habitat Data for Gulf of Mexico Coast, Louisiana, 1988
Image: 2009 Ascension and Livingston Parishes USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 4.8
Date: November 2009
Scale: 1:90,000
Source: USDA/NWRC/GEC
Map ID: 27850108-1850

Table 4.4. Common Plant Species in the Study Area by Habitat Type (USDA, 2008)

Common Name	Scientific Name	Habitat Type(s)
Bald cypress	*Taxodium distichum*	Bald cypress-Tupelo
Black Willow	*Salix nigra*	Bald cypress-Tupelo
Green Ash	*Fraxinus pennsylvanica*	Bald cypress-Tupelo
Swamp Tupelo	*Nyssa biflora*	Bald cypress-Tupelo
Tupelo Gum	*Nyssa aquatica*	Bald cypress-Tupelo
Buttonbush	*Cephalanthus occidentalis*	Bald cypress-Tupelo Fresh Marsh
Bulltongue	*Sagittaria lancifolia*	Fresh Marsh Intermediate Marsh
Dwarf Spikerush	*Eleocharis parvula*	Fresh Marsh Intermediate Marsh
Wax Myrtle	*Myrica cerifera*	Fresh Marsh Intermediate Marsh
Alligator Weed	*Alternanthera philoxeroides*	Fresh Marsh
Arrow Arum	*Peltandra virginica*	Fresh Marsh
Lizard's Tail	*Saururus cernuus*	Fresh Marsh
Maidencane	*Panicum hemitomon*	Fresh Marsh
Swamp Smartweed	*Polygonum punctatum*	Fresh Marsh
Chinese Privet	*Ligustrum sinense*	Upland Ridge
Chinese Tallowtree	*Triadica sebifera*	Upland Ridge
Swamp Red Maple	*Acer rubrum var. drummondii*	Upland Ridge Bald cypress-Tupelo
Water Oak	*Quercus nigra*	Upland Ridge Bald cypress-Tupelo
Laurel Oak	*Quercus laurifolia*	Upland Ridge Bald cypress-Tupelo

Much of the bald cypress-tupelo swamp habitat within the LCA ARDC study area is not fully stocked, suggesting that environmental stressors are affecting regeneration and stand growth (Chambers *et al.*, 2005). Altered hydrological conditions in southeastern LA have reduced or eliminated natural regeneration of bald cypress and water tupelo, and reduced productivity. Neither bald cypress nor water tupelo seeds germinate in water, and submerged cypress seedlings die within three to six weeks (Demaree, 1932, Souther, 2000). Flooding caused by relative sea level rise (primarily as a result of regional subsidence) has decreased the probability of natural regeneration of many stands of bald cypress-tupelo forest (Conner *et al.*, 1981; Chambers *et al.*, 2005). The swamps in the LCA ARDC study area and vicinity are impacted by elevated levels of subsidence and consequent saltwater intrusion, and experience a lack of sediment and nutrient input. Tree recruitment is further severely limited by the mammalian seedling predator nutria (*Myocastor coypus*), and in many areas of the swamp, bald cypress and water tupelo are defoliated annually by outbreaks of bald cypress leafrollers (*Archips goyerana*) and forest tent caterpillars (*Malacosoma disstria*) (Myers *et al.*, 1995; Beville, 2002; Effler, *et al.*, 2006).

Vegetative communities are affected by water level and RSLR. The RSLR that can be expected for the LCA ARDC Modification project area is from 5 to 9 mm/year (2 to 4 mm/year of subsidence and 3 to 5 mm/year of eustatic sea level rise) (Penland and Ramsey 1990). Guidance provided from EC-1165-2-211 gives a means by which to estimate the impacts of relative sea level rise. Specifically, within the LCA ARDC study area, sea level rise is predicted to occur from 1.5 ft (0.46 m) to 3.2 ft (0.97 m) over the 50-year period of analysis of the project.

Whether marsh substrate accretion can keep pace with sea level rise depends on processes involving sediment deposition on the marsh surface and below ground production of organic matter (DeLaune *et al.*, 1983; Turner, 1990; Reed, 1995; Day *et al.*, 2000). These processes vary both spatially and temporally and are not well understood in many LA marsh systems (Jarvis C. Jessie, unpublished data). It is estimated that the net accretion rate would be 8mm/year within the healthiest portions of the LCA ARDC study area (Bernard Wood, unpublished data, 2005 through 2009). These net accretion rates account for subsidence, but not eustatic sea level rise. Based on these estimates, accretion rates could reduce the potential impacts of sea level rise within the healthiest portions of the LCA ARDC study area.

4.2.6.3 Upland Vegetation

Several ridge remnants run through the LCA ARDC study area. These ridges are mostly near the mid-point of the east-west stretch of the ARDC. The dominant tree structure includes bald cypress, black gum, swamp gum, Drummond's red maple, green ash, diamond oak, water oak, black willow, American elm, and tallow (Field Investigation, 2009). Wax myrtle, black berry, black willow, Chinese tallow tree, and Chinese privet typically dominate the shrub stratum. In addition, an old railroad grade and several earthen levees run through the LCA ARDC study area with similar habitats.

Historic Conditions. Historically, the upland vegetation composition has changed little from what can be found today. These uplands constituted old natural levees that subsided at a different rate than the surrounding marsh. Ultimately, as subsidence occurs over the course of thousands of years, these areas are converted into freshwater swamps and then marshes before becoming open water as they sink beneath mean water level. The vegetation of the ridges in the coastal region served as refuges for wildlife and native people during high water events and was important, both for food and forage.

Settlers began to move into the area around 1721 (Haydel, 1998), but no large scale alterations in the upland vegetation structure occurred until logging operations for cypress began in 1891 and continued until the early 1930s (Haydel, 1998). A fully functional railroad carried logs that fell in the swamp to the sawmill; the railroad was abandoned shortly after the mill closed. The great majority of the forests were logged, leaving small, deformed target trees, and some non-target species behind. The mature forest we see today is a regrowth.

The ARDC was completed in the 1964. The upland vegetation of the dredged material berms lining the ARDC and the old railroad grade differs little from the natural ridges in community composition.

Existing Conditions. Upland vegetation on the natural ridges is being impacted due to increasing water in impounded areas. This stresses existing trees and shifts the community toward a wetter cypress/tupelo forest. This disturbance also provides an opportunity for invasive species to gain a foothold and crowd out developing native vegetation. Upland vegetation on the dredged material berms (spoil) and the railroad grade is undergoing a much more dramatic change as threats from residential development impact the site.

4.2.6.4 Submerged Aquatic Vegetation

Submerged aquatic vegetation (SAV) is an important source of food and habitat for both aquatic resources and wildlife. SAV provides structure and habitat for many invertebrates that provide food for larger aquatic resources, such as many stages of fishes. SAV also provides food for many avian species such as waterfowl. SAV also provides feeding habitat for fish-eating birds such as herons and egrets.

Historic Conditions. SAV is limited to shallow areas with flow that is high enough to keep the area clear of floating species within the ARDC and other waterbodies. Historically, SAV communities within the LCA ARDC study area have been dominated by native species such as fanwort (*Cabomba carolinana*), coontail (*Ceratophyllum demersum*), small pondweed (*Potamogeton pusillus*), bladderwort (*Utricularia vulgaris*), water nymph (*Najas guadalupensis*), widgeon grass (*Ruppia maritima*), and wild celery (*Vallisneria americana*).

Existing Conditions. SAV communities within the LCA ARDC study area are largely confined to areas of higher flow within the LCA ARDC study area. This includes natural waterways and natural cuts into the swamp interior. Shallow water habitats within the LCA ARDC study area that have insufficient flow have become choked with floating vegetation, greatly limiting light penetration within the water column.

4.2.6.5 Invasive Species – Vegetation

The EO 13112 was signed on February 3, 1999 establishing the National Invasive Species Council 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.

In coastal LA, water hyacinth (*Eichhornia crassipes*), alligatorweed (*Alternanthera philoxeroides*), hydrilla (*Hydrilla verticillata*), and Chinese tallow (*Triadica sebifera*) are well-known invasive plants. More recently, common salvinia (*Salvinia minima*), giant salvinia (*Salvinia molesta*), and variable-leaf milfoil (*Myriophyllum heterophyllum)* also have become invasive, displacing native aquatic species and degrading water quality and habitat quality (LACPR, 2009). Invasive plant species within the LCA ARDC study area include water hyacinth, alligatorweed, hydrilla, common salvinia, giant salvinia, Chinese tallow, and Chinese privet (*Ligustrum sinense*) (LCA, 2004).

Historic Conditions. Natural processes form coastal vegetation resources. Invasive species have been intentionally and unintentionally released and are outcompeting native vegetation species and spreading throughout many habitat types. Historically (pre-European), the LCA ARDC study area consisted of several palustrine habitats including submerged aquatic beds, fringe freshwater marsh, and cypress/tupelo swamp. These systems were not impacted by any invasive species.

Existing Conditions. Each of these invasive species is well established within the LCA ARDC study area. The impacts of each of these species on the native flora include physical competition for resources such as nutrients and light, impacts to community structure and composition, and impact to ecosystem processes and system wide parameters. Water hyacinth, common salvinia, giant salvinia, and hydrilla all limit the amount of light penetrating the water column which in turn impacts plankton biomass production. Alligatorweed, Chinese tallow and Chinese privet are of minimal wildlife value and can proliferate until nearly monocultural stands exist, limiting food available for wildlife.

4.2.6.6 Rare, Unique, and Imperiled Vegetative Communities

The unique communities, nestled 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 stability of the bionetwork. 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 would accelerate decline in the interdependent processes of plant production and vertical accretion necessary for a stable ecosystem.

The Louisiana Natural Heritage Program (LNHP), administered by the Louisiana Department of Wildlife and Fisheries (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; and has identified approximately 380 ecologically significant sites statewide (**http://www.wlf.louisiana.gov/experience/naturalheritage/**). The LNHP was queried for site-specific rare, unique, or imperiled vegetative community occurrence data in the LCA ARDC study area. According to this database, the only communities present in the LCA ARDC study area are cypress-tupelo swamp and fresh marsh.

4.2.7 Wildlife and Habitat

This resource is institutionally significant because of NEPA; 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 ESA of 1973, as amended; the Fish and Wildlife Conservation Act of 1980; the North American Wetlands Conservation Act; EO 13186 Migratory Bird Habitat Protection; Migratory Bird Conservation Act; and the Marine Mammal Protection Act (MMPA). Wildlife resources are technically significant because they are a critical element of the coastal barrier 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 the public places a high priority on their aesthetic, recreational, and commercial value.

The USFWS, in letters dated October 15, 2008 and January 20, 2009, formally requested that significant fish and wildlife resources within the LCA ARDC study area be fully considered and addressed in this study (Appendix B). The USFWS identified two threatened and endangered species, Gulf sturgeon (*Acipenser oxyrhynchus desotoi*) and West Indian manatee (*Trichechus manatus*), and one delisted species, bald eagle (*Haliaeetus leucocephalus*) that are known to occur within the LCA ARDC study area. Further information on Gulf Sturgeon and the West Indian Manatee is available in Section 4.7.11 of the report. Additionally, the USFWS indicated that the LCA ARDC study area is known to support colonial nesting waterbirds (e.g., herons, egrets, ibis, night-herons, and roseate spoonbills). As a result of the public review process, the USFWS recommended minimizing disturbance to colonies containing nesting wading birds, 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, the USFWS recommended 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.

Historic Conditions. The Amite/Blind River mapping unit contains part of one of the largest remaining tracts of forested wetlands in the Lower Mississippi River Valley and is extremely important to Neotropical migratory songbirds, waterfowl and many other species of wildlife (LCWCRTF and WCRA, 1999). Stopover habitat, where migratory birds can rest and refuel, is critical to successful migrations, particularly across the Gulf of Mexico (Stouffer and Zoller, 2006). Louisiana coastal wetlands provide Neotropical migrants essential stopover habitat on their annual migration route. The greatest threat facing Neotropical migrants is habitat loss (American Bird Conservancy, 2009). The coastal wetlands in the LCA ARDC study area provide important wildlife habitats, especially transitional habitat between estuarine and marine environments, used for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements. Table 4.5 shows the status, functions of interest, trends, and projections through 2050 for avifauna, furbearers, game mammals, and reptiles within the LCA ARDC study area and vicinity (LCWCRTF and WCRA, 1999). See Section 4.2.11 for information about threatened and endangered species.

The bald eagle was officially removed from the List of Endangered and Threatened Species on August 8, 2007. However, the species continues to be protected under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA). The USFWS developed the National Bald Eagle Management (NBEM) Guidelines to provide landowners, land managers, and others with information and recommendations regarding how to minimize potential project impacts to bald eagles, particularly where such impacts may constitute "disturbance," which is prohibited by the BGEPA. The guidelines recommend maintaining: (1) a specified distance between the activity and the nest (buffer area); (2) natural areas (preferably forested) between the activity and nest trees (landscape buffers); and (3) avoiding certain activities during the breeding season. The buffer areas serve to minimize visual and auditory impacts associated with human activities near nest sites. Ideally, buffers would be large enough to protect existing nest trees and provide for alternative or replacement nest trees. A copy of the NBEM Guidelines is available at: **www.fws.gov/migratorybirds/issues/BaldEagle.**

Table 4.5. Status, Functions of Interest, Trends, and Projections through 2050 for Avifauna, Furbearers, Game Mammals, and Reptiles within the LCA ARDC Study Area (LCWCRTF and WCRA, 1999)

Mapping Unit	Type	% of unit	Furbearers												Game Mammals							
			Nutria				Muskrat				Mink, Otter, and Raccoon				Rabbit				Deer			
			Function	Status	Trend	Projection	Function	Status	Trend	Projection	Function	Status	Trend	Projection	Function	Status	Trend	Projection	Function	Status	Trend	Projection
Amite/Blind (Includes LCA ARDC study area)	FS	73	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	D	D	Mu	Mo	I	D
	HF	21	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	D	D	Mu	Mo	I	S

Mapping Unit	Type	% of unit	Reptiles				Avifauna											
			Alligator				Brown Pelican				Seabirds				Wading Birds			
			Function	Status	Trend	Projection	Function	Status	Trend	Projection	Function	Status	Trend	Projection	Function	Status	Trend	Projection
Amite/Blind (Includes LCA ARDC study area)	FS	73	Mu	Mo	I	I	---	NH	---	---	---	NH	---	---	Ne	Hi	I	I
	HF	21	Mu	Lo	Sy	Sy	---	NH	---	---	---	NH	---	---	---	NH	---	---

Mapping Unit	Type	% of unit	Avifauna (cont'd)																											
			Shorebirds				Dabbling Ducks				Diving Ducks				Raptors				Rails, Coots Gallinules				Other Woodland Residents				Other Woodland Migrants			
			Function	Status	Trend	Projection	Function	Status	Trend	Projection	Function	Status	Trend	Projection	Function	Status	Trend	Projection	Function	Status	Trend	Projection	Function	Status	Trend	Projection	Function	Status	Trend	Projection
Amite/Blind (Includes LCA ARDC study area)	FS	73	---	NH	---	---	Mu	Lo	Sy	Sy	---	NH	---	---	---	NH	---	---	---	NH	---	---	Ne	Mo	I	Sy	Mu	Mo	Sy	Sy
	HF	21	---	NH	---	---	Mu	Lo	Sy	Sy	---	NH	---	---	---	NH	---	---	---	NH	---	---	Ne	Hi	I	D	Mu	Mu	Sy	D

Type: FS = Fresh Swamp; HF = Hardwood Forest.
Function: Ne = Nesting; St = Stopover Habitat; W = Wintering; Mu = Multiple Use
Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo = Moderate Numbers; Hi = High Numbers
Trends (since 1985)/Projections (through 2050): Sy = Steady; D = Decrease; I = Increase; U = Unknown

Existing Conditions. Louisiana's coastal areas have many different wildlife species, including important game animals such as white-tailed deer (*Odocoileus virginianus)*, eastern cottontail (*Sylvilagus floridanus*), swamp rabbit *(Sylvilagus aquaticus)*, gray squirrel *(Sciurus canadensis)*, fox squirrel *(S. niger)*, and raccoon *(Procyon lotor)*; furbearers include muskrat *(Ondatra zibethicus)*, nutria (*Myocastor coypus)*, mink *(Mustela vison)*, Virginia opossum (*Didelphis virginiana*), striped skunk *(Mephitis mephitis)*, bobcat *(Lynx rufus)*, beaver *(Castor canadensis)*, and coyote *(Canis latrans)*; insectivores, bats, rodents, and the nine-banded armadillo *(Dasypus novemcinctus)* (Gosselink *et al.,* 1998.) The American alligator *(Alligator mississippiensis),* wild turkey *(Meleagris gallopavo),* river otter *(Lutra canadensis),* wading birds, dabbling ducks, and Neotropical songbirds are also found. Hunting for deer, feral hogs, wild turkey, rabbits, squirrels, and ducks occurs within and around the LCA ARDC study area.

Bald eagles nest in Louisiana from October through mid-May. Eagles typically nest in mature trees (e.g., bald cypress, sycamore, willow) near fresh to intermediate marshes or open water in the southeastern parishes. Areas with high numbers of nests include the Lake Verret Basin south to Houma, the marsh/ridge complex south of Houma to Bayou Vista, the north shore of Lake Pontchartrain, and Lake Salvador. Eagles also winter, and infrequently nest, in mature pine trees near large lakes in central and northern Louisiana. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants (i.e., organochlorine pesticides and lead). Breeding bald eagles occupy "territories" that they would typically defend against intrusion by other eagles, and that they likely return to each year. A territory may include one or more alternative nests that are built and maintained by the eagles, but which may not be used for nesting in a given year. Bald eagles are vulnerable to disturbance during courtship, nest building, egg laying, incubation, and brooding. Disturbance during this critical period may lead to nest abandonment, cracked and chilled eggs, and exposure of small young to the elements. Human activity near a nest late in the nesting cycle may also cause flightless birds to jump from the nest tree, thus reducing their chance of survival. Bald eagles are commonly seen in the LCA ARDC study area. A bald eagle nest has been located within the LCA ARDC study area.

Invasive Wildlife Resources. Two invasive mammals, nutria and feral hogs (*Sus scrofa*), can be found in the LCA ARDC study area (LDWF, 2010; Keddy, *et al.,* 2007).

Nutria are large semi-aquatic rodents introduced from South America that live in fresh, intermediate and brackish marsh and feed on vegetation that is vital to sustaining Louisiana's coastline. High nutria population densities damage wetland vegetation and further wetland loss. Nutria consume both above and below ground parts of wetland plants (Keddy, *et al*., 2007). Nutria damage to areas, referred to as "eat outs," can be great. Nutria grazing can strip large patches of marsh, and their digging overturns the marsh's upper peat layers (Keddy *et al.*, 2007). Aerial surveys estimated 80,000 acres of marsh were damaged by nutria; nutria damage in recent years is concentrated in the Deltaic Plain in southeastern Louisiana (Keddy et. al. 2007).

The feral hog is an exotic species which has expanded its range throughout most of Louisiana. Feral hogs cause extensive damage to natural wildlife habitat, privately-managed food plots for deer and turkey, and farm ponds and watering holes for livestock. In Louisiana, the frequency of feral hogs around agricultural areas has led to conflicts with sugarcane, rice, and corn farmers by the destruction of crops from excessive digging (Reed, 2007). Additionally, the wild omnivores compete with native wildlife for food resources; prey on young domestic animals and wildlife; and carry diseases that can affect pets, livestock, wildlife and people (Seward *et al.*, 2004).

4.2.8 Aquatic Resources

Planktonic organisms are institutionally significant because of NEPA, the Coastal Zone Management Act, and the Estuary Protection Act. This resource is technically significant because plankton may 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; 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 in freshwater lakes and larger rivers, plankton form the lowest trophic food level for many larger organisms important to commercial and recreational fishing (Hynes, 1970).

Benthic organisms are institutionally significant because of NEPA; the Coastal Zone Management Act; and the Estuary Protection Act. Benthic species are technically significant because they are directly or indirectly involved in most physical and chemical processes and trophic relationships that occur in aquatic ecosystems. This resource is publicly significant because benthic organisms are food for many larger organisms important to commercial and recreational fishing.

4.2.8.1 Plankton

Historic Conditions. Construction of the ARDC resulted in dredged material berms which limits exchange of organisms and water between the swamp and the ARDC. Phytoplankton (microscopic plants) are the primary producers of the water column and form the base of the plankton community. Freshwater zooplankton are dominated by four major groups of animals: protozoa, rotifers, cladocerans, and copepods. Zooplankton provide the trophic link between the phytoplankton and the intermediate level consumers such as aquatic invertebrates, larval fish, and smaller forage fish species (Day, *et al.*, 1989). Zooplankton populations in Louisiana ponds, swamps, ditches, and streams were found to be primarily protozoa by Bamforth (1962). Rotifer populations peak once or twice a year in coastal Louisiana freshwater systems, and during this peak may constitute almost the entire zooplankton community (Gosselink *et al.*, 1998).

Phytoplankton blooms can create anoxic conditions and can cause widespread mortality of fish populations (Day *et al.,* 2001). Phytoplankton production in coastal wetland systems is most likely to be nitrogen limited (Day *et al.,* 2001). Swamps such as those present within the LCA ARDC study area have been shown at times to be both sources and sinks of nutrients, particularly nitrogen. Although phosphorus is typically the limiting nutrient which is attributed to excessive algal growth (blooms), Lane *et al. (*2003) found that the Maurepas swamps are nitrogen limited compared to phosphorus, and dissolved inorganic nitrogen, especially nitrate, is the most important nutrient in the formation of phytoplankton blooms in Lake Maurepas. Little phosphorus appears to be retained in swamp vegetation, but instead is retained in the sediments. As long as sediment mobilization remains low, phosphorus export should remain low (Mitsch and Gosselink, 2000). Nitrogen is largely reduced by denitrification, but can also undergo substantial reductions via burial in subsiding sediments (2003). Unsteady State Hydraulic Models (UNET) (2003) predict that the Maurepas Swamp ecosystem can remove up to 95 percent of nitrogen loads from surface waters via several pathways, thus limiting potential algal blooms from freshwater diversions.

Existing Conditions. Plankton population changes may be associated with the conversion of swamp habitat to freshwater marsh and open water. Little information appears to be available on plankton communities in the swamps along the ARDC. In general, running water almost always contains free-floating microorganisms, and in large rivers or sluggish streams, many of these microorganisms are planktonic. However, these populations are unstable and subject to constant change due to variable flows, turbidity, etc. (Hynes, 1970). Such a variable plankton community, likely to be found in the ARDC, would be subject to the flows of the Amite River and tidal influences through Lake Maurepas.

Within the swamp, the plankton community would be affected by existing conditions, including the lack of hydrological connectivity with the ARDC. A lack of nutrients, combined with shading due to a forest canopy and/or the presence of floating plants (e.g., water hyacinth, salvinia, duckweed), could depress photosynthesis and, therefore, phytoplankton populations. Zooplankton populations could, in turn, be depressed.

4.2.8.2 Benthic

Historic Conditions. Construction of the ARDC resulted in dredged material berms which limits exchange of benthic organisms and water between the swamp and the ARDC. Benthic community structure is not static; it provides a residence for many sessile, burrowing, crawling, and even swimming organisms. The benthic community is a storehouse of organic matter and inorganic nutrients, as well as a site for many vital chemical exchanges and physical interactions. Major consumer groups of the benthic habitat include bacteria and fungi, microalgae, meiofauna, and microfauna (Mitsch and Gosselink, 2000). One of the main functions of a benthic community is secondary production, the conversion of plant material (formed in primary production) by benthic detritivores and herbivores to animal tissue, thereby forming major links in the aquatic food web between plants and predators (Cole, 1975).

Existing Conditions. Benthic population changes are associated with the conversion of swamp habitat to freshwater marsh and open water. Within the LCA ARDC study area, the benthic community is seasonally abundant, typically during winter months when cooler water temperatures facilitate higher DO concentrations. Organisms found in winter include a wide variety of segmented and flatworms, snails, crustaceans, and insects. During summer, when little DO is present, the benthic community is sparse, and air-breathing insects and crustaceans; a few tubificid oligochaetes and dipterans, which can tolerate lower oxygen conditions; and crawfish, especially burrowing crawfish, may be found. During periods when the swamp floor dries, these organisms survive through the production of resistance stages (eggs, cocoons, etc.) and repopulate the area when flooding of the swamp floor returns (Loden, 1978).

4.2.9 Fishery Resources

Fishery resources are institutionally significant because of the Fish and Wildlife Coordination Act of 1958, as amended; the Endangered Species Act(ESA) of 1973; the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended (Magnuson-Stevens Act); the Magnuson-Stevens Reauthorization Act 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.

National Marine Fisheries Service (NMFS), in a letter dated February 20, 2009, indicated that aquatic and wetland habitats in the LCA ARDC study area provide foraging and nursery habitat for a few economically important marine fishery species that use freshwater habitats in this area. The species expected to be found in the LCA ARDC study area include striped mullet *(Mugil cephalus)* and Gulf menhaden *(Brevoortia patronus)*. Although the area likely provides some habitat for a few euryhaline species, it is not classified as Essential Fish Habitat (EFH) (EFH - Rick Hartman, NMFS, pers. comm.). In addition, the waterbodies and wetlands of the LCA ARDC study area provide nursery and foraging habitats supportive of a variety of fishery species, some of which may serve as prey for other fish species.

Emergent wetlands and shallow open water areas in the LCA ARDC study area provide important and essential fishery habitats including transitional habitat between freshwater and estuarine environments used by migratory and resident fish and other aquatic organisms for nursery, foraging, breeding and spawning, and other life requirements. The area historically and currently provides habitat for recreational fishing; some commercial catfishing and crabbing occurs in the Blind River and the Amite River near the LCA ARDC study area. Population trends for fishery species within the LCA ARDC study area are presented in Table 4.6 (LCWCRTF and WCRA 1999). The Amite/Blind River mapping unit has shown steady populations over the last 10 to 20 years for blue crab (*Callinectes sapidus*), largemouth bass (*Micropterus salmoides*), and channel catfish (*Ictalurus punctatus*). In the LCA ARDC study area, populations are expected to remain steady through 2050. Globally, overfishing and habitat change have resulted in the depletion of 90 percent of the world's seafood resources (Worm *et al.*, 2006). Of the species studied, 38 percent have experienced more than 90 percent depletion. Seven percent of the species studied have become extinct (Worm *et al.*, 2006).

Historic Conditions. Construction of the ARDC and dredged material berms has prevented exchange of organisms and water between the swamp and the ARDC. The fish species assemblage in the vicinity of the ARDC is primarily composed of freshwater species, with occasional transient marine and diadromous species. Laiche (1980) sampled fish at 73 different locations along the Amite River using seines. Trammel net and additional seine samples were taken in the lower portion of the river. Forty-nine species were collected in 11 collections from the middle mainstream of the river (north of the LCA ARDC study area) and 41 species were collected in 10 seine collections from the lower mainstream (near the confluence of the ARDC and the Amite River). Most of the species collected were freshwater species; however, a few transient marine species were observed or collected. The most abundant species collected were 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*).

Table 4.6. Population Trends and Projections through 2050 For Fishery Species within the Amite/Blind River Mapping Unit (LCWCRTF and WCRA, 1999)

Fishery Species	Amite/Blind Mapping Unit (Includes LCA ARDC study area)	
	Trend	Projection
Red drum	Not Applicable	Not Applicable
Black drum	Not Applicable	Not Applicable
Spotted sea trout	Not Applicable	Not Applicable
Gulf menhaden	Unknown	Unknown
Southern flounder	Not Applicable	Not Applicable
American oyster	Not Applicable	Not Applicable
White shrimp	Not Applicable	Not Applicable
Brown shrimp	Not Applicable	Not Applicable
Blue crab	Steady	Steady
Spanish mackerel	Not Applicable	Not Applicable
Largemouth bass	Steady	Steady
Channel catfish	Steady	Steady

A total of 21 species were collected in the Amite River by Lantz (1970) using rotenone and seine. Primarily freshwater species were collected, although a few transient marine species were also collected or reported. The species with the highest standing crop collected by rotenone were blue catfish (*Ictalurus furcatus*), gizzard shad (*Dorosoma cepedianum*), spotted gar (*Lepisosteus oculatus*), freshwater drum (*Aplodinotus grunniens*), channel catfish (*I. punctatus*), striped mullet, and largemouth bass. Young-of-the-year 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.

Watson *et al.* (1981) used rotenone and gill nets to collect 57 species of fish in the Blind River, including 43 freshwater species, 12 estuarine species, and two diadromous species. The authors suggested the confluence of the ARDC was a point of separation between the upper and lower reaches of Blind River. The lower Blind River had the greatest species diversity, primarily due to the presence of estuarine species. The low concentrations of DO above the ARDC could be an important limiting factor in the distribution of fish.

Hastings *et al.* (1987) utilized trawls, gill nets, and rotenone to collect 67 species of fish in Lake Maurepas. Two of the sampling stations were located at the mouths of the Amite and Blind Rivers. The distributions of species were: 55 percent freshwater, 40 percent marine, and 4 percent diadromous. The salinity in Lake Maurepas was variable; during periods of higher salinities, marine species comprised a larger component of the lake's species assemblage (Hastings *et al.*, 1987). When the salinity in the lake is higher, marine species are also more likely to be present in the Amite and Blind Rivers.

Existing Conditions. Fishery population changes are associated with the conversion of swamp habitat to freshwater marsh and open water habitat and as water quality declines. Coastal wetlands and open waters in the LCA ARDC study area provide important habitat for aquatic species. The area historically and currently provides valuable habitat for recreational fishing and nursery areas for a variety of finfish (Laiche, 1980; Watson *et al.*, 1981; Hastings *et al.*, 1987).

4.2.10 Essential Fish Habitat (EFH)

EFH is institutionally significant because of the Magnuson-Stevens Fishery Conservation and Management Act of 1996. EFH is technically significant because EFH includes "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." The high value that the public places on seafood, recreational and commercial opportunities makes EFH a publicly significant resource. Specific categories of EFH include all estuarine waters and substrates (mud, sand, shell, rock, and associated biological communities), including the sub-tidal vegetation (sea grasses and algae) and adjacent inter-tidal vegetation (marshes and mangroves).

The LCA ARDC study area does not contain any areas classified as EFH, although the area likely provides some habitat for a few euryhaline species (Rick Hartman, NMFS, pers. comm., March 27, 2009).

Historic Conditions. The LCA ARDC study area has never contained any areas classified as EFH. Although the area likely provides some habitat for a few euryhaline species, it is not classified as EFH (Rick Hartman, NMFS, personal communication, April 2009).

Existing Conditions. The LCA ARDC study area does not contain any areas classified as EFH. Although the area likely provides some habitat for a few euryhaline species, it is not classified as EFH (Rick Hartman, NMFS, personal communication, April 2009).

4.2.11 Threatened and Endangered Species

This resource is institutionally significant because of the ESA of 1973, as amended, and the MMPA. Endangered and threatened species are technically significant because the status of such species provides an indication of the overall health of an ecosystem. These species are publicly significant because of the desire of the public to protect them and their habitats.

The ESA of 1973 (16 USC 1531-1543) specifies that all Federal agencies are required to undertake programs for the conservation of threatened and endangered species and are prohibited from authorizing, funding, or undertaking any action that jeopardizes a species protected under the ESA or modifies its designated critical habitat. The provisions of the ESA apply only to species listed in the Federal Register as threatened or endangered.

Historic Conditions. There has been a decrease in some animal and plant populations and their critical habitat including loss of wetlands.

Federally-Listed Endangered and Threatened Species. Within the State of Louisiana, 29 animal and three plant species (some with critical habitats) are under the jurisdiction of the USFWS and NMFS that are presently classified as threatened or endangered (Table 4.7). The USFWS and NMFS share jurisdictional responsibility for sea turtles and the Gulf sturgeon. The USFWS, in a letter dated January 20, 2009, identified two threatened and endangered species (Gulf sturgeon and West Indian manatee) and one delisted species (bald eagle) that are known to occur within the LCA ARDC study area.

West Indian Manatee – The West Indian manatee is listed as endangered in Ascension Parish. The West Indian manatee occurs in shallow, slow-moving rivers, estuaries, saltwater bays, canals and coastal areas. Manatees occasionally enter Lakes Pontchartrain and Maurepas and associated coastal waters and streams during the summer months, i.e., June through September. Manatee occurrences appear to be increasing in coastal Louisiana, and sightings have been reported in the Amite, Blind, Tchefuncte, and Tickfaw rivers, and in canals within the adjacent coastal wetlands. The manatee has declined in numbers as a result of collisions with boats, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect the species.

Gulf Sturgeon - The Gulf sturgeon is listed as threatened in Ascension and Livingston Parishes. The Gulf sturgeon is anadromous and occurs in many rivers, streams, and estuarine waters along the northern Gulf coast between the Mississippi River and the Suwannee River in Florida. In Louisiana, Gulf sturgeon has been reported at Rigolets Pass, rivers and lakes of the Lake Pontchartrain Basin, and adjacent estuarine areas. Spawning occurs in coastal rivers between late winter and early spring (i.e., March to May). Adults and sub-adults may be found in those rivers and streams until November, and in estuarine or marine waters during the remainder of the year. Sturgeon, less than two years old, appear to remain in riverine habitats and estuarine areas throughout the year, rather than migrate to marine waters. Habitat alterations such as those caused by water control structures that limit and prevent spawning, poor water quality, and overfishing have negatively affected the species.

Table 4.7. Endangered (E) and Threatened (T) Plant and Animal Species in Louisiana

Species Under Jurisdiction of the USFWS **Status Common Name** **(*Scientific Name*)**	**Species Under Jurisdiction of NMFS** **Status Common Name** **(*Scientific Name*)**
<u>Mammals</u> 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*) <u>Birds</u> 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*) <u>Reptiles</u> 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*) <u>Fish</u> E -- Pallid sturgeon (*Scaphirhynchus albus*) **T[3] -- Gulf sturgeon (*Acipenser oxyrinchus desotoi*)** <u>Invertebrates</u> E -- Mussel, Fat pocketbook (*Potamilus capax*) E -- Pink pearlymussel Mucket (*Lampsilis abrupta*) T -- Inflated (Alabama) heelsplitter (*Potamilus inflatus*) T -- Louisiana pearlshell (*Margaritifera hembeli*) <u>Plants</u> E -- American chaffseed (*Schwalbea americana)* E -- Louisiana quillwort (*Isoetes louisianensis*) T -- Earth fruit (*Geocarpon minimum*) <u>Candidate Species[5]</u> C -- Snake, Louisiana pine (*Pituophis ruthveni*)	<u>Marine Mammals</u> 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*) <u>Sea Turtles[3]</u> 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*) <u>Fish</u> **T -- Gulf sturgeon (*Acipenser oxyhyinchus desotoi*)** <u>Candidate Species[5]</u> Dusky shark (*Carcharhinus obscurus*) Sand tiger shark (*Odontaspis taurus*) Night shark (*Carcharinus signatus*) Speckled hind (*Epinephelus drummondhayi*) Saltmarsh topminnow (*Fundulus jenkensi*) Jewfish (*Epinephelus itajara*) 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.

Legend: E=Endangered; T= Threatened; C=Candidate
Species in bold type are those potentially found within the LCA ARDC study area

On March 19, 2003, the USFWS and NMFS published a final rule in the Federal Register (Volume 68, No. 53) designating critical habitat for the Gulf sturgeon in Louisiana, Mississippi, Alabama, and Florida. Within Louisiana, this critical habitat includes portions of the Pearl and Bogue Chitto rivers, Lake Pontchartrain east of the Greater New Orleans Expressway Commission Causeway, Little Lake, the Rigolets, Lake St. Catherine, and Lake Borgne. Gulf sturgeon have been observed in waterbodies within the LCA ARDC study area; however, these waterbodies are not within the critical habitat.

Louisiana State Rare, Threatened, and Endangered Species and Natural Communities. The LNHP, founded in 1984 through a partnership with the State of Louisiana and The Nature Conservancy, is maintained by the LDWF. The LNHP was founded with the goal of developing and maintaining a database on rare, threatened and endangered species of plants and animals, and natural communities for Louisiana. According to the database, 21 species and natural communities (Table 4.8) occur in Ascension and Livingston Parishes. The USFWS, in a letter dated October 15, 2008, also noted that the proposed LCA ARDC study area is known to support colonial nesting waterbirds.

Table 4.8. Rare, Threatened, and Endangered Species and Natural Communities Tracked by the LNHP, Ascension and Livingston Parishes-January 2010

Scientific Name	Common Name	State Rank[1]
Acipenser oxyrinchus desotoi	Gulf sturgeon	S1S2/Threatened
Aimophila aestivalis	Bachman's sparrow	S3
Alosa alabamae	Alabama shad	S1
Bottomland hardwood forest	Bottomland hardwood forest	S4
Cypress-tupelo swamp	Cypress-tupelo swamp	S4
Haliaeetus leucocephalus	Bald eagle	S2N,S3B/Endangered
Hemidactylium scutatum	Four-toed salamander	S1
Lampsilis ornata	Southern pocketbook	S3
Mustela frenata	Long-tailed weasel	S2S4
Ophisaurus ventralis	Eastern glass lizard	S3
Picoides borealis	Red-cockaded woodpecker	S2
Potamilus inflatus	Inflated heelsplitter	S1/Threatened
Rhadinaea flavilata	Pine woods snake	S1
Rhynchospora miliacea	Millet beakrush	S2
Sorex longirostris	Southeastern shrew	S2S3
Spilogale putorius	Eastern spotted skunk	S1
Spruce pine-hardwood mesic flatwoods	Spruce pine-hardwood mesic flatwoods	S2
Stewartia malacodendron	Silky camellia	S2S3
Trichechus manatus	West Indian manatee	SZN/Endangered
Trichomanes petersii	Dwarf filmy-fern	S2
Waterbird nesting colony	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; S? = rank uncertain.
Source: http://www.wlf.louisiana.gov/experience/naturalheritage/rarespeciesandparishhabitats/)

Existing Conditions

Federal Designation. Two animals under the Federal jurisdiction of the USFWS and/or the NMFS, presently classified as endangered or threatened are within the LCA ARDC study area (Table 4.9).

Table 4.9. Threatened and Endangered Plant and Animal Species in the LCA ARDC Study Area (LNHP, 2008)

Species	Critical Habitat	Status		Jurisdiction	
		Federal	State	USFWS	NMFS
LISTED SPECIES					
Red-cockaded woodpecker (*Picoides borealis)*		E	E	X	
West Indian manatee (*Trichechus manatus*)		**E**	**E**	**X**	
Gulf sturgeon (*Acipenser oxyrhynchus desotoi*)		**T**	**T**	**X**	**X**
Alabama shad (*Alosa alabamae*)		C	S1	X	
Inflated heelsplitter (*Potamilus inflatus*)		T	T	X	
RARE SPECIES					
Bachman's sparrow (*Aimophila aestivalis*)			S3		
Dwarf filmy fern (*Trichomanes petersii*)			S2		
Eastern glass lizard (*Ophisaurus ventralis*)			S3		
Eastern spotted skunk (*Spilogale putorius*)			S1		
Four-toed salamander (*Hemidactylium scutatum*)			S1		
Long-tailed weasel (*Mustela frenata*)			S2S4		
Millet beakrush (*Rhynchospora miliacea*)			S2		
Pine woods snake (*Rhadinaea flavilata*)			S1		
Silky camellia (*Stewartia malacodendron*)			S2S3		
Southeastern shrew (*Sorex longirostris*)			S2S3		
Southern pocketbook (*Lampsilis ornata*)			S3		

Notes: Species with occurrences within LCA ARDC study area as documented by USFWS and/or LNHP are denoted by a **bold** font.

Status: E-Endangered S1-Critically imperiled in LA
T-Threatened S2-Imperiled in LA
C-Candidate S3-Rare and local throughout LA
D-Delisted S4-Apparently secure in LA
SR-Reported in LA

State Designation. The LNHP maintains a database of rare, threatened, and endangered species of plants, animals, and natural communities for Louisiana. The LNHP lists 11 rare species within Ascension and Livingston Parishes that may potentially be present within the LCA ARDC study area (Table 4.8). Additionally, the LNHP lists the following species or rare elements as occurring in the LCA ARDC study area:

- Bald cypress-tupelo swamp habitat,

- A bald eagle nest; and
- Two great blue heron rookeries.

4.2.12 Cultural and Historic Resources

This resource is institutionally significant because of NEPA and the National Historic Preservation Act of 1966 (NHPA). This resource is technically significant due to the importance of protection and conservation of traditional cultural resources, historic buildings and structures, and other valued cultural resources. This resource is publicly significant because the public demands the preservation of cultural resources.

Section 106 of the NHPA requires Federal agencies to take into account the effects of their undertakings on historic properties, and afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment. The historic preservation review process mandated by Section 106 is outlined in regulations issued by ACHP. Revised regulations, "Protection of Historic Properties" (36 CFR Part 800), became effective January 11, 2001.

The State Historic Preservation Office (SHPO) administers the national historic preservation program at the state level, reviews National Register of Historic Places nominations, maintains data on historic properties that have been identified but not yet nominated, and consults with Federal agencies during Section 106 review. The two historic properties located within the LCA ARDC study area are the ARDC (Division of Archeology site number 16LV103/16AN84) and the abandoned railroad grade (Division of Archeology site number 16LV102).

The ARDC is a 10.6 mi. long artificial channel that extends from the Amite River at Mile 25.3 to Mile 4.8 of the Blind River in Ascension and Livingston Parishes (see Figure 1.2). The ARDC is recommended not eligible for National Register of Historic Places (NRHP) nomination. While a number of historic canals are NRHP listed—the Chesapeake and Ohio Canal, the Delaware Canal, and the Ohio and Erie Canal for example—the significant examples are typically pre-20th century transportation features that contributed significantly to their region's historic economy and, in some cases, also represent significant engineering innovations or feats. In contrast, the ARDC is one of a number of similarly constructed post WW II canals that were simply designed to improve flood control and drainage. Other examples in the immediate vicinity include the Chinquapin Canal and the New River Canal.

The abandoned railroad grade is an 8 km long linear feature within the LCA ARDC study area (see Figure 1.2). It extends south from the Chinquapin Canal, across Chene Blanc Bayou and the ARDC, and then turns east as it approaches the Blind

River. Additionally, it extends north and south of the LCA ARDC study area in the adjoining swamps that are beyond the LCA ARDC study area.

The old railroad grade is recommended not eligible for NRHP nomination. Abandoned railroad grades that are associated with the historic lumber industry are ubiquitous in Louisiana. The old grade represents only a portion of the former railroad infrastructure, and it has been modified by the removal of the wooden ties and steel rails.

Historical Conditions. Cultural resources have been subject to natural and man-made processes. Recorded archival and historical research was conducted to develop a baseline level of knowledge for prehistoric and historic period cultural developments and to identify archeological and historical sites previously recorded in the LCA ARDC study area. Among the research efforts, a review of historical literature and previous archeological investigation reports yielded information useful for developing a general chronology of cultural developments across the region.

Existing Conditions. Human activities, as well as natural processes, can potentially destroy historic and natural resources. The loss of land threatens the existence and integrity of these resources. An inventory of identified cultural resource sites within the LCA ARDC study area was compiled through database and paper map searches located at the SHPO. The SHPO manages these resources through the Divisions of Archaeology and Historic Preservation for use during the Section 106 Review process. The Division of Archaeology houses records of archaeological resources both on USGS 7.5-minute series quadrangle maps and a confidential cultural resources geodatabase layer. Cultural affiliation, National Register status, and other descriptive details of the archaeological sites are recorded on site forms stored at the Division. Information concerning areas previously surveyed for cultural resources depicted on parish-wide street maps and the corresponding reports can also be obtained from the Division of Archaeology. Standing structure forms are managed by the Division of Historic Preservation and are housed at the Louisiana State Library. These forms record data providing National Register status, structural details, historical significance, and photographs of the surveyed structure. Locations and ownership information for these standing structures are also maintained in a public cultural resources geodatabase layer.

Preliminary archival research of recorded cultural resources in the geodatabase layers and USGS quadrangle maps identified five archaeological sites within or immediately adjacent to the LCA ARDC study area, including a mound site on the Bayou Chene Blanc bankside, shell middens on Bayou Chene Blanc (two sites) and ARDC (one site north of the LCA ARDC study area) banksides, and a shell midden and prehistoric scatter on the lower Amite River bankside (Table 4.10). The mound site on Bayou Chene Blanc could not be located and is presumed to be destroyed. While these sites are located within the vicinity of the LCA ARDC study area, no impact to these identified sites is anticipated from project activities. No standing structures were identified within or immediately adjacent to the LCA ARDC study area during preliminary archival research. No archaeological sites were located at the five proposed cuts.

Table 4.10. Identified Archaeological Sites Within the LCA ARDC Study Area (SHPO, 2008)

Site ID No.	Description	Location	Comments	NRHP Status
16LV91	Destroyed mound site	Bayou Chene Blanc bankside	Possible camp site	Eligible
16LV92	Shell midden	Bayou Chene Blanc bankside	Possible camp site	Potentially eligible
16LV93	Shell midden	Bayou Chene Blanc bankside	Possible camp site	Potentially eligible
16LV5	Shell midden and prehistoric scatter	Amite River bankside	Possible prehistoric hamlet or village	Eligible
16AN16	Shell midden	ARDC bankside	Possible prehistoric hamlet or village	Unknown

On October 19, 2009, Panamerican Consultants Inc. performed a cultural resources survey of the five proposed cuts in the ARDC. No archeological sites were located at five proposed cuts, but one modern Rangia scatter was observed near cut 5. The Rangia scatter was considered an insignificant finding. The two historic properties located within the LCA ARDC study area are the ARDC (Division of Archeology site number 16LV103/16AN84) and the abandoned railroad grade (Division of Archeology site number 16LV102). Both of these sites are ineligible for the National Register of Historic Places.

A letter of SHPO concurrence with these findings was received January 2010 (Appendix F). This letter states that the office concurs with the findings. It does not appear that any significant archeological sites or historic properties will be affected by the proposed project. Therefore, cultural resources need not be further considered during pursuit of the project for which the investigations were conducted.

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) (Appendix F). The Programmatic Agreement establishes the procedures for consultation, identification of historic properties, assessment and resolution of adverse effects.

4.2.13 Aesthetics

This resource is institutionally significant because of the Natural and Scenic River Systems and the National Wild and Scenic Rivers System created by Congress in 1968 (Public Law 90-542; 16 U.S.C. 1271 *et seq*.) Aesthetics is technically significant because the visual complexity provides an indication of the overall health of an ecosystem. Aesthetics are publicly significant because of the desire of the public to protect habitats and viewscapes.

Historic Conditions. The streams of the project area were essentially what they are today, and there were no canals. The streams were not seen by many people because the area was remote and opportunities for fishing and boating were widespread for people in the major population centers such as Baton Rouge and New Orleans. The project area was a virgin forest before it was clear cut in the early 1900s. However, the interior swamps would have been seen only by a few trappers. The logging operations decimated the swamps, which subsequently were recovering from an aesthetic perspective until the construction of the ARDC introduced new conditions of decline and cut across some of the existing streams such as the Petite Amite River. However, one of the major effects of the ARDC was to open the project area to a high level of visitation and enjoyment.

Louisiana 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 (Louisiana State University [LSU] Agricultural Center, 2009). It encompasses over 80 streams or stream segments including over 3,000 linear miles (4,827 km) of Louisiana's streams, rivers, and bayous (LDWF, 2005). The streams in the system vary from fast flowing upland streams with riffles and waterfalls to sluggish swamp bayous flanked by Spanish moss draped cypress trees to brackish water tidal creeks in the coastal marshes. A natural or scenic river is a river, stream, or bayou that is in a free-flowing condition and has not been altered by channelization or realignment (Louisiana Scenic Rivers Act [LSRA] - Acts 1988, No. 947, § 1, eff. July 27, 1988). A stream can also be classified as scenic if it has been altered, but contains native vegetation and has little or no manmade structures along its bank. The LDWF administers the Louisiana Natural and Scenic Rivers system established in 1970 for the purpose of preserving, developing, reclaiming and enhancing the wilderness qualities, scenic beauties and ecological regime of designated free-flowing waterbodies. The LCA ARDC study area is made up mostly of open water marshes, swamps and bayous. Blind River is a designated scenic river located adjacent to the LCA ARDC study area.

Existing Conditions

Streams and Canals - The primary streams in the project area are the Petite Amite River, Blind River, Little Bayou Chene Blanc, and Bayou Chene Blanc. All of these streams are placid, run through swamps, have low banks that allow views into the immediate interior, and are occasionally fringed by large cypress trees that were too decayed or deformed to harvest. The water is generally clean and free of debris and obstructions, with the exception of rapidly spreading *Salvinia* sp. that stretches across portions of the Petite Amite River and the Blind River and forms a solid mass on the Blind River before its confluence with the Petite Amite River. The Blind River is a designated Wild and Scenic River, a status suggestive of its aesthetic qualities.

The two canals in the project area are the Chinquapin Canal and the ARDC. The Chinquapin Canal runs through swamp and is straight and narrow, with dredged materials placed on the north bank and the south open to views of the swamp. It is generally clean and free of debris until nearing Berthelot's Campground.

The primary feature of the ARDC from an aesthetic perspective is its large bank-to-bank size and a length that establishes a sense of vista, whether viewed from a boat, a bridge, or a residence. Housing on the north side of the canal in Riverfront East is elegant, with manicured yards. Campsites on the south side in Three Rivers Island are architecturally varied and rise to greater heights than the homes on the north side, providing visual contrast. Residents enjoy sitting in their back yards simply to view the water.

Swamps and Ridges - Apart from Berthelot's Campground, the small strip of housing and campsite development on the ARDC, and the old railroad grade, most of the project area is composed of swamps and ridges. The ridges are small rises in the swamp and are occupied by water oak, diamond oak, sweetgum, ash, wax myrtle, black willow, Chinese tallow, and privet. They provide an idyllic setting in contrast to the surrounding darkness and wetness of the swamps and a welcome relief for hunters, nature observers, bird watchers, and ecologists.

From an aesthetic perspective, the swamps of the project area can be characterized as either healthy or degraded. The healthy areas have a fairly dense canopy constituted by bald cypress and water tupelo trees. The baldcypress are not majestic because the original trees were removed by logging operations in the early

1900s. The understory, which is not dense, is composed primarily of swamp red maple and green ash. The ground is hard bottom. The swamps are perennially wet, but the water is clear. The setting is tranquil and shaded.

The degraded swamps, which were formerly of the bald cypress-tupelo type, are located in the low interior areas as the elevations decrease away from the ridges and dredged material deposits. The canopy has largely or completely disappeared, eliminating the shading in the surrounding swamp. The ground is bog-like, with a danger of sinking past hip boots, and the water is covered with green floating scum. There is a strong odor that smells like decayed matter. The degraded swamps are decidedly unpleasant from an aesthetic perspective.

View Sheds. The Blind River, Little Bayou Chene Blanc, Bayou Chene Blanc, and the scenic portions of the Petite Amite River are only observable by boat within the project area. The Chinquapin Canal is observable from land but only through streets in Berthelot's Campground that are separated from the canal by private properties. The only expansive view of the ARDC (other than by boat) is from the Hwy. 22 bridge by automobile, but the view is of short duration because it is dangerous to stop on the bridge.

There are no public views of the interior of the swamps, which are seen only by a small number of hunters (fewer than 40). The only public thoroughfare in and around the project area is the ARDC, which is used by recreational boaters. The view sheds for this portion of the project area include the areas surrounding the dredged material berm and minimal areas within the interior swamp. These views are made up mostly of the development along the banks of the canal and some overgrown portions of the bank; therefore, a majority of the impacts that occur within the project area would not be noticeable from these view sheds.

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. Recreation activities in the LCA ARDC study area are centered on natural resources. There was little in the way of recreational activities in the LCA ARDC study area historically because the area was remote and opportunities for boating, fishing, and hunting were widespread for people in the major population centers such as Baton Rouge and New Orleans. Usage of the streams for boating and fishing developed gradually as the quality and range of recreational boats increased, and usage of the swamps for hunting developed gradually as resources near population centers became scarcer. However, there was a burst of recreation activity during the post-war economic expansion, which provided the resources and leisure for higher levels of recreational participation. The construction of the ARDC opened the area for those higher levels of participation.

Existing Conditions. Recreation activities in the LCA ARDC study area are centered on the area's natural resources. The waterways within and comprising the boundaries of the LCA ARDC study area are used extensively for recreational purposes. According to the LDWF (personal communication), the most important of these activities is pleasure boating, followed by fishing and then by hunting. Water access is available from private docks along the waterways and from public and private boat ramps.

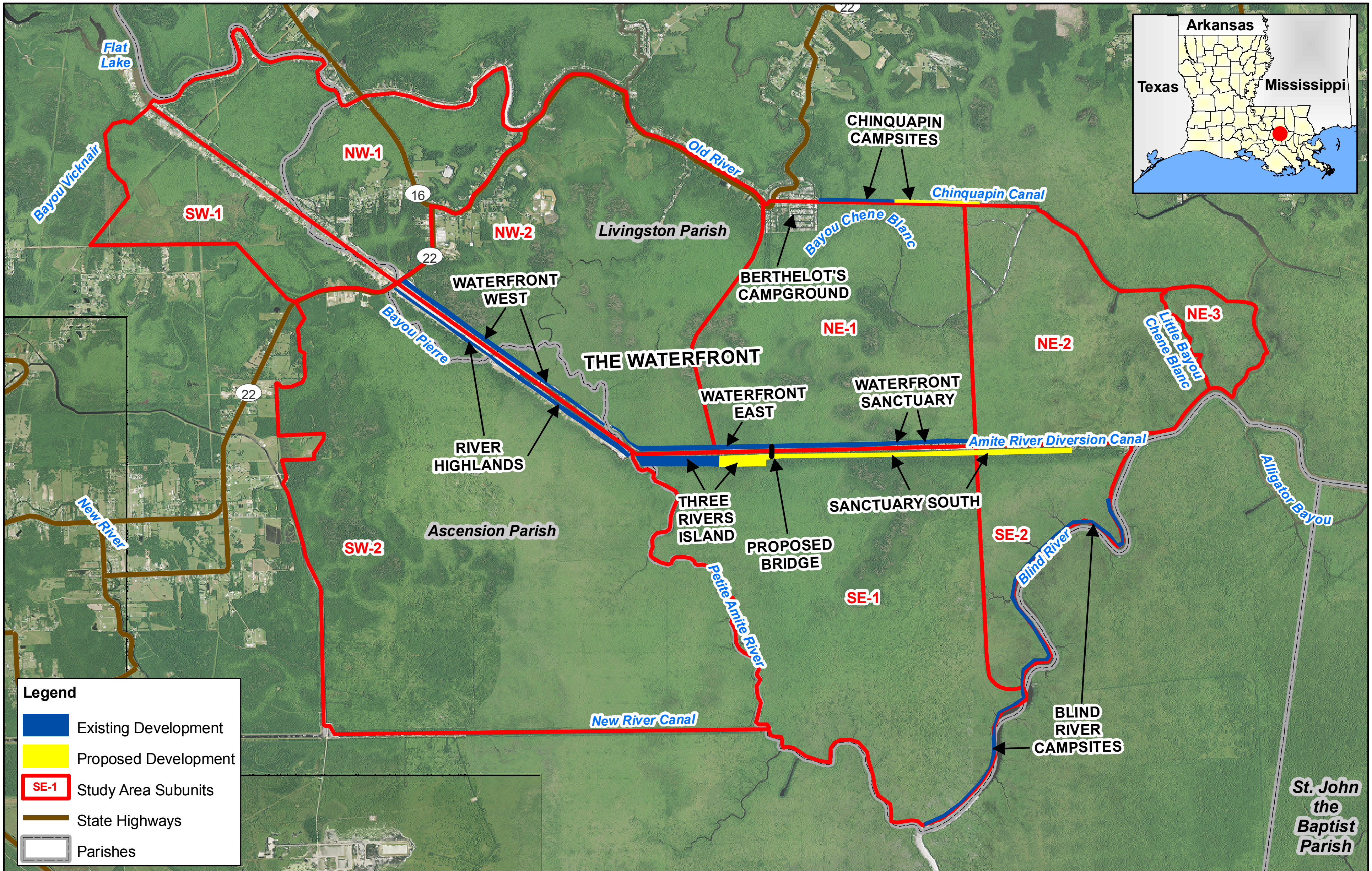
4.2.15 Socioeconomics and Human Resources

This resource is institutionally significant because of NEPA; the Estuary Protection Act; the CWA; 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.

The *Final Programmatic Environmental Impact Statement* (FPEIS) for the *Louisiana Coastal Area (LCA) Louisiana Ecosystem Restoration Study* is incorporated by reference. The FPEIS deals with the whole of the coastal area and therefore does not contain information specific to the LCA ARDC study area. The FPEIS points out that water has traditionally acted as an attractant for settlement. This is also the situation in the LCA ARDC study area.

4.2.15.1 Population and Housing

Historic Conditions. The Chinquapin Canal was constructed in the 1950s by the Livingston Parish Department of Public Works with the assistance of the State of Louisiana and discharges water from Old River into Bayou Chene Blanc. Berthelot's Campground was developed in the 1960s at the intersection of the canal and the river (Figure 4.9). The campground was developed on both sides of the canal and displayed a typical subdivision street pattern. Other than



EXISTING AND PROPOSED DEVELOPMENT NEAR THE LCA-ARDC STUDY AREA

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Ascension and Livingston Parishes USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 4.9	
Date: October 2009	
Scale: 1:80,000	
Source: NAIP/GEC	
Map ID: 27850108-1790	

Berthelot's Campground, the LCA ARDC study area has had little in the way of population or housing. Development along the dredged material berms has occurred, leading to an increase in population and residential housing within the LCA ARDC study area.

Existing Conditions. Development in the LCA ARDC study area is generally along the ARDC, Amite and Blind Rivers and on ridges (Figure 4.9). The LCA ARDC study area is located within an area that historically has been known as Maurepas Island, which is bounded on the north by the Amite River, on the west by Bayou Pierre, on the south by the Petite Amite and Blind rivers, and on the east by Lake Maurepas. This designation was apparently used from the earliest settlement period, because it appears in Act 95 of the 1850 Louisiana Legislature, which transferred the island from Ascension Parish to Livingston Parish.

The community of Head of Island, which is on the Amite River immediately west of the LCA ARDC study area, was so named because it is at the head of this island. The English name and its suggestion of upstream movement indicate that it was a late landing for boats, although it may have been a stopping place as early as the 1700s. Mary Ann Sternberg in *Winding Through Time: The Forgotten History and Present-Day Peril of Bayou Manchac* indicates that Head of Island was a landing for steamboats from New Orleans from at least 1868, and it begins to appear on maps in the 1870s.

The newer housing developments that constitute the distinctive feature of the ARDC did not begin until the present decade, with Blind River Properties as one of the major developers. The Blind River Properties is the largest property holder in the LCA ARDC study area and its environs. The Blind River Properties owns 32,806 acres along the southwest shore of Lake Maurepas, along both banks of Blind River, and along the ARDC (Annie Fugler, "Boat-ing in Your Own Backyard," *Livingston Business and Real Estate Journal*, August 2006, pp.7-9). Approximately 85 to 90 percent is clear cut bald cypress swamp. The balance consists of higher elevations along various oak ridges, lake shore banks, and canal dredged material areas.

4.2.15.2 Employment and Income

Historic Conditions. In the past, employment within the LCA ARDC study area was less than current figures due to limited population and business. Income levels were also lower than present, due to the socioeconomic makeup of the local residents. An increase in development has led to increased incomes and employment. Census information is difficult to interpret for the LCA ARDC study area due to the differential between the size of the census block and the LCA ARDC study area.

Existing Conditions. The permanent-resident population of Berthelot's Campground is about 180. About half of the adults are retired. The non-retired permanent residents work in Baton Rouge, Denham Springs, Gonzales, and the plants along the Mississippi River. The permanent-resident population of Waterfront East is about 247. About 30 percent of the adults are retired. The non-retired permanent residents work in Baton Rouge, New Orleans, and Denham Springs. The permanent-resident population of Three Rivers Island is about 23, mostly single persons working at the industrial facilities on the Mississippi River. The unemployment rate was 7.2 percent for Livingston Parish in July 2009. There is nothing to indicate that the permanent residents of the project area are experiencing any particular difficulties with respect to employment, although for sale signs suggest that many were affected by the downturn in the housing market.

Berthelot's Campground is populated by middle income persons, with some low income persons. Waterfront East, and particularly the Sanctuary, is populated by high income persons. The Three Rivers Island Campground is populated by middle to upper income persons.

4.2.15.3 Community Cohesion

Historic Conditions. Berthelot's Campground was a well defined community with good community cohesion since the 1960s. No other communities existed in the LCA ARDC study area. Therefore, there were no other issues affiliated with community cohesion.

Existing Conditions. The LCA ARDC study area is populated along the ARDC, Amite and Blind Rivers, and on adjacent ridges. Community cohesion must be addressed from the perspective of the LCA ARDC study area and the individual communities within the LCA ARDC study area. The three communities within the LCA ARDC study area are Berthelot's Campground, Waterfront East, and Three Rivers Island. The Blind River Campsites should not be considered a potential community because only one camp has been established. The three communities are internally homogeneous and not related to each other.

4.2.15.4 Environmental Justice

Environmental Justice (EJ) is institutionally significant because of Executive Order 12898 of 1994 (E.O. 12898) and the Department of Defense's Strategy on Environmental Justice of 1995, which direct Federal agencies to identify and address any disproportionately high adverse human health or environmental effects of Federal actions to minority and/or low-income populations. Minority populations are those persons who identify themselves as Black, Hispanic, Asian American, American Indian/Alaskan Native, and Pacific Islander. A minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population. Low-income populations as of 2000 are those whose income are $22,050.00 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 LCA ARDC 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 LCA ARDC study area. Livingston Parish, of which the LCA ARDC Modification 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 ARDC 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.

Existing Conditions. The proposed LCA ARDC Modification project area follows the boundary of the Petite Amite River which borders Ascension and Livingston Parishes in Louisiana. The LCA ARDC Modification project area is primarily freshwater swamp that is sparsely populated, with a few residential streets and businesses in the northwestern section of the project boundary as well as residences along the Amite River Diversion Canal.

According to the 2000 U.S. Census, the LCA ARDC Modification project boundary for Livingston Parish is located within census tract 409.2, and has not changed from 2000 to 2008. The 2000 Census records indicate that the minority population in Livingston Parish was 6.3 percent and the low-income population was 11.4 percent. According to 2008 ESRI estimates (ESRI 2008), 8.2 percent of the population was minority and the 2007 ESRI estimates indicate 10.8 percent of the population was low income. The percentage of the population that is minority and low-income in Livingston Parish is significantly lower than state figures. Per the 2000 U.S. Census data, the LCA ARDC Modification project area was not a minority and/or low income community in 2000.

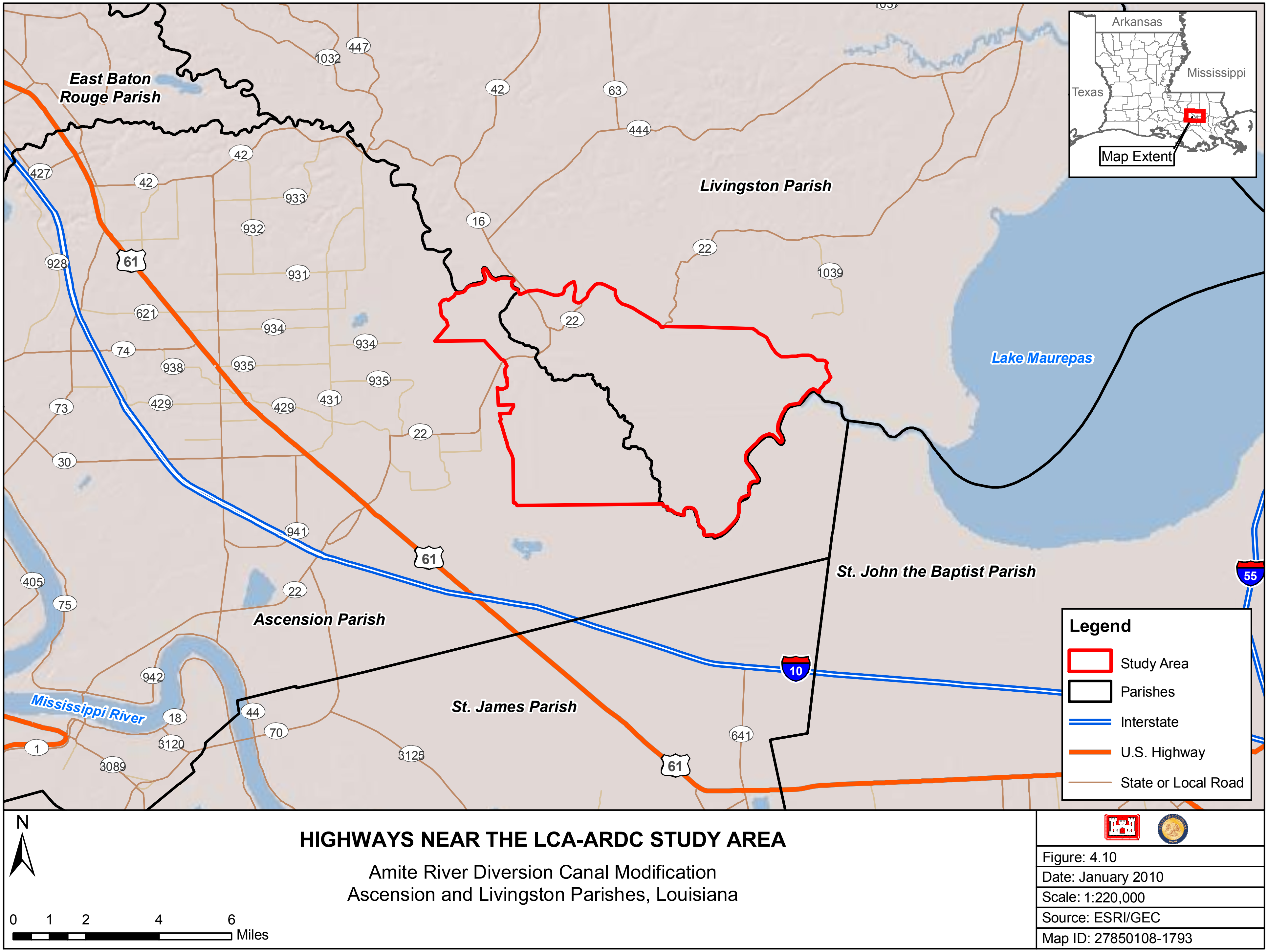
4.2.15.5 Infrastructure

Historic Conditions. Little in the way of highway development existed within the LCA ARDC study area until the 1950s, at which time LA-22 was constructed (Figure 4.10). The increase in development along the dredged material berms has led to the development of additional access roads and bridges associated with these new communities.

Existing Conditions. Plans for a proposed development along the right descending bank of the ARDC east of the Petite Amite River (as presented in Coastal Use Permit Application P20060256 [DOA Permit Application MVN-2006-1335-CZ]) include a new residential access road along the right descending bank (2.7 miles) and a new bridge that would traverse the ARDC at an elevation of 26 ft National Geodetic Vertical Datum of 1929 (NGVD 29), approximately 1.5 miles east of the Petite Amite River (subunit SE-1), for access to the new development. Two 20-foot by 40-foot bridge crossings are proposed along the new residential access road to coincide with proposed locations for dredged material berm cuts. Additionally, the U.S. Coast Guard has proposed the construction of a new bridge across the ARDC at Mile 3.37, near Head of Island, Louisiana (subunits NW-2/SW-2). The bridge would be accessed by Homeport Drive and would provide access to waterfront developments along the ARDC.

4.2.15.6 Business and Industry

Historic Conditions. Within the LCA ARDC study area, little in the way of business and industry existed over the last 100 years. Some businesses, including boat launches, bars, and restaurants have formed as a result of population and housing increases and added infrastructure.



HIGHWAYS NEAR THE LCA-ARDC STUDY AREA

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Figure: 4.10
Date: January 2010
Scale: 1:220,000
Source: ESRI/GEC
Map ID: 27850108-1793

Existing Conditions. Businesses are generally retail stores and restaurants. There are only six businesses in the LCA ARDC study area, of which five are located in Berthelot's Campground. Val's marina, bar, restaurant, and grocery is an old establishment on LA- 22 at the west entrance to the campground and is oriented toward the campground and campsites along Old River. D&J's bait shop is run out of a home and serves campground residents as well as nearby launches. There are two unnamed sinker cypress lumber mills that mill submerged logs from bayous and lakes of the region. There is also an unnamed Recreational Vehicle (RV) park that contains six covered spaces. The Blind River Bar is located within the LCA ARDC study area south of the ARDC at its confluence with the Blind River and is accessible only by water. This is the only business in the LCA ARDC study area other than the businesses in Berthelot's Campground.

There are no businesses in Waterfront East, Three Rivers Island, and the Blind River Campsites. However, there are three areas of new businesses contiguous to the LCA ARDC study area that are important to Waterfront East and Three Rivers Island and the general area of the ARDC.

4.2.15.7 Traffic and Transportation

Historic Conditions. Little to no traffic and transportation existed within the LCA ARDC study area until the 1950s, at which time LA-22 was constructed (Figure 4.10). The increase in development along the dredged material berms has led to additional vehicular traffic associated with these new communities. Boat traffic has also increased as a result of increased development, and the construction of the ARDC and the Chinquapin Canal in the 1950s and 1960s, respectively.

Existing Conditions. State and local roads traverse the LCA ARDC study area. Traffic is generally confined to residents and recreational visitors. Louisiana Highways 22 and 16, which were blacktopped in the 1950s, are the major roads in the vicinity of the LCA ARDC study area. The roads in the LCA ARDC study area are residential access roads. Berthelot's Campground contains a subdivision street pattern. Waterfront East, including The Sanctuary, is served by a single road (Waterfront East Drive) that parallels the ARDC and runs in back of the homes on the canal. Waterfront East Drive is accessed through Homeport Drive, which serves a similar function for Waterfront West and connects with LA-22. Three Rivers Island is served by a golf cart path that parallels the ARDC and runs in back of the camps on the canal. The golf cart path is accessed by River Highlands Drive, which serves a similar function for the River Highlands development and connects with LA-22. There is no vehicular access to the Blind River Campsites.

4.2.15.8 Public Facilities and Services

Historic Conditions. Little to no public facilities and services existed within the LCA ARDC study area until increases in development along the dredged material berms occurred. With these developments, public services such as wastewater treatment, water service, and electricity were implemented.

Existing Conditions. Public facilities and services generally serve residents and recreational visitors. The LCA ARDC study area is not serviced by a municipal sewer system. Wastewater Treatment of Louisiana, Inc. provides sewer service to the two existing Blind River Properties developments along the left descending bank of the ARDC. Those properties within the LCA ARDC study area not receiving sewer service from private companies use septic systems for treatment and disposal of sewage. DOA Section 10/404 Permits for the two existing Blind River Properties developments on the left descending bank of the ARDC identify the locations of four existing sewer treatment facilities (approximately 0.2, 0.5, and 2.0 miles southeast of LA-22 and 2.2 miles east of the Petite Amite River) and six sewer pump stations (approximately 0.2, 0.5, 1.0, 1.3, 1.7, and 2.0 miles southeast of LA-22). A proposed sewer treatment facility within the new Blind River Properties development on the right descending bank of the ARDC east of the Petite Amite River is planned for installation approximately 1.3 miles west of the Blind River. This new development would also receive sewer service from Wastewater Treatment of Louisiana, Inc.

Mail service is provided through the Maurepas Post Office northeast of the project area (which is why all of the residences and businesses have Maurepas addresses). Schools are readily available in Livingston Parish, which has benefitted from the movement of population to the east out of Baton Rouge.

4.2.15.9 Local Government Finance

Historic Conditions. Historically, government finances within the LCA ARDC study area were small proceeds directed towards Ascension and Livingston Parishes. Increased development, as well as increases in income levels, has led to increases in government finances.

Existing Conditions. Increasing population growth increased local government finances. There are no incorporated towns within the LCA ARDC study area and therefore no issues connected with local government finance. Head of Island and Coteau Bourgeois west of the LCA ARDC study area are not incorporated.

4.2.15.10 Tax Revenue and Property Values

Historic Conditions. The development of properties on the dredged material berms within and outside of the project area, along with increases in business, have resulted in increased property values and tax revenues for Ascension and Livingston Parishes.

Existing Conditions. Increasing population growth increases tax revenue and property values. The development of properties on both banks of the ARDC within and outside of the LCA ARDC study area has resulted in increased property values and tax revenues for Livingston Parish.

4.2.15.11 Community and Regional Growth

Historic Conditions. An increase in residential development on the dredged material berms has led to community and regional growth within the LCA ARDC study area. Berthelot's Campground (Figure 4.9) has experienced very little growth since its inception in the 1960s. Waterfront East and Three Rivers Island were only recently developed and therefore have experienced absolute growth if measured from the point of inception and nearly complete growth if measured from the expected point of completion. These developments and others on the ARDC have been important factors in the growth of the southern portion of Livingston Parish.

Existing Conditions. Increasing population is resulting in community and regional growth. The three communities within the LCA ARDC study area are Berthelot's Campground, Waterfront East, and Three Rivers Island. The Blind River Campsites should be considered a potential community because only one camp has been established. Berthelot's Campground has experienced very little growth since its inception in the 1960s. Waterfront East and Three Rivers Island were only recently developed and, therefore, have experienced absolute growth if measured from the point of inception and nearly complete growth if measured from the expected point of completion. Both of these communities are nearly fully developed in the sense that most of the lots in Waterfront East and Three Rivers Island have been sold and contain residences or campsites. These developments and others on the ARDC have been important factors in the growth of the southern portion of Livingston Parish.

4.2.15.12 Land Use Socioeconomics

Agriculture

Historic Conditions. Historically, a significant amount of agricultural development existed just beyond the LCA ARDC study area. No significant agriculture has existed within the LCA ARDC study area.

Existing Conditions. There is no agricultural or pasturage acreage in the project area.

Forestry

Historic Conditions. Timber was harvested extensively throughout the LCA ARDC study area prior to the 1940s (John McKenna, 1975 Louisiana State University Thesis, *The Role of Water Transportation in the Settlement of Bayou Manchac and the Amite River*).

Existing Conditions. A timber survey and appraisal was conducted in 1994 by professional forestry consultants for the 32,806 acres owned by Blind River Properties. The consultants found that there were no areas of cypress and tupelo in the swamps with trees of sufficient size and volume to be considered merchantable. Merchantable size timber (red oak, sweet gum, and ash) was found only on the ridges, including those in the LCA ARDC study area. However, marketability was considered doubtful because of inaccessibility. Little timber harvesting occurs within the LCA ARDC study area. However, submerged cypress logs are extracted from nearby bayous and lakes and processed by several local timber mills.

Public Lands

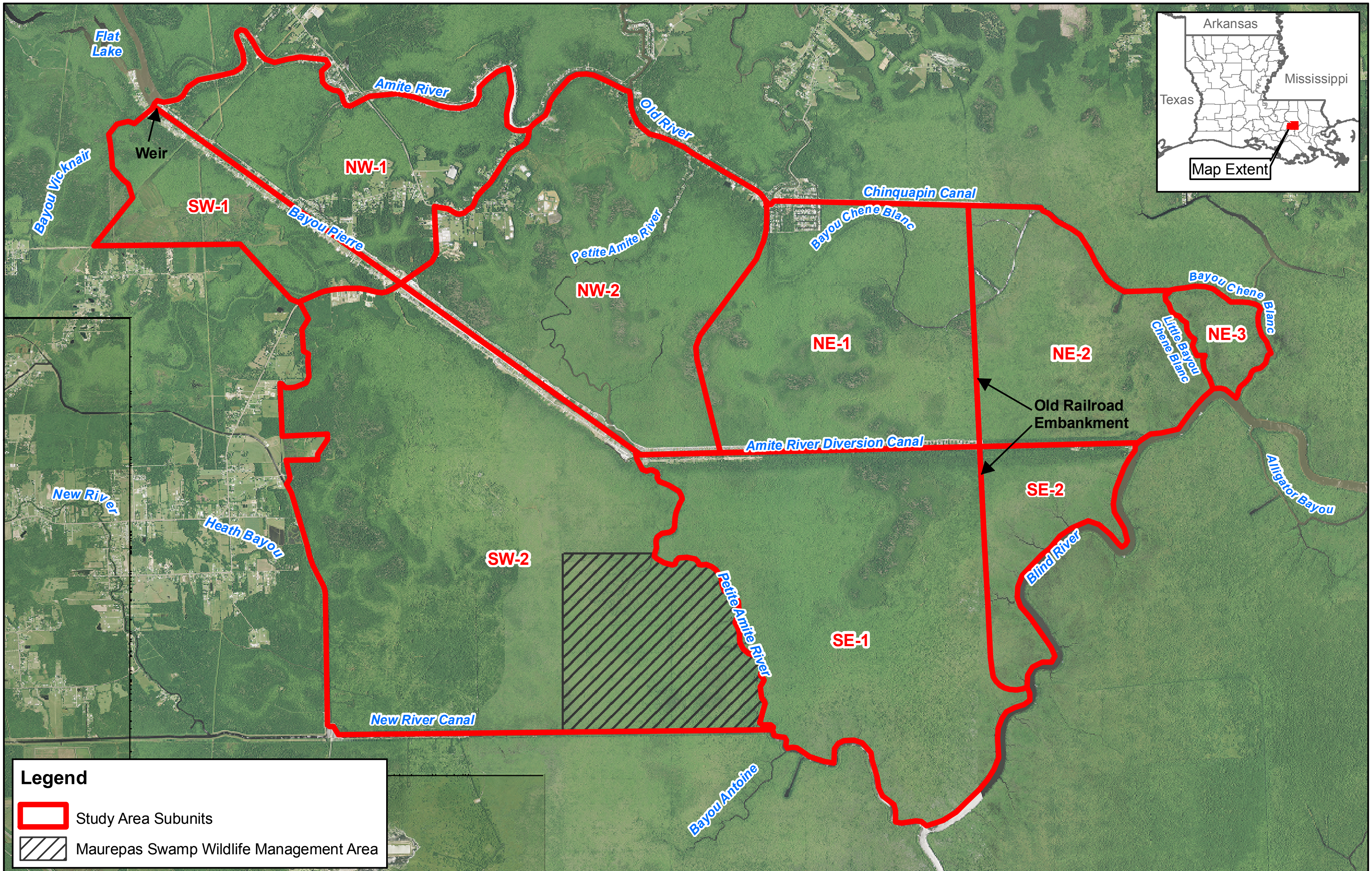
Historic Conditions. In 2001, the Maurepas Swamp Wildlife Management Area (WMA) was donated by the Richard King Mellon Foundation to the State of Louisiana (Figure 4.11). This management area consists of 1,742 acres within the LCA ARDC study area. No other public lands have existed within the LCA ARDC study area.

Existing Conditions. The LDWF administers the Maurepas Swamp WMA within the LCA ARDC study area. This WMA consists of 1,742 acres just north of New River Canal (Figure 4.11).

4.2.15.13 Navigation

Historic Conditions. The construction of the ARDC and the Chinquapin Canal in the late 1950s and early 1960s respectively, has led to increased recreational boat navigation.

Existing Conditions. There is minimal commercial navigation in the LCA ARDC study area. The streams and canals of the project area are used for recreational boating and fishing, particularly during the summer.



PUBLIC LANDS NEAR THE LCA-ARDC STUDY AREA

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Ascension and Livingston Parishes USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 4.11
Date: January 2010
Scale: 1:80,000
Source: USDA/GEC
Map ID: 27850108-1506

4.2.15.14 Man-Made Resources

Oil, Gas, Utilities and Pipelines

Historic Conditions. The western Maurepas Swamp has undergone significant oil and gas exploration activity, particularly in the early to mid-20th century. However, most oil and gas exploration and production activities in the region have occurred southwest of the LCA ARDC study area.

Existing Conditions. Data from the LDNR Strategic Online Natural Resources Information System (SONRIS) (**http://sonris-www.dnr.state.la.us/www_root/sonris_portal_1.htm**) indicate that oil and gas production activities within the LCA ARDC study area have been relatively light and occurred primarily in the late-20th century (Figure 4.12). The oil and gas wells in the project area are dry holes, plugged and abandoned.

Flood Control and Hurricane Protection Levees

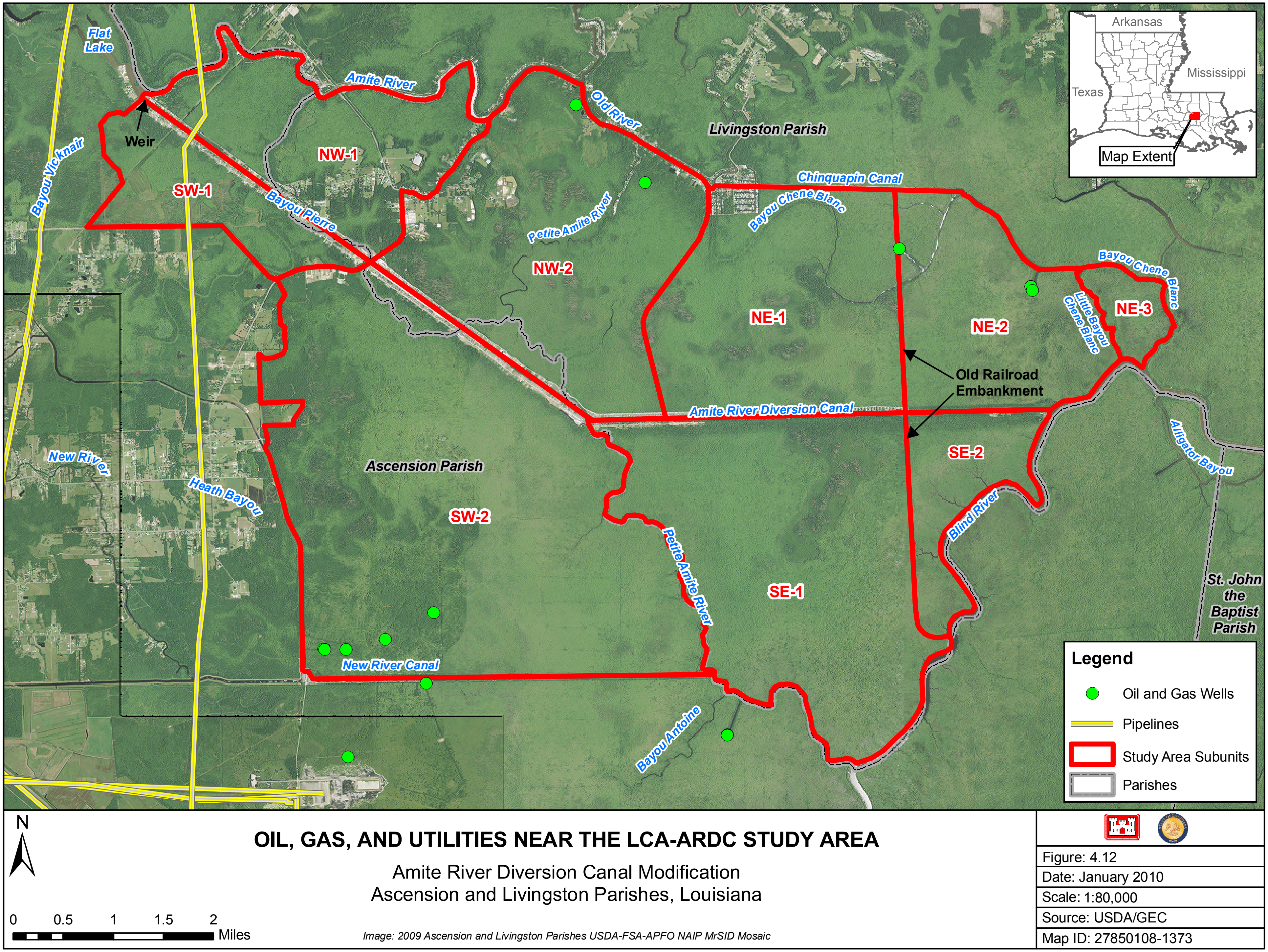
Historic Conditions. Hurricane protection levees have not been utilized within the LCA ARDC study area. Localized flood control has consisted of the construction of minor ditches for drainage. The construction of the Chinquapin Canal in the early 1960s and the ARDC in 1957 was initiated in an effort to provide flood control within the LCA ARDC study area.

Existing Conditions. The ARDC and the Chinquapin Canal were both constructed for flood control and drainage. These are the only flood control measures in the project area. The New River Canal southwest of the project area conveys water from the Marvin Breaux Pump Station at Gonzales and discharges into the Petite Amite River at the southwest boundary of the project area. There are no hurricane protection levees in the study area. Hurricane protection has been increased beyond the study area by West Lake Shore Pontchartrain Hurricane Protection Project

4.2.15.15 Natural Resources

Commercial Fisheries

Historic Conditions. Some small, localized commercial fishery operations have existed within the LCA ARDC study area, including operations harvesting catfish within the Blind River. Very little commercial fishery harvesting has taken place within the LCA ARDC study area.


Flat Lake
Amite River
Old River
Livingston Parish
Weir
NW-1
SW-1
Bayou Vicknair
Bayou Pierre
Petite Amite River
NW-2
Chinquapin Canal
Bayou Chene Blanc
NE-1
NE-2
NE-3
Little Bayou Chene Blanc
Old Railroad Embankment
Amite River Diversion Canal
Ascension Parish
New River
Heath Bayou
SW-2
SE-2
Alligator Bayou
Blind River
SE-1
St. John the Baptist Parish
New River Canal
Bayou Antoine
Arkansas
Mississippi
Texas
Map Extent
Legend
Oil and Gas Wells
Pipelines
Study Area Subunits
Parishes
N
0 0.5 1 1.5 2 Miles
OIL, GAS, AND UTILITIES NEAR THE LCA-ARDC STUDY AREA
Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana
Image: 2009 Ascension and Livingston Parishes USDA-FSA-APFO NAIP MrSID Mosaic
Figure: 4.12
Date: January 2010
Scale: 1:80,000
Source: USDA/GEC
Map ID: 27850108-1373

Existing Conditions. The LCA ARDC study area provides some habitat for gulf menhaden and striped mullet, but no commercial fishery for these species is present. There are little commercial fisheries in the LCA ARDC study area. A number of catfish are taken by commercial fishermen employing hoop nets on the Blind River and Petite Amite River. There is also a limited amount of crabbing on the same streams. There are no oyster leases located within the LCA ARDC study area.

4.2.16 Hazardous, Toxic, and Radioactive Wastes (HTRW)

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, would 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 Environmental Site Assessment (ESA) of the LCA ARDC study area was conducted in accordance with USACE Regulation ER 1165-2-132, Water Resources Policies and Authorities for HTRW Guidance for Civil Works Projects, 26 June 1992 and the American Society for Testing and Materials (ASTM) Standard E 2247-08 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process for Forestland or Rural Property in order to identify recognized environmental conditions (REC) located on, or in the vicinity of, the LCA ARDC study area. See Appendix M

The environmental conditions were evaluated for the LCA ARDC study area by:

- Reviewing Federal, state, and local environmental databases;
- Conducting historical research;
- Interviewing pertinent personnel; and
- Performing a site investigation.

Based on the review of Federal, state, and local environmental databases, historical research, interviews, and site investigations, the assessment identified two RECs that may have adversely impacted, or may potentially impact, environmental conditions in the LCA ARDC study area:

- Underground Storage Tanks (UST) at the former Chinquapin Grocery, and
- Aboveground Storage Tank (AST) at Val's Marina.

A limited HTRW survey was conducted for the LCA ARDC study area to REC sites or potential REC sites in connection with the LCA ARDC study area. This survey was performed using the USEPA's EnviroMapper program and the LDEQ Geographic Information Systems (GIS) website. Multisystem queries of the available USEPA and LDEQ databases were used to identify the potential REC sites located within or in the vicinity of the LCA ARDC study area. Potential REC sites located within or near the LCA ARDC study area are summarized in Table 4.11.

Table 4.11. Potential REC Sites Located Within or Near the LCA ARDC Study Area (USEPA, LDEQ, 2008)

Facility Name	Facility Address	Database
USEPA Databases		
Creative Cajun Cooking	14468 Bayou Terrace, St. Amant	NPDES
Island Car Wash	14989 Hwy. 16, French Settlement	NPDES
Island Car Wash	**18961 LA Hwy. 22, Maurepas**	**NPDES**
Mecca Inn Restaurant and Lounge	14365 Mecca Rd., French Settlement	NPDES
Swamp Pop Café	**18897 LA Hwy. 22, Maurepas**	**NPDES**
Island Car Wash	Unknown	NPDES
Val's Marina, LLC	21162 LA Hwy. 22, Maurepas	NPDES
Don Stout	**13027 Deer St., Maurepas**	**RCRAGN**
LDEQ Databases		
Best Stop Quick Mart #12	15250 Hwy. 16, French Settlement	RUST
Brian's Superette	**18886 LA Hwy. 22, Maurepas**	**RUST**
Fisherman's One Stop	45273 LA Hwy. 22, St. Amant	RUST
Thunder Bayou Marina	**11191 River Highlands Dr., St. Amant**	**RUST**
Weedy's Pitt Stop	**18985 LA Hwy. 22, Maurepas**	**RUST**

Note: Facilities located within LCA ARDC study area are denoted by **bold** font.
Information gathered during Phase I ESA within LCA ARDC study area (Appendix L).
Investigations were conducted within a one mile radius surrounding the LCA ARDC study area.

A review of various Federal and state databases (i.e., USEPA, Notice of Proposed License Action [NPLA], CERCLA, No Further Response Action Plan [NFRAP], RCRA Corrective Action Sites [CORRACTS], Resource Conservation and Recovery Act Generator [RCRAGN], RCRA TSD, National Pollution Discharge Elimination System [NPDES], and Toxic Release Inventory (TRI) databases; LDEQ Landfills Type I and II, RUST, and Motor Fuel UST Active 2005 databases) indicates that none of the potential REC sites listed in Table 4.11 would be likely to expose the public or construction workers to HTRW or to adversely affect the project.

5.0 ENVIRONMENTAL CONSEQUENCES

This section describes the potential environmental consequences of implementing alternative plans to reverse the trend of degradation in the western portion of the Maurepas Swamp. The following analysis compares the No-Action Alternative (future without project conditions) to the final array of alternatives over the 50-year period of analysis (2012 - 2062). The final array of alternatives includes Alternatives 33, 34, 35, 36, 37, 38 and 39 (see Section 2 for detailed descriptions). Alternative 33 was the Tentatively Selected Plan (TSP) and was later confirmed as the Recommended Plan. Alternative 39 is the National Ecosystem Restoration (NER) Plan.

A comparison of the direct, indirect, and cumulative impacts for alternatives to reverse the trend of degradation in the western portion of the Maurepas Swamp is presented herein. Direct impacts are effects caused by the proposed action that occur at the same time and place (Section 1508.8(a) of 40 CFR Parts 1500-1508). Indirect impacts are effects caused by the action that occur later in time or further removed in distance, but are still reasonably foreseeable (Section 1508.8(b) of 40 CFR Parts 1500-1508). Cumulative impacts are effects 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).

The cumulative impact analysis followed the 11-step process described in the Council of Environmental Quality 1997 report entitled *Considering Cumulative Effect under the National Environmental Policy Act*. Table 5.1 summarizes cumulative impacts for each of the alternatives in the final array of alternative plans across all important resources.

This environmental analysis evaluates and compares, from a qualitative and quantitative perspective, the alternatives carried over for detailed analysis. Impact analysis described in this section is based on a combination of scientific and engineering analyses, professional judgment, field investigations, and previously compiled information.

5.1 SOILS AND WATERBOTTOMS

5.1.1 Soils

5.1.1.1 No-Action Alternative

Direct. No direct impacts to soil resources would occur.

Indirect. Indirect impacts would include the continued erosion and land loss that would continue throughout the study area, eroding primarily Barbary, Fausse, and Maurepas soils. Most of the erosion would occur in the interfaces between open water with marsh and/or upland habitat. Soils would be indirectly impacted by habitat conversion from swamp to marsh and the eventual loss of existing soil resources converting to shallow open water.

Cumulative. Loss of soil resources from the study area would continue, in addition to the loss of soil resources throughout coastal Louisiana. The Louisiana Coastal Area (LCA) Near-term Ecosystem Restoration Plan (U.S. Army Corps of Engineers [USACE], 2004) estimated coastal Louisiana would continue to lose land at a rate of approximately 6,600 acres per year over the next 50 years. It is estimated that an additional net loss of 328,000 acres may occur by 2050, which represents nearly 10 percent of Louisiana's remaining coastal wetlands. However, these impacts to wetland soils within the study area and vicinity would be offset to some extent by other Federal, state, local, and private restoration efforts across coastal Louisiana (Figure 5.1 and Table 5.2). Overall cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system, which would be additive with other swamp losses and degradation impacts to soils throughout the region and state. This acreage represents the total area, which is predicted to convert from freshwater swamp and marsh to open water over the 50-year period of analysis, as shown in Figure 2.2.

5.1.1.2 Alternative 33 (Recommended Plan)

Direct. Direct impacts to soil resources would result from construction activities associated with the removal of the existing dredged material berm along the Amite River Diversion Canal (ARDC), dredging of new conveyance channels, as well as the placement of dredged material to create Bottom Land Hardwood (BLH) "islands" along dredged conveyance channels. Implementation of Alternative 33 would remove approximately 2.6 acres of the existing ARDC dredged material berms. The material dredged from the existing berms would be placed along the swamp-side of the excavated cut as 5.0 acres of new BLH habitat "islands." Dredging of the conveyance channels would remove approximately 28.6 acres of soil from the swamp floor. All material dredged during construction of the conveyance channels would be placed along the channels to also create BLH habitat "islands," approximately 9.9 acres. The BLH "islands" would be located to allow sufficient sheet flow to be conveyed from the swamp. The excavation and placement of dredged materials would directly release sediments into the ARDC and adjacent swamp. Sediment introduction would temporarily increase total suspended and

Table 5.1. Comparison of Cumulative Impacts*

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Soil and Waterbottoms-Soils	*US:* Institutional recognition of importance of soils via formation of Natural Resources Conservation Service (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).	*US, LA, and SA:* Continued institutional recognition; continued loss of soil resources. 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 land loss due to natural and human-induced causes. Barbary, Fausse, and Maurepas soils are primarily affected.	*US, LA, and SA:* Continued institutional recognition; continued loss of soil resources. *SA:* Shoreline erosion and land loss persist resulting in the loss of soil resources. Over 50-year period of analysis; projected conversion of 18,204 acres of swamp soils to fresh marsh and open water. Barbary, Fausse, and Maurepas soils would primarily be affected.	*US & LA:* Continued institutional recognition and programs for soil conservation to reduce soil losses. ALT 33 (Recommended Plan): This alternative would have positive effects on soil resources when combined with other Federal, state, local, and private restoration efforts. A net total of 1,602 acres of wetland soils would be hydrologically restored and nourished; 2.6 acres of soils along ARDC berms and 28.6 acres of existing swamp soils would be impacted by construction of conveyance channels, however these sediments would be used to construct 5.0 acres of "BLH islands". ALT 34: Cumulative impacts similar to ALT 33 (RECOMMENDED PLAN). A net total of 1,459 acres wetland soils would be hydrologically restored and nourished; 3.4 acres ARDC berm soils and 15.4 acres of existing swamp soils would be impacted and used to construct 2.7 acres of "BLH islands". ALT 35: Cumulative impacts similar to ALT 33. A net total of 820 acres wetland soils would be hydrologically restored and nourished; 2.4 acres ARDC berm soils and 10.9 acres of existing swamp soils would be impacted and used to construct 2.2 acres of "BLH islands". ALT 36: Cumulative impacts similar to ALT 33. A net total of 3,061 acres wetland soils would be hydrologically restored and nourished; 6.0 acres ARDC berm soils and 44.0 acres of existing swamp soils would be impacted and used to construct 7.8 acres of "BLH islands". ALT 37: Cumulative impacts similar to ALT 33. A net total of 2,279 acres wetland soils would be hydrologically restored and nourished; 5.8 acres ARDC berm soils and 26.3 acres of existing swamp soils would be impacted and used to construct 4.9 acres of "BLH islands". ALT 38: Cumulative impacts similar to ALT 33. A net total of 2,422 acres wetland soils would be hydrologically restored and nourished; 5.0 acres ARDC berm soils and 39.5 acres of existing swamp soils would be impacted and used to construct 7.2 acres of "BLH islands". ALT 39: Cumulative impacts similar to ALT 33. A net total of 3,881 acres wetland soils would be hydrologically restored and nourished; 8.4 acres ARDC berm soils and 54.9 acres of existing swamp soils would be impacted and used to construct 9.9 acres of "BLH islands".
Soils and Water bottoms-Water bottoms	*US, LA, & SA:* Water bottoms develop in response to natural and man-made conditions. *SA:* Construction of the ARDC and side-cast dredged material berms restricts hydrologic connectivity and impounds swamp habitat.	*US & LA:* Continuing land loss results in increasing acreage of shallow open water and water bottoms. *SA:* Increasing acreages of water bottoms due to conversion of swamp habitat to freshwater marsh and open water habitats.	*US & LA:* Increased acreage of shallow water bottoms in response to wetland loss. *SA:* Continued conversion of swamp to freshwater marsh and open water.	*US & LA:* Increased acreage of shallow water bottoms in response to wetland loss. ALT 33 (Recommended Plan): This alternative would have positive effects on water bottoms when combined with other Federal, state, local, and private restoration efforts. Reestablishing hydrologic connections would aid in restoring swamp habitat and would decrease acreage of water bottoms within the swamp; construction of conveyance channels would create 18.6 acres of water bottom habitats. ALT 34: Cumulative impacts would be similar to ALT 33 except would create 10.5 acres of water bottom habitats. ALT 35: Cumulative impacts would be similar to ALT 33 except would create 7.2 acres of water bottom habitats. ALT 36: Cumulative impacts would be similar to ALT 33 except would create 29.1 acres of water bottom habitats. ALT 37: Cumulative impacts would be similar to ALT 33 except would create 17.7 acres of water bottom habitats. ALT 38: Cumulative impacts would be similar to ALT 33 except would create 25.8 acres of water bottom habitats. ALT 39: Cumulative impacts would be similar to ALT 33 except would create 36.3 acres of water bottom habitats.
Hydrology–Flow and Water Levels	*US & LA:* Flows and water levels respond to natural conditions and man-made conditions. *SA:* Decreased flows into and out of the swamp due to construction of dredged material berms along ARDC.	*US & LA:* Increased flows and water levels with increased runoff due to increasing urbanization and wetland loss. Rate of RSLR increasing over historic conditions. *SA:* Decreased flows into and out of the swamp due to dredged material berms along ARDC. 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 increasing over historic conditions. *SA:* Decreased flows into and out of the swamp due to dredged material berms along ARDC. Increased water levels due to 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. Rate of RSLR increasing over historic conditions. ALT 33 (Recommended Plan): This alternative would have positive effects on water levels and flows when combined with other Federal, state, local, and private restoration efforts. Three cuts in the ARDC dredged material berm would reconnect the hydrology and increase flows into and out of 1,602 acres of swamp; water levels fluctuate in response to ARDC and sea level rises. ALT 34: Cumulative impacts would be similar to ALT 33 except one cut reconnect hydrology of 1,459 acres. ALT 35: Cumulative impacts would be similar to ALT 33 except one cut reconnect hydrology of 820 acres. ALT 36: Cumulative impacts would be similar to ALT 33 except four cuts reconnect hydrology of 3,061 acres. ALT 37: Cumulative impacts would be similar to ALT 33 except two cuts reconnect hydrology of 2,279 acres. ALT 38: Cumulative impacts would be similar to ALT 33 except four cuts reconnect hydrology of 2,422 acres. ALT 39: Cumulative impacts would be similar to ALT 33 except five cuts reconnect hydrology of 3,881 acres.

Table 5.1. Comparison of Cumulative Impacts*

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Hydrology–Sediment	*US:* Decreasing sedimentation due to reduction of erosion on land, reservoirs, and stream banks by stabilization. *LA & SA:* Sediment delivery by crevasses ended after Flood Control Act of 1928. *SA:* Decreased redistribution of sediments into and out of the swamp due to dredged material berms along ARDC. Amite River is primary source of sediments.	*US:* Decreasing sedimentation due to reduction of erosion on land, reservoirs, and stream banks by stabilization. *LA & SA:* Inflow of suspended sediments by Mississippi River limited by construction of levees. *SA:* Decreased redistribution of sediments into and out of the swamp due to dredged material berms along ARDC.	*US:* Continued decreasing sedimentation due to reduction of erosion. *LA:* Sediment supply would not offset coastal land loss. *SA:* Storms cause some redistribution of sediments to and from the swamp and surrounding water, but the ARDC dredged material berm would continue to block exchange and therefore sedimentation. The swamp would continue to deteriorate due to this impoundment and lack of sediment supply.	*US & LA:* Continued decreasing sedimentation due to reduction of erosion. ALT 33 (Recommended Plan): This alternative would have positive effects on hydrology sediments when combined with other Federal, state, local, and private restoration efforts. Reconnected hydrology increases potential for sediment inputs into 1,602 acres. ALT 34: Cumulative impacts would be similar to ALT 33 except increased potential for 1,459 acres. ALT 35: Cumulative impacts would be similar to ALT 33 except increased potential for 820 acres. ALT 36: Cumulative impacts would be similar to ALT 33 except increased potential for 3,061 acres. ALT 37: Cumulative impacts would be similar to ALT 33 except increased potential for 2,279 acres. ALT 38: Cumulative impacts would be similar to ALT 33 except increased potential for 2,422 acres. ALT 39: Cumulative impacts would be similar to ALT 33 except increased potential for 3,881 acres.
Hydrology–Water Use and Supply	*US, LA, & SA:* Increasing surface water use and supply demands due to increasing human populations, agriculture and industry uses. *SA:* No significant surface water use or supply issues for humans.	*US, LA, & SA:* Continued increasing demands for surface water use and supply due to increasing human populations, agriculture and industry uses. *SA:* No significant surface water uses or supply issues for humans; conversion of swamp habitat to open water habitat reduces water purification function of forested wetlands.	*US, LA, & SA:* Continued increasing demands for surface water use and supply due to increasing human populations, agriculture and industry uses. *SA:* Continued conversion of swamp habitat to open water habitat reduces water purification function of wetlands indirectly impacting human uses.	*US & LA:* Continued increasing demands on surface water use and supply due to increasing human populations, agriculture and industry uses. ALT 33 (Recommended Plan): Continued increase in human water use and supply demands; reconnected hydrology improves water purification function over 1,602 acres swamp. ALT 34: Cumulative impacts would be similar to ALT 33 except improves purification function of 1,459 acres. ALT 35: Cumulative impacts would be similar to ALT 33 except improves purification function of 820 acres. ALT 36: Cumulative impacts would be similar to ALT 33 except improves purification function of 3,061 acres. ALT 37: Cumulative impacts would be similar to ALT 33 except improves purification function of 2,279 acres. ALT 38: Cumulative impacts would be similar to ALT 33 except improves purification function of 2,422 acres. ALT 39: Cumulative impacts would be similar to ALT 33 except improves purification function of 3,881 acres.
Hydrology–Groundwater	*US, LA, & SA:* Increasing demands for groundwater by increasing human populations, agriculture, and industry. *SA:* Groundwater is not an issue of concern; groundwater is primarily from the Chicot Equivalent aquifer.	*US, LA, & SA:* Decreased groundwater resources due to increasing demands by increasing human populations, agriculture, and industry. *SA:* Groundwater is not an issue of concern; groundwater is primarily from the Chicot Equivalent aquifer.	*US, LA, & SA:* Decreased groundwater resources due to increasing demands by increasing human populations, agriculture, and industry. *SA:* Groundwater is not an issue of concern; groundwater is primarily from the Chicot Equivalent aquifer.	*US & LA:* Decreased groundwater resources due to increasing demands by increasing human populations, agriculture, and industry. ALT 33 (Recommended Plan): This alternative would have little to no impact on groundwater, which is primarily taken from the Chicot Equivalent aquifer. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Water Quality	*US & LA, SA:* Clean Water Act of 1977, NEPA of 1969, Coastal Zone Management Act, and Estuary Protection Act institutional recognition to restore and protect water bodies, especially with respect to point sources. Non-point sources still unregulated. *SA:* Human developments along the ARDC, Amite and Blind Rivers and on ridges begin to adversely impact water quality. The ARDC northeast of Sorrento is listed as impaired for mercury.	*US, LA, & SA:* Continued institutional recognition. Increasing human populations, agriculture and industrialization result in increased potential for water quality problems. *SA:* Human developments result in wastewater and polluted runoff from nearby urban areas; continued conversion of swamp habitat to marsh and open water reduces natural filtration of water.	*US, LA & SA:* Continued institutional recognition. Increasing human populations and industrialization result in increased potential for water quality problems. *SA:* Conversion of 18,204 acres of swamp to marsh and open water reduces natural filtration of water by swamp vegetation; continued discharge of untreated stormwater runoff from nearby populated areas.	*US, LA & SA:* Continued institutional recognition. Increasing human populations and industrialization result in increased potential for water quality problems. ALT 33 (Recommended Plan): This alternative would have positive effects on water quality when combined with other Federal, state, local, and private restoration efforts. Temporary negative impacts (e.g., increased turbidity, decreased dissolved oxygen (DO)) during construction. Water quality improves over 1,602 acres of swamp habitat due to increased hydrologic connectivity as well as absorption and filtering of untreated stormwater runoff from nearby populated areas. ALT 34: Cumulative impacts would be similar to ALT 33 except 1,459 acres. ALT 35: Cumulative impacts would be similar to ALT 33 except 820 acres. ALT 36: Cumulative impacts would be similar to ALT 33 except 3,061 acres. ALT 37: Cumulative impacts would be similar to ALT 33 except 2,279 acres. ALT 38: Cumulative impacts would be similar to ALT 33 except 2,422 acres. ALT 39: Cumulative impacts would be similar to ALT 33 except 3,881 acres.

Table 5.1. Comparison of Cumulative Impacts*

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Water Quality – Salinity	*US & LA:* Increase in salinity levels inland due to salt water intrusion, due in part to wetlands loss. *SA:* Construction of ARDC results in impounding storm driven higher salinity waters within SA and causes it to absorb into the substrate resulting in degradation of freshwater swamp ecosystem.	*US & LA:* Increase in salinity levels inland due to salt water intrusion from wetlands loss and reduction in freshwater inflow. *SA:* Continued impounding of higher salinity waters causing it to absorb into the substrate resulting in degradation of freshwater swamp ecosystem.	*US & LA:* Increase in salinity levels inland due to salt water intrusion from wetlands loss and reductions in freshwater inflow. Salinities may also increase due to projected relative sea level rise. *SA:* Continued impoundment and lack of hydrologic connections result in longer residence time of higher salinity water resulting in absorption of salinity into swamp soils continuing the degradation of freshwater swamp and BLH vegetation.	*US & LA:* Increase in salinity levels inland due to salt water intrusion from wetlands loss and reductions in freshwater inflow. Salinities may also increase due to projected RSLR. ALT 33 (Recommended Plan): This alternative would reduce salinity when combined with other Federal, state, local, and private restoration efforts. Restored hydrologic connectivity of 1,602 acres would reduce impoundment of higher salinity waters. ALT 34: Cumulative impacts would be similar to ALT 33 except restored hydrologic connectivity of 1,459 acres. ALT 35: Cumulative impacts would be similar to ALT 33 except restored hydrologic connectivity of 820 acres. ALT 36: Cumulative impacts would be similar to ALT 33 except restored hydrologic connectivity of 3,061 acres. ALT 37: Cumulative impacts would be similar to ALT 33 except restored hydrologic connectivity of 2,279 acres. ALT 38: Cumulative impacts would be similar to ALT 33 except restored hydrologic connectivity of 2,422 acres. ALT 39: Cumulative impacts would be similar to ALT 33 except restored hydrologic connectivity of 3,881 acres.
Air Quality	*US, 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:* not an issue.	*US, LA, & SA:* Continued institutional recognition; deterioration of air quality in the region due to increases in human populations and industry. *LA, & SA:* These impacts are coupled with the loss of Louisiana coastal wetland vegetation that is no longer available to remove gaseous pollutants. *SA:* Human development along the ARDC, Amite and Blind Rivers and on ridges. In nonattainment area for ozone.	*US, LA, & SA:* Continued institutional recognition; continued deterioration of air quality due to continued population growth and increased industrialization. *LA, & SA:* These impacts would be coupled with the continued loss of Louisiana coastal wetland vegetation that would no longer be available to remove gaseous pollutants. *SA:* Conversion of 18,204 acres of swamp vegetation to fresh marsh and open water habitat over 50-year period of analysis reduces function of swamp vegetation to act as natural filter for air pollutants.	*US & LA:* Continued institutional recognition; continued deterioration of air quality due to continued population growth and increased industrialization. ALT 33 (Recommended Plan): This alternative would have positive effects on air quality when combined with other Federal, state, local, and private restoration efforts. Restoration of 1,602 acres freshwater swamp habitat may act as natural filters for air pollutants. ALT 34: Cumulative impacts would be similar to ALT 33 except restoration of 1,459 acres. ALT 35: Cumulative impacts would be similar to ALT 33 except restoration of 820 acres. ALT 36: Cumulative impacts would be similar to ALT 33 except restoration of 3,061 acres. ALT 37: Cumulative impacts would be similar to ALT 33 except restoration of 2,279 acres. ALT 38: Cumulative impacts would be similar to ALT 33 except restoration of 2,422 acres. ALT 39: Cumulative impacts would be similar to ALT 33 except restoration of 3,881 acres.
Noise	*US, LA, & SA:* Institutional recognition via Noise Control Act of 1972. *SA:* Noise pollution sources are development along the ARDC, Amite, and Blind Rivers, on ridges, and boat traffic on ARDC, Amite and Blind Rivers. Noise is not yet an issue.	*US, LA, and SA:* Continued institutional recognition; continued human population growth and development cause some noise pollution. *SA:* Ambient noise from boats and airboats on ARDC, Amite and Blind Rivers, and other human activities may cause some minimal and temporary disturbances.	*US, LA, and SA:* Continued institutional recognition; continued human population growth and development would cause some noise pollution. *SA:* Ambient noise from boats and airboats on ARDC, Amite and Blind Rivers, and other human activities continue to cause some minimal and temporary disturbances.	*US & LA:* Continued institutional recognition; continued human population growth and development would cause some noise pollution. ALT 33 (Recommended Plan): Short term, localized and temporary increased noise associated with construction activities. Long term, impacts similar to No-Action Alternative. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Vegetation - Riparian Vegetation	*US, LA, & SA:* Natural processes form coastal vegetation resources. Riparian vegetation is located at the interface of land and a flowing water body. *SA:* Construction of ARDC results in creation of riparian habitat along dredged material berms along the ARDC as well as the banks of other water bodies.	*US, LA, & SA:* Deterioration and loss of wetlands nationwide and statewide. *SA:* Riparian habitat is primarily limited to the dredged material berms along the ARDC and the banks of other water bodies. Saltwater intrusion from storm events has additionally stressed the swamp habitat along the Blind River.	*US, LA, and SA:* Continued deterioration and loss of vegetated wetland habitat acreage due to natural and human-induced processes. *SA:* Riparian vegetation along ARDC berms likely unchanged over 50-year period of analysis.	*US & LA:* Continued institutional recognition and programs for soil conservation to reduce soil losses. ALT 33 (Recommended Plan): This alternative would have positive effects on riparian vegetation when combined with other Federal, state, local, and private restoration efforts. There would be creation of riparian habitat along conveyance channels. Riparian vegetation on dredged material berms would be impacted by construction. ALTS 34-39: Cumulative impacts similar to ALT 33.

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Vegetation-Wetland Vegetation	*US, LA, & SA:* Natural processes form coastal wetland vegetation resources. *SA:* Degradation of approximately 26,493 acres of primarily bald cypress-tupelo swamp habitat, leaving approximately 18,204 acres in the Amite/Blind River mapping unit.	*US, LA, & SA:* Deterioration and loss of wetlands nationwide and statewide due to natural and human-induced processes. *SA:* About 18,204 acres of primarily bald cypress-tupelo swamp habitat are presently impounded to differing levels. Existing swamp habitats converting to marsh and shallow open water habitats. Saltwater intrusion from storm events has additionally stressed the swamp habitat along the Blind River.	*US, LA, and SA:* Continued deterioration and loss of vegetated wetland habitat acreage due to natural and human-induced processes. *SA:* Conversion of 18,204 acres of existing swamp to fresh marsh and open water over 50-year period of analysis.	*US & LA:* Continued deterioration and loss of vegetated wetland habitat acreage due to natural and human-induced processes. ALT 33 (Recommended Plan): This alternative would have positive effects on wetland vegetation resources when combined with other Federal, state, local, and private restoration efforts. A net total of 1,602 acres of primarily bald cypress-tupelo swamp habitat would be restored and nourished. Vegetation reduces shoreline erosion and potentially helps future healthy productive swamps to accrete sediments at rates near or equal to local sea level rise, such that localized relative subsidence may also be reduced. Additionally, the enhanced wetland acreage would provide some protection to ecosystems inland from the study area, potentially reducing loss rates. ALT 34: Cumulative impacts similar to ALT 33 except 1,459 acres swamp habitat restored and nourished. ALT 35: Cumulative impacts similar to ALT 33 except 820 acres swamp habitat restored and nourished. ALT 36: Cumulative impacts similar to ALT 33 except 3,061 acres swamp habitat restored and nourished. ALT 37: Cumulative impacts similar to ALT 33 except 2,279 acres swamp habitat restored and nourished. ALT 38: Cumulative impacts similar to ALT 33 except 2,422 acres swamp habitat restored and nourished. ALT 39: Cumulative impacts similar to ALT 33 except 3,881acres swamp habitat restored and nourished.
Vegetation-Upland Vegetation	*US, LA, & SA:* Natural processes form coastal vegetation resources. *SA:* Upland habitat is primarily limited to the dredged material berms along the ARDC.	*US, LA, & SA:* Deterioration and loss of uplands nationwide and statewide. *SA:* Upland habitat is primarily limited to the dredged material berms along the ARDC and the banks of other water bodies in the area.	*US, LA, & SA:* Continued deterioration and loss of vegetated upland habitat acreage due to natural and human-induced processes. *SA:* The upland vegetation would convert to unstable freshwater marsh, which in turn would convert to open water.	*US & LA:* Continued deterioration and loss of vegetated wetland habitat due to natural and human-induced processes. ALT 33 (Recommended Plan): This alternative would have little effect on upland vegetation when combined with other Federal, state, local, and private restoration efforts. Upland vegetation located on dredged material berms along the ARDC would be impacted by construction. ALTS 34-39: Cumulative impacts similar to ALT 33.
Vegetation-Submerged Aquatic Vegetation (SAV)	*US, LA, & SA:* Natural and man-influenced processes form SAVs. *SA:* SAVs limited to shallow areas with flow that is high enough to keep the area clear of floating species within the ARDC and other water bodies.	*US, LA, & SA:* Deterioration and loss of wetlands nationwide and statewide. *SA:* SAVs limited to shallow areas with flow that is high enough to keep the area clear of floating species within the ARDC and other water bodies.	*US, LA, and SA:* Continued deterioration and loss of vegetated wetland habitat acreage due to natural and human-induced processes. *SA:* Conversion of 18,204 acres swamp vegetation to fresh marsh and open water habitat with little to no flow over 50-year period of analysis. Associated poor water quality likely not conducive to growth of SAVs.	*US & LA:* Continued deterioration and loss of vegetated wetland habitat due to natural and human-induced processes. ALT 33 (Recommended Plan): This alternative would have positive effects on SAVs when combined with other Federal, state, local, and private restoration efforts due to the creation of more shallow, flowing habitat in the swamp interior. Reconnecting hydrology to 1,602 acres of swamp makes conditions conducive for SAV. ALT 34: Cumulative impacts similar to ALT 33 except 1,459 acres reconnected. ALT 35: Cumulative impacts similar to ALT 33 except 820 acres reconnected. ALT 36: Cumulative impacts similar to ALT 33 except 3,061 acres reconnected. ALT 37: Cumulative impacts similar to ALT 33 except 2,279 acres reconnected. ALT 38: Cumulative impacts similar to ALT 33 except 2,422 acres reconnected. ALT 39: Cumulative impacts similar to ALT 33 except 3,881 acres reconnected.
Vegetation-Invasive Species	*US, LA, & SA:* Natural processes form coastal vegetation resources. Invasive species have been intentionally and unintentionally released and are outcompeting native vegetation species and spreading throughout many habitat types.	*US, LA, & SA:* Continued spread of invasive species throughout many habitat types. *SA:* The spread of invasive species continues to alter ecosystem function by decreasing native plant communities.	*US, LA, and SA:* Continued spread of invasive species throughout many different habitats. Continued deterioration and loss of vegetated wetland habitat acreage due to natural and human-induced processes. *SA:* Conversion of 18,204 acres of swamp vegetation to fresh marsh and open water habitat. Invasive species would continue to spread throughout.	*US & LA:* Continued spread of invasive species throughout many different habitats. Continued deterioration and loss of vegetated wetland habitat acreage due to natural and human-induced processes. ALT 33 (Recommended Plan): This alternative would increase invasive vegetation spread when combined with other Federal, state, local, and private restoration efforts due to the habitat disturbance from construction efforts. Reconnecting hydrology to 1,602 acres of swamp makes conditions conducive for invasive species to spread further. ALT 34: Cumulative impacts similar to ALT 33 except 1,459 acres reconnected. ALT 35: Cumulative impacts similar to ALT 33 except 820 acres reconnected. ALT 36: Cumulative impacts similar to ALT 33 except 3,061 acres reconnected. ALT 37: Cumulative impacts similar to ALT 33 except 2,279 acres reconnected. ALT 38: Cumulative impacts similar to ALT 33 except 2,422 acres reconnected. ALT 39: Cumulative impacts similar to ALT 33 except 3,881 acres reconnected.

Table 5.1. Comparison of Cumulative Impacts*

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Wildlife Resources	*US, LA, & SA:* Wetland dependent wildlife populations respond primarily to natural population-regulating mechanisms. *SA:* The bald eagle was removed from the endangered species list in 2007, but is currently undergoing five years of monitoring to confirm the revised status. The Southeast United States Regional Waterbird Conservation Plan was completed in 2006.	*US, LA, & SA:* Continued nationwide degradation and loss of wetlands leads to decline of wetland-dependent wildlife populations. *SA:* Continued swamp degradation and conversion to marsh and open water leads to increased competition between local wetland-dependent wildlife populations, displacement to other more suitable swamp wetland areas, and localized decline in wetland-dependent wildlife population. Bald eagle populations in the area are steady. A bald eagle nesting site is located within the study area. Habitat for wading birds in the area are declining due to swamp degradation	*US, LA, and SA:* Nationwide degradation and loss of swamp habitat continues to adversely impact wetland-dependent wildlife populations. SA: Conversion of 18,204 acres of swamp vegetation to fresh marsh and open water habitat resulting in continued decline in quality of and availability of swamp wildlife habitat. Conversion of swamp to open water will adversely affect populations of bald eagle and colonial nesting wading birds due to decreased nesting habitat and decreased food availability.	*US & LA:* Continued nationwide loss of vegetated wetlands continues to adversely impact wetland-dependent wildlife populations. ALT 33 (Recommended Plan): This alternative would have positive effects on wildlife resources when combined with other Federal, state, local, and private restoration efforts. Creation and nourishment of a net total of 1,602 acres of wildlife habitats. Migratory neo-tropical songbirds and waterfowl could increase as important migratory habitat is created and nourished. Although unlikely to impact wildlife populations on a continental scale, local populations of game animals, furbearers, reptiles, amphibians, and invasive species (especially nutria) would benefit from the cumulative effects of creating and nourishing important and essential transitional wetlands. Local populations of the bald eagle and colonial nesting wading birds would benefit from the cumulative effects of creating and nourishing wetlands. ALT 34: Cumulative impacts similar to ALT 33 except 1,459 acres swamp habitat created and nourished. ALT 35: Cumulative impacts similar to ALT 33 except 820 acres swamp habitat created and nourished. ALT 36: Cumulative impacts similar to ALT 33 except 3,061 acres swamp habitat created and nourished. ALT 37: Cumulative impacts similar to ALT 33 except 2,279 acres swamp habitat created and nourished. ALT 38: Cumulative impacts similar to ALT 33 except 2,422 acres swamp habitat created and nourished. ALT 39: Cumulative impacts similar to ALT 33 except 3,881 acres swamp habitat created and nourished.
Aquatic Resources - Plankton	*US & LA:* Institutionally recognized by the National Environmental Policy Act of 1969, the Coastal Zone Management Act, and the Estuary Protection Act. Plankton populations respond to natural conditions. *SA:* Construction of the ARDC resulted in dredged material berms which limits exchange of organisms and water between the swamp and the ARDC.	*US:* Continued institutional recognition. 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:* Continued institutional recognition. 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. *LA & SA:* Conversion of swamp to fresh marsh and open water may shift populations, but there are no direct adverse impacts.	*US & LA:* Continued institutional recognition. Continued nationwide loss of vegetated wetlands continues to adversely impact wetland-dependent wildlife populations. ALT 33 (Recommended Plan): This alternative would have positive effects on plankton resources when combined with other Federal, state, local, and private restoration efforts. The creation of conveyance channels in concert with wetland creation and nourishment would result in greater productivity of plankton organisms due to the export of dissolved organic compounds. ALTS 34-39: Cumulative impacts similar to ALT 33.
Aquatic Resources-Benthic	*US, LA, & SA:* Benthic populations respond to natural and to human induced conditions. *SA:* Construction of the ARDC resulted in dredged material berms which limits exchange of benthic organisms and water between the swamp and the ARDC.	*US & LA:* Increased acreage of shallow water bottoms in response to wetland loss. 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.	*US & LA:* Increased acreage of shallow water bottoms in response to wetland loss. 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:* 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:* Increased acreage of shallow water bottoms in response to wetland loss. 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. ALT 33 (Recommended Plan): This alternative would have positive effects on benthic resources when combined with other Federal, state, local, and private restoration efforts. Wetland restoration, nourishment, and reconnection of hydrology of 1,602 acres would result in greater resources for benthic organisms due to the export of dissolved organic compounds and detritus from the wetlands. ALT 34: Cumulative impacts similar to ALT 33 except 1,459 acres swamp habitat restored. ALT 35: Cumulative impacts similar to ALT 33 except 820 acres swamp habitat restored. ALT 36: Cumulative impacts similar to ALT 33 except 3,061 acres swamp habitat restored. ALT 37: Cumulative impacts similar to ALT 33 except 2,279 acres swamp habitat restored ALT 38: Cumulative impacts similar to ALT 33 except 2,422 acres swamp habitat restored. ALT 39: Cumulative impacts similar to ALT 33 except 3,881 acres swamp habitat restored.
Fishery Resources	*US, LA, & SA:* Reduction in fisheries habitat, increased catches, gear improvement, catch regulations, Magnuson-Stevens Fishery Conservation and Management Act and amendments, Formation of NMFS and LDWF. 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%; 7% of the species of fish studied by researchers have become extinct (Worm *et al.*, 2006). *SA:* Construction of the ARDC and dredged material berms prevent exchange of organisms and water between the swamp and the ARDC.	*US, LA, & SA:* Continued institutional recognition, catch regulations, habitat loss decreased somewhat by coastal restoration efforts, and continued net habitat loss. *LA & SA:* Fishery populations in Louisiana are shifting towards more marine and higher salinity tolerant species as land loss and saltwater intrusion into interior regions continues. *SA:* Fishery population changes associated with conversion of swamp habitat to freshwater marsh and open water habitat and as water quality declines.	*US, LA, & SA:* Continued institutional recognition and catch regulations. Continued loss of fishery resources unless intensified efforts to protect them locally, statewide, and nationally. *LA & SA:* Populations in Louisiana would likely continue to shift towards more saline-oriented species as land loss and saltwater intrusion into interior regions continues. *SA:* Conversion of 18,204 acres of swamp vegetation to fresh marsh and open water habitat increases availability of open water habitat for fish and aquatic organisms. However, ARDC berms limit aquatic organism access; water quality declines make environment suitable only for those aquatic organisms tolerant of low DO conditions.	*US & LA:* Continued loss of fishery resources unless intensified efforts to protect them, locally, statewide, and nationally. ALT 33 (Recommended Plan): This alternative would have positive effects on fishery resources when combined with other Federal, state, local, and private restoration efforts. This alternative would restore a net total of 1,602 acres of bald cypress-tupelo swamp habitat. Swamp restoration and reconnected hydrology would result in greater resources for aquatic and fishery resources due to the export of dissolved organic compounds and detritus from wetlands. ALT 34: Cumulative impacts similar to ALT 33 except 1,459 acres reconnected and restored. ALT 35: Cumulative impacts similar to ALT 33 except 820 acres reconnected and restored. ALT 36: Cumulative impacts similar to ALT 33 except 3,061 acres reconnected and restored. ALT 37: Cumulative impacts similar to ALT 33 except 2,279 acres reconnected and restored. ALT 38: Cumulative impacts similar to ALT 33 except 2,422 acres reconnected and restored. ALT 39: Cumulative impacts similar to ALT 33 except 3,881 acres reconnected and restored.

Table 5.1. Comparison of Cumulative Impacts*

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Essential Fish Habitat (EFH)	*US and LA:* General decrease in quality of EFH beginning in the mid-1990s. Institutional recognition of decline in EFH quality; passage of Magnuson-Stevens Fishery Conservation and Management Act, as amended. *SA:* No EFH present.	*US and LA:* Continued institutional recognition; continued wetland loss and decline in quality of EFH. *SA:* No EFH present.	*US and LA:* Continued institutional recognition; continued wetland loss and decline in quality of EFH. *SA:* Continues to be no EFH present.	*US and LA:* Continued institutional recognition; continued wetland loss and decline in quality of EFH. ALT 33 (Recommended Plan): This alternative would have no effect on EFH. EFH not likely to develop. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Threatened and Endangered Species	*US, LA & SA:* Institutional recognition of importance of wetlands decline in listed species via the Endangered Species Act (ESA). Decrease in some animal and plant populations and their critical habitat including loss of wetlands.	*US, LA, & SA:* Continued institutional recognition of decline in listed species; continued loss of wetlands that are critical habitat to many listed species. *SA:* Degradation and loss of important fish and wildlife habitats for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements.	*US, LA, & SA:* Continued institutional recognition of decline in listed species; continued loss of wetlands. *SA:* Conversion of 18,204 acres of swamp habitat to fragmented and degraded fresh marsh and open water habitats; any listed species that may be presently utilizing the habitats would likely not be impacted.	*US and LA:* Continued institutional recognition of decline in listed species; continued loss of wetlands. ALT 33 (Recommended Plan): This alternative would have positive effects on threatened and endangered resources when combined with other Federal, state, local, and private restoration efforts. This alternative would restore a net total of 1,602 acres of swamp habitat that would be available for use by listed and other species. ALT 34: Cumulative impacts similar to ALT 33 except 1,459 acres of habitat restored. ALT 35: Cumulative impacts similar to ALT 33 except 820 acres of habitat restored. ALT 36: Cumulative impacts similar to ALT 33 except 3,061 acres of habitat restored. ALT 37: Cumulative impacts similar to ALT 33 except 2,279 acres of habitat restored. ALT 38: Cumulative impacts similar to ALT 33 except 2,422 acres of habitat restored. ALT 39: Cumulative impacts similar to ALT 33 except 3,881 acres of habitat restored.
Cultural and Historic Resources	*US, LA, & SA:* Institutional recognition via the National Historic Preservation Act (and others). Historic and cultural resources subjected to natural processes and man-made actions.	*US, LA, & SA:* Continued institutional recognition. Human activities as well as natural processes can potentially destroy historic and natural resources. The loss of land threatens the existence and integrity of these resources.	*US, LA, & SA:* Continued institutional recognition. Potential loss of resources due to natural and human causes. *SA:* The loss of land within the SA threatens the existence and integrity of these resources.	*US & LA:* Potential loss of resources due to natural and human causes. ALT 33 (Recommended Plan): All types of stabilization would prevent further land loss and erosion. This alternative would benefit cultural and historical resources in the long term by slowing or stopping land loss and erosion that threatens their existence. No archaeological sites were located at the proposed cuts, however one modern *Rangia cuneata* scatter was observed near the easternmost cut. The old railroad grade and the ARDC are recommended as not eligible for NHRP listing. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Aesthetics	*US, LA, & SA:* Technical recognition via 1988 USACE Visual Resources Assessment Procedure. Institutional recognition via Wild and Scenic Rivers Act, Louisiana Scenic Rivers Act, Scenic Byways and others. *LA & SA:* Aesthetic resources negatively impacted by hurricanes Katrina, Rita, Gustav, and Ike. Blind River is a designated Scenic River.	*US, 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 bayous and swamps.	*US, LA, & SA:* Continued institutional recognition. Continued human population growth and development and other human activities have the potential to destroy, enhance or preserve visual resources. *SA:* Erosion and land loss could result in the loss of vegetation that may provide a visually complex environment and desirable views and reduce opportunities for viewing wildlife.	*US & LA:* Continued human population growth and development and other human activities have the potential to destroy, enhance or preserve visual resources. ALT 33 (Recommended Plan): This alternative would have positive effects on aesthetics when combined with other Federal, state, local, and private restoration efforts. Maintaining visually appealing resources systems would support tourism on Louisiana's Scenic Byways and remote areas of visual interest. Restoration features would provide a more contiguous swamp, which would increase and protect desirable viewscapes. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Recreational	*US, LA, & SA:* Recreational resources not an issue. Institutional recognition via Federal Water Project Recreation Act, Land and Water Conservation Act, and National Wildlife Refuge System Acts. *SA:* Recreation activities in SA centered on natural resources. A portion of Maurepas Swamp WMA is present.	*US & LA:* Continued institutional recognition. Increased recreational activities impact national and state wetlands. *SA:* Recreation activities centered on natural resources. Continued conversion of marsh and swamp to open water resulting in decreasing recreational opportunities.	*US, LA, & SA:* Continued institutional recognition. Potential loss of recreational resource base due to continued swamp and freshwater marsh degradation and loss.	*US & LA:* Continued loss of recreational resource base due to continuing coastal and wetland degradation and loss. ALT 33 (Recommended Plan): This alternative would have positive effects on recreational resources when combined with other Federal, state, local, and private restoration efforts. It would support and sustain a greater number of wetland-dependent recreational activities, provide for a more stable localized recreational economy, and possibly increase local recreation-related employment and income. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Socioeconomic and Human Resources – Population and Housing	*US:* Population increasing in some areas, decreasing in other areas. *LA:* Hurricanes Katrina and Rita adversely affected populations throughout the state. *SA:* Development along the ARDC, Amite and Blind Rivers and on ridges. Populations within Ascension and Livingston Parishes increasing.	*US:* Increasing population (7.2%) from 2000-2007; with over 300 million people. *LA:* Slight decrease (-3.9%) in population from 2000-2007. *SA:* Development along the ARDC, Amite and Blind Rivers and on ridges. Populations within Ascension and Livingston Parishes have been increasing.	*US & LA:* Increasing populations worldwide. *SA:* There may be further construction and an increase in the population. Populations within Ascension and Livingston Parishes projected to increase further. Study area populations would be adversely impacted by continued habitat degradation and conversion.	*US & LA:* Increasing populations worldwide. Populations within Ascension and Livingston Parishes are projected to increase further. ALT 33 (Recommended Plan): This alternative would have no cumulative impacts on populations. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Socioeconomic and Human Resources– Employment and Income	*US:* Increased habitation, employment and tourism. *LA:* Slight increase in employment in Louisiana. Hurricanes Katrina and Rita had an adverse effect on employment and personal income. Rebuilding efforts provide some new job opportunities. *SA:* Development along the ARDC, Amite and Blind Rivers and on ridges. Total employment in Ascension and Livingston Parishes increasing.	*US & LA:* Increasing population growth and employment and personal income opportunities. Economic activity related to wetland resources would be adversely affected by the depletion of these resources. *SA:* Development along the ARDC, Amite and Blind Rivers and on ridges. Employment and income resources are primarily retail, eating and drinking establishments. Total employment in Ascension and Livingston Parishes increasing.	*US & LA:* Increasing population growth and employment and personal income opportunities. Economic activity related to wetland resources would be adversely affected by the depletion of these resources. *SA:* Development along the ARDC, Amite and Blind Rivers and on ridges. Total employment in Ascension and Livingston Parishes expected to increase.	*US & LA:* Increasing human populations lead to competition for employment and income. Economic activity related to wetland resources would be adversely affected by the depletion of these resources. ALT 33 (Recommended Plan): This alternative would have positive effects on employment and income when combined with other Federal, state, local, and private restoration efforts. Cumulative impacts of the proposed action are related to the increased stability of the wetland resources throughout the region. Local wetland-dependent jobs, such as recreation and commercial fisheries, would likely be positively impacted. ALTS 34-39: Cumulative impacts would be similar to ALT 33.

Table 5.1. Comparison of Cumulative Impacts*

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Socioeconomic and Human Resources– Community Cohesion	*US, LA, & SA:* Community cohesion is affected by infrastructure development and community development. *LA:* Hurricanes Katrina and Rita adversely affected community cohesion in southern portions of the state. *SA:* The SA is populated along the ARDC, Amite and Blind Rivers, and on ridges.	*US, LA, & SA:* Community cohesion is affected by infrastructure development and community development. *LA:* Hurricanes Katrina and Rita adversely affected community cohesion in southern portions of the state. *SA:* The SA is populated along the ARDC, Amite and Blind Rivers, and on ridges.	*US, LA, & SA:* Community cohesion would continue to be affected by infrastructure development and community development. *SA:* Several of the current subdivisions would expand. A proposed bridge over the ARDC would increase community cohesion.	*US & LA:* Increasing populations worldwide. Increasing opportunity for infrastructure development and community cohesion development. ALT 33 (Recommended Plan): There would be no cumulative impacts on community cohesion. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
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 of Head of Island has 30-40% minority composition; poverty levels low within study area.	*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 within study area 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. Environmental Justice resources may increase; these resources would likely remain unchanged.	*US & LA:* Increasing populations worldwide. Increasing opportunity for the development of minority communities and the expansion of low-income populations worldwide. ALT 33 (Recommended Plan): There would be no cumulative impacts on environmental justice. There is no opportunity for the development of minority communities or the expansion of low-income populations as the areas impacted by this alternative are not populated. Environmental justice issues are unlikely to occur when combined with other Federal, state, local, and private restoration efforts. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Socioeconomic and Human Resources – Infrastructure	*US & LA:* Increasing population growth and supporting infrastructure in the form of roads, bridges, pipelines, homes, businesses, and decreases in coastal and other wetlands. *LA & SA:* Extensive damages to infrastructure due to Hurricanes Katrina and Rita which is still being repaired. State and local roads, railroad grade, overhead distribution lines, and underground telephone lines traverse the study area.	*US:* Increasing population growth and supporting infrastructure contributes to degradation and loss of coastal and other wetlands, which contributes to increased maintenance costs of infrastructure. *LA & SA:* State and local roads, relict railroad grade, overhead distribution lines, and underground telephone lines traverse the study area.	*US & LA:* Continued population growth and supporting infrastructure contributes to degradation and loss of coastal and other wetlands. Degradation and loss of wetlands would contribute to increased maintenance costs of infrastructure. *SA:* Wetland land loss potentially threatens infrastructure passing through area and would result in increased maintenance. Several of the current subdivisions would expand, creating additional roads, bridges, and associated utilities.	*US & LA:* Continued population growth and supporting infrastructure contributes to degradation and loss of coastal and other wetlands. Degradation and loss of wetlands contribute to increased maintenance costs of infrastructure. ALT 33 (Recommended Plan): This alternative would have positive effects on infrastructure when combined with other Federal, state, local, and private restoration efforts. There would be a reduced level of infrastructure damages and relocations compared to the No-Action Alternative. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Socioeconomic and Human Resources– Business and Industry	*US & LA:* Increasing population growth and supporting infrastructure in the form of roads, bridges, pipelines, homes, and businesses. *LA & SA:* Extensive damages to businesses and industry due to Hurricanes Katrina and Rita which is still being repaired. *SA:* Businesses are generally retail stores and restaurants.	*US & LA:* Increasing population growth and supporting businesses and industry development contributes to degradation and loss of coastal and other wetlands. *SA:* Businesses are generally retail stores and restaurants.	*US & LA:* Continued population growth and supporting business and industry development contributes to degradation and loss of coastal and other wetlands. Degradation and loss of wetlands would contribute to potential losses of businesses. *SA:* Wetland land loss would potentially threaten businesses in the study area.	*US & LA:* Continued population growth and supporting business and industry development contributes to degradation and loss of coastal and other wetlands, which contributes to potential loss of businesses. ALT 33 (Recommended Plan): This alternative would have little effects on business and industry when combined with other Federal, state, local, and private restoration efforts. The study area does not appear to provide many opportunities for future business growth. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Socioeconomic and Human Resources– Traffic and Transportation	*US & LA:* Increasing population growth increases traffic and transportation issues. *SA:* State and local roads traverse the study area. Traffic is generally confined to residents and recreational visitors.	*US & LA:* Increasing population growth increases traffic and transportation issues. *SA:* State and local roads traverse the study area. Traffic is generally confined to residents and recreational visitors.	*US & LA:* Continued population growth increases traffic and transportation issues *SA:* Wetland land loss potentially threatens roads passing through area and results in increased maintenance. Several of the current subdivisions would expand, creating additional roads, bridges, and traffic.	*US & LA:* Continued population growth increases traffic and transportation issues. ALT 33 (Recommended Plan): This alternative would have little effect on traffic and transportation when combined with other Federal, state, local, and private restoration efforts. There would be a reduced level of road damages and relocations compared to the No-Action Alternative. ALTS 34-39: Cumulative impacts would be similar to ALT 33.

Table 5.1. Comparison of Cumulative Impacts*

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Socioeconomic and Human Resources– Public Facilities and Services	*US & LA:* Increasing population growth increases public facilities and services issues. *SA:* Public facilities and services generally serve residents and recreational visitors.	*US & LA:* Increasing population growth increases public facilities and services issues. *SA:* Public facilities and services generally serve residents and recreational visitors.	*US & LA:* Increasing population growth increases public facilities and services issues. *SA:* Wetland land loss potentially threatens public facilities and services and increases maintenance. Several of the current subdivisions would expand, creating additional needs for public facilities and services.	*US & LA:* Continued population growth increases public facilities and services issues. ALT 33 (Recommended Plan): This alternative would have little effect on public facilities and services when combined with other Federal, state, local, and private restoration efforts. There would be a reduced level of public facilities and services damages and relocations compared to the No-Action Alternative. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Socioeconomic and Human Resources– Local Government Finances	*US & LA & SA:* Increasing population growth increased local government finances.	*US & LA & SA:* Increasing population growth increases local government finances.	*US & LA:* Increasing population growth would increase local government finances. *SA:* There is no potential for new town development, and none would be developed in the future. Expansion of the current subdivisions would increase the tax base, thus increasing local government finances.	*US & LA:* Continued population growth increases local government finances. ALT 33 (Recommended Plan): This alternative would have little effect on local government finances when combined with other Federal, state, local, and private restoration efforts. There is no potential for new town development within or contiguous to the area impacted by this alternative, and none would be developed in the future. Expansion of the current subdivisions would increase the tax base, thus increasing local government finances. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
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:* Additional increases in property values and tax revenues would be sustained through the filling of lots in the existing and proposed subdivisions. At the same time, property values may drop from lowering aesthetics due to swamp degradation.	*US & LA:* Continued population growth increases tax revenue and property values. ALT 33 (Recommended Plan): This alternative would have little effect on tax revenue and property values when combined with other Federal, state, local, and private restoration efforts. Additional increases in property values and tax revenues would be sustained through the filling of lots in the existing and proposed subdivisions as well as due to increased aesthetics. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Socioeconomic and Human Resources– Community and Regional Growth	*US & LA & SA:* Increasing population growth increases community and regional growth.	*US & LA & SA:* Increasing population growth increases community and regional growth.	*US & LA:* Increasing population growth increases community and regional growth. *SA:* Additional increases in community and regional growth would be sustained through the filling of lots in the existing and proposed subdivisions.	*US & LA:* Continued population growth increases community and regional growth. ALT 33 (Recommended Plan): This alternative would have little effect on community and regional growth when combined with other Federal, state, local, and private restoration efforts. Additional increases in community and regional growth would be sustained through the filling of lots in the existing and proposed subdivisions. ALTS 34-39: Cumulative impacts would be similar to ALT 33.

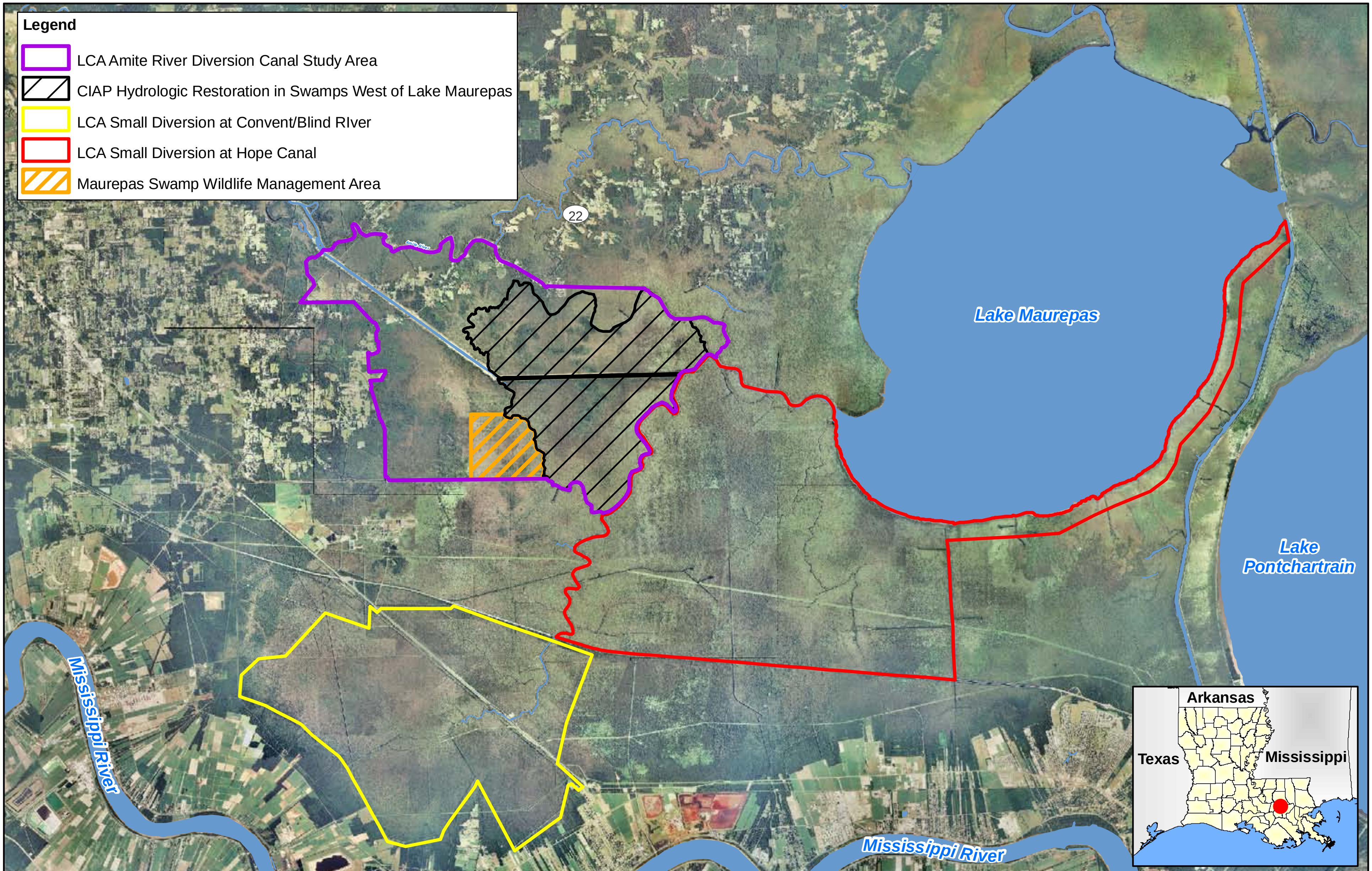
Table 5.1. Comparison of Cumulative Impacts*

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Socioeconomic and Human Resources – Land Use Socioeconomics-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:* Approximately 373 acres of agricultural lands, primarily livestock pastures are present.	US & LA: Agriculture is important to the economy of the US and coastal Louisiana. *LA:* Important crops include sugar cane, rice, and soybeans. *SA:* Approximately 373 acres of agricultural lands, primarily livestock pastures are present.	*US & LA:* Agriculture would continue to be important to the economy of the US and coastal Louisiana. *SA:* Agricultural lands, primarily livestock pastures, within the study area would continue to be used and may be adversely impacted by habitat conversion and land loss.	*US & 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. ALT 33 (Recommended Plan): This alternative would have positive effects on agriculture when combined with other Federal, state, local, and private restoration efforts. There would be a reduced level of agriculture land habitat conversion and land loss compared to the No-Action Alternative. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Socioeconomic and Human Resources – Land Use Socioeconomics-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 Livingston Parishes. *SA:* Timber was harvested extensively before 1940.	US & LA: Timber production is important to the economy of the US and Louisiana. LA: Timber continues to be important to the economy of Ascension and Livingston Parishes. SA: Increased interest in harvesting within the study area in recent years, but little harvesting is currently taking place.	US & LA: Timber production would continue to be important to the economy of the US and Louisiana. LA: Timber would continue to be important to the economy of Ascension and Livingston Parishes. SA: Little harvesting would likely take place in the future due to the lack of quality timber.	*US & 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. ALT 33 (Recommended Plan): Channel Improvement, Flowage and Deposition, and Wetland Creation and Restoration easements would be placed within the primary and secondary areas of impact for Alternative 33 , effectively restricting timber harvesting within portions of the study area over an indefinite period of time. Therefore this alternative would have negative impacts on timber harvesting within portions of the study area. The Real Estate Plan in Appendix J provides descriptions of the easements which will be placed within the areas of impact. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Socioeconomic and Human Resources – Land Use Socioeconomics-Public Lands	*US & LA:* Public lands are important to the economy of the US and Louisiana. *SA:* A portion of the Maurepas WMA is the only public lands present.	*US & LA:* Public lands are important to the economy of the US and Louisiana. *SA:* A portion of the Maurepas WMA is the only public lands present.	*US & LA:* Public lands would continue to be important to the economy of the US and Louisiana. *SA:* A portion of the Maurepas WMA is the only public lands present. These lands may be adversely affected by future sea level rise and continued habitat conversion and land loss.	*US & LA:* Continued importance of public lands to the economy of the US and Louisiana. Public lands may be adversely impacted by habitat conversion and land loss. ALT 33 (Recommended Plan): This alternative would have positive effects on public lands when combined with other Federal, state, local, and private restoration efforts. There would be a reduced level of public land habitat conversion and land loss compared to the No-Action Alternative. At the same time, public lands may be adversely impacted by future sea level rise. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Socioeconomic and Human Resources – Navigation	*US, 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. Hurricanes Katrina and Rita impacted navigation infrastructure and investments. Public and private reinvestment to rebuild navigation, port facilities, and inland waterways. *SA:* One Federal navigation channel (Amite River and Bayou Manchac) and one Federal flood control channel (AR&T) are present. No major port or terminal installations are present.	*US, LA & SA:* Continued investment in port facilities and inland waterways. Navigation continues to be important part of the national transportation and commerce activities. *SA:* Amite River and Bayou Manchac Federal navigation channel and AR&T flood control channel are primarily used for recreational navigation.	*US & LA:* Continued investment in port facilities and inland waterways. Navigation continues to be important part of the national transportation and commerce activities. *SA:* Amite River and Bayou Manchac Federal navigation channel and AR&T flood control channel are likely to continue to be used primarily for recreational navigation.	*US & LA:* Continued investment in port facilities and inland waterways. Navigation continues to be important part of the national transportation and commerce activities. ALT 33 (Recommended Plan): This alternative would have positive effects on navigation when combined with other Federal, state, local, and private restoration efforts. Cumulative impacts would be the protection of navigation channels. ALTS 34-39: Cumulative impacts would be similar to ALT 33.

Table 5.1. Comparison of Cumulative Impacts*

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts (Comparison of Future With Proposed Action Impacts)
Socioeconomic and Human Resources – Man-Made Resources Oil, Gas, Utilities, and Pipelines	*US, 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 southwest of study area.	*US, LA, & SA:* Increasing O&M costs as well as increasing investment for oil and gas production facilities and pipelines, due to widespread coastal wetland loss. *SA:* Thirteen wells identified, plugged or abandoned or no oil produced; two inactive well bores and one active well bore; one active crude oil pipeline across northeastern corner.	*US, 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. *SA:* Wells likely to remain and active pipelines likely to be present.	*US & LA:* Continued investment in oil, gas, utilities, and pipelines. ALT 33 (Recommended Plan): This alternative would have positive effects on the protection of oil, gas, utilities, and pipelines when combined with other Federal, state, local, and private restoration efforts. These facilities would be less susceptible to storm surges and other damage due to wetland loss. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Socioeconomic and Human Resources – Man-Made Resources Flood Control and 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:* The AR&T flood control project was completed in 1964. Municipal and parish flood control measures, including drainage canals and control structures are present.	*US & LA:* Largest national restoration effort of hurricane and flood control in nation's history. *SA:* The AR&T Federal flood control project is present. Municipal and parish flood control measures including drainage canals and control structures are present.	*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 would be needed. *SA:* Continued degradation of wetlands would result in increases localized storm surge and storm wave damages.	*US & LA:* Continued loss of flood control and hurricane protection due to continued coastal and wetland degradation and loss. ALT 33 (Recommended Plan): This alternative would have positive effects on flood control and hurricane protection when combined with other Federal, state, local, and private restoration efforts. The proposed action would nourish and create swamp that is currently converting to open water, leaving adjacent areas more vulnerable to storm surges. Cumulative impacts include some protection of the ARDC and surrounding developments from storm damages. ALTS 34-39: Cumulative impacts would be similar to ALT 33.
Socioeconomic and Human Resources – Natural Resources Commercial Fisheries	*US, LA, & SA:* Institutional recognition, formation of NMFS and LDWF; Magnuson-Stevens Fishery Conservation and Management Act and amendments. Reduction in fisheries habitat, increased commercial catches, gear improvement, catch regulations. Commercial landings in the US in 2007 were nearly 4.2 million metric tons. Of the 528 individual stocks, 45 (24%) are overfished and 41 (17%) are subject to overfishing (NOAA). *LA:* Commercially important species, including brown and white shrimp, blue crabs, eastern oysters, and menhaden abundant. *SA:* Study area may provide some habitat for gulf menhaden and striped mullet but no commercial fishery for these species is present.	*US, LA & SA:* Continued institutional recognition and regulation of commercial fisheries. *LA:* Largest producer of shrimp, menhaden, blue crabs, and eastern oysters. *SA:* Study area may provide some habitat for gulf menhaden and striped mullet, but commercial fishery for these species is not present.	*US:* 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. *LA & SA:* Loss of commercial fishery habitat due to loss of essential wetland habitats and salinity changes.	*US & 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 33 (Recommended Plan): This alternative would have positive effects on commercial fisheries when combined with other Federal, state, local, and private restoration efforts. A net total of 1,602 acres of swamp habitat would be restored and nourished. Localized improvements of fishery habitats would provide some undetermined positive benefits to local commercial fisheries. ALT 34: Cumulative impacts similar to ALT 33 except 1,459 acres swamp habitat restored and nourished. ALT 35: Cumulative impacts similar to ALT 33 except 820 acres swamp habitat restored and nourished. ALT 36: Cumulative impacts similar to ALT 33 except 3,061 acres swamp habitat restored and nourished. ALT 37: Cumulative impacts similar to ALT 33 except 2,279 acres swamp habitat restored and nourished. ALT 38: Cumulative impacts similar to ALT 33 except 2,422 acres swamp habitat restored and nourished. ALT 39: Cumulative impacts similar to ALT 33 except 3,881 acres swamp habitat restored and nourished.
Hazardous, Toxic, and Radioactive Waste	*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 results 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:* Increasing human populations worldwide. Increasing opportunity for HTRW problems. ALT 33 (Recommended Plan): There would be no cumulative impacts on HTRW. HTRW issues are unlikely to occur when combined with other Federal, state, local, and private restoration efforts. ALTS 34-39: Cumulative impacts would be similar to ALT 33.

**Includes Spatial/Geographic Extent (Continental United States [US], 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 on Environmental Quality entitled "Considering Cumulative Effect Under the National Environmental Policy Act".*



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RELATED PROJECTS IN VICINITY OF
AMITE RIVER DIVERSION CANAL MODIFICATION

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2007 Ascension, Livingston, St. James, St. John, and Tangipahoa Parishes USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 5.1
Date: July 2010
Scale:1:220,000
Source: NAIP/GEC
Map ID: 27850108-1381

Table 5.2. Net Acres[1] Created, Restored, and/or Protected by Other Federal, State, Local, and Private Restoration Efforts (LCA, 2004)

Program	Net Acres Created (LCA Subprovince 1)
Breaux Act CWPPRA[1]	33,690
State	2,543
PCWRP[2]	14
Mitigation Civil Works Projects[3]	4,990
Mitigation Regulatory Permits	6,411
Vegetation[4]	535
Section 204/1135, Beneficial Use	226
WRDA[5]	16,000
Other[6]	0
TOTALS	**64,410**

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 (12,376 ha) restored and 340,348 (137,840 ha) acres enhanced by North American Wetlands Conservation Act (NAWCA), administered by the U.S. Fish and Wildlife Service (USFWS); unable to determine exact locations.
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 (20,250 ha) of non-mitigation land bought in fee in the Atchafalaya Basin by the District.

dissolved solids and turbidity, as well as potentially increase total metals and nutrients as they are released from the sediments. These impacts would be temporary and localized, lasting until the soils become compacted and vegetation is re-established. In addition, Best Management Practices (BMPs) would be used to minimize the amount of sediment entering the water, both during and after construction, until dredged material berms are vegetated.

Indirect. Indirectly, this alternative would improve hydrologic connectivity to a net total of 1,602 acres of wetland soils located between the ARDC and the adjacent swamp. Improved hydrologic connectivity would also allow nutrients and sediments to be introduced from the ARDC into the swamp during flood events and from runoff during localized rainfall events. Nutrients and sediment delivered to the swamp would improve biological productivity and reduce the chances of further habitat deterioration. Finally, the establishment of hydrologic connectivity would reduce the likelihood of the swamp being converted to marsh or open water.

Cumulative. Alternative 33 would work additively with other projects within the general area to benefit soil resources including a net total of 1,602 acres of wetland soils would be hydrologically restored and nourished. The impacts to wetland soils within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.1.1.3 Alternative 34

Direct. Direct impacts of this alternative would be similar to Alternative 33 (Recommended Plan), except approximately 3.4 acres of soil from the existing dredged material berm would be excavated and approximately 10.5 acres of conveyance channel habitat would be created.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan), except 1,459 acres of swamp would be benefited.

Cumulative. Cumulative impacts of implementing this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.1.1.4 Alternative 35

Direct. Direct impacts of this alternative would be similar to Alternative 33 (Recommended Plan), except approximately 2.4 acres of soil from the existing dredged material berm would be excavated and approximately 7.2 acres of conveyance channel habitat would be created.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan), except 820 acres of swamp would be benefited.

Cumulative. Cumulative impacts of implementing this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.1.1.5 Alternative 36

Direct. Direct impacts of this alternative would be similar to Alternative 33 (Recommended Plan), except approximately 6.0 acres of soil from the existing dredged material berm would be excavated and approximately 29.1 acres of conveyance channel habitat would be created.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan), except 3,061 acres of swamp would be benefited.

Cumulative. Cumulative impacts of implementing this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.1.1.6 Alternative 37

Direct. Direct impacts of this alternative would be similar to Alternative 33 (Recommended Plan), except approximately 5.8 acres of soil from the existing dredged material berm would be excavated and approximately 17.7 acres of conveyance channel habitat would be created.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan), except 2,279 acres of swamp would be benefited.

Cumulative. Cumulative impacts of implementing this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.1.1.7 Alternative 38

Direct. Direct impacts of this alternative would be similar to Alternative 33 (Recommended Plan), except approximately 5.0 acres of soil from the existing dredged material berm would be excavated and approximately 25.8 acres of conveyance channel habitat would be created.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan), except 2,422 acres of swamp would be benefited.

Cumulative. Cumulative impacts of implementing this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.1.1.8 Alternative 39

Direct. Direct impacts of this alternative would be similar to Alternative 33 (Recommended Plan), except approximately 8.4 acres of soil from the existing dredged material berm would be excavated and approximately 44.0 acres of conveyance channel habitat would be created.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan), except 3,881 acres of swamp would be benefited.

Cumulative. Cumulative impacts of implementing this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.1.2 Waterbottoms

5.1.2.1 No-Action Alternative

Direct. There would be no direct impacts to waterbottoms.

Indirect. Existing swamp habitat would continue to be converted to water bottoms. The decomposition of swamp vegetation would initially increase the availability of nutrients and detritus. However, the continued degradation from fresh marsh to shallow open water would ultimately decrease available nutrients and detritus.

Cumulative. Throughout coastal Louisiana, and within the study area, an increase in shallow water bottom acreage would occur in response to wetland loss. Overall cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system (Figure 2.2), which would be additive with other swamp losses and degradation impacts to waterbottoms throughout the region, state, and nation. However, the impacts to waterbottoms in the study area and vicinity would be offset to some extent by other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.1.2.2 Alternative 33 (Recommended Plan)

Direct. Direct impacts to waterbottoms would generally be associated with construction activities including dredging and placement of borrow material. A very small amount of waterbottom in the ARDC adjacent to the dredged material berm would also be excavated during the conveyance channel construction. Construction of the conveyance channels would create 18.6 acres of waterbottoms.

Indirect. Indirect impacts to waterbottoms would be related primarily to construction activities primarily associated with dredging and placement of dredged material for creation of BLH "islands". Construction of conveyance channels would decrease swamp habitat degradation, benefiting waterbottoms by providing increased dissolved organic compounds and detritus. Restoring hydrologic connectivity would contribute to re-establishing a wet-dry cycle to existing swamp waterbottoms, thereby increasing swamp vegetation productivity and health. In addition, dissolved organic compounds and detritus from the restored swamp vegetation would also increase the health and productivity of the swamp. A net total of 1,602 acres of swamp habitat and associated water bottoms would be benefitted by this alternative.

Cumulative. Throughout Coastal Louisiana, an increase in shallow water bottom acreage would occur in response to wetland loss. Implementation of Alternative 33 (Recommended Plan) would decrease the amount of waterbottoms created from the deterioration and conversion of existing swamp habitat to shallow open water habitat. The impacts to waterbottoms within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.1.2.3 Alternative 34

Direct. Direct impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan), except approximately 10.5 acres of conveyance channel habitat would be created.

Indirect. Indirect impacts would be similar to those described for Alternative 33 (Recommended Plan), except approximately 1,459 acres of swamp habitat would be benefited.

Cumulative. Cumulative effects of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.1.2.4 Alternative 35

Direct. Direct impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan), except approximately 7.2 acres of conveyance channel habitat would be created.

Indirect. Indirect impacts would be similar to those described for Alternative 33 (Recommended Plan), except approximately 820 acres of swamp habitat would be benefited.

Cumulative. Cumulative effects of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.1.2.5 Alternative 36

Direct. Direct impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan), except approximately 29.1 acres of conveyance channel habitat would be created.

Indirect. Indirect impacts would be similar to those described for Alternative 33 (Recommended Plan), except approximately 3,061 acres of swamp habitat would be benefited.

Cumulative. Cumulative effects of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.1.2.6 Alternative 37

Direct. Direct impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan), except approximately 17.7 acres of conveyance channel habitat would be created.

Indirect. Indirect impacts would be similar to those described for Alternative 33 (Recommended Plan), except approximately 2,279 acres of swamp habitat would be benefited.

Cumulative. Cumulative effects of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.1.2.7 Alternative 38

Direct. Direct impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan), except approximately 25.8 acres of conveyance channel habitat would be created.

Indirect. Indirect impacts would be similar to those described for Alternative 33 (Recommended Plan), except approximately 2,422 acres of swamp habitat would be benefited.

Cumulative. Cumulative effects of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.1.2.8 Alternative 39

Direct. Direct impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan), except approximately 36.3 acres of conveyance channel habitat would be created.

Indirect. Indirect impacts would be similar to those described for Alternative 33 (Recommended Plan), except approximately 3,881 acres of swamp habitat would be benefited.

Cumulative. Cumulative effects of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.2 HYDROLOGY

Hydrologic change is the main measure by which the swamps can be restored in the study area. Hydrologic restoration must account for the Relative Sea Level Rise (RSLR). Given the hydrologic influence of tidal Lake Maurepas and the regional subsidence conditions, RSLR could affect the computed flows in the proposed conveyance channels and the stage durations. In response to this concern, the Project Delivery Team (PDT) evaluated the potential impact of RSLR on the TSP/Recommended Plan. The evaluation adhered to guidelines established in Incorporating Sea Level Change Considerations in Civil Works Programs, EC 1165-2-211 (USACE, 2009a).

EC 1165-2-211 provides USACE guidance for incorporating the direct and indirect physical effects of projected future sea-level change in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects and systems of projects. Recent climate research by the Intergovernmental Panel on Climate Change predicts continued or accelerated global warming for the 21st Century and possibly beyond, which will cause a continued or accelerated rise in global mean sea-level. Impacts to coastal and estuarine zones caused by sea-level change must be considered in all phases of Civil Works programs.

In the preparation of the EC, USACE has relied entirely on climate change science performed and published by agencies and entities external to USACE. The EC documents this science and provides information on how to calculate three proposed sea level rise scenarios for use in projects.

The USACE guidance requires an assessment of project performance based on three estimates (low, intermediate, and high) of predicted relative sea level rise (RSLR). The low estimate reflects the local historic rate for the study area, based on long-term local gage data. The intermediate and high estimates reflect a combination of the local historic subsidence rate with either the modified NRC Curve I or the NRC Curve III estimate of eustatic sea level rise. The USACE New Orleans District prepared RSLR estimates in accordance with EC 1165-2-211 for LCA projects Amite River Diversion Canal and Small Diversion at Convent/Blind River (USACE, 2009b). The study areas for both projects are hydrologically independent; therefore any proposed actions would not result in ecosystem benefits or impacts between the two projects. The following estimates of RSLR account for both the eustatic rate of sea level rise and the local subsidence rate.

Low Rate RSLR - Consistent with guidance provided in EC1165-2-211, the USACE gauge at the West End in Lake Pontchartrain was used to calculate a representative historic rate for the project area. Daily stage data from 1959 to 2009 indicate a rate of 9.20 mm/yr (0.0302 ft/yr; see Figure 5.2) with a standard error of the linear trend line of 0.65 foot. Using the rate of 9.20 mm/yr, a starting year of 2012, and a 50-year period of analysis, the USACE projects a sea level rise of 1.5 feet for 2062. The rate of 9.20 mm/yr includes both the eustatic sea level rise and the local subsidence contributions to the estimated total RSLR.

Intermediate and High Rates - To estimate the local subsidence rate for the project area, the USACE subtracted the global eustatic rate (1.7 mm/yr) from the local sea level rate or

Local subsidence rate = 9.20 mm/yr – 1.7 mm/yr = 7.50 mm/yr.

The following formula yields an estimate of the total rise in eustatic sea level for the project life for the intermediate and high rate cases of sea level rise:

$$E(t_2) - E(t_1) = 0.0017(t_2 - t_1) + b(t_2^2 - t_1^2)$$

where: b=the acceleration factor for each curve, or 2.36E-5 and 1.005E-4, respectively, t_1=the time in years between the project's construction date and 1986, and t_2=the time between a future date at which one wants an estimate for sea level rise and 1986.

These eustatic estimates, when added to the local subsidence estimate, yield the total sea level rise for the intermediate and high rate cases. Table 5.3 presents a summary of the estimated total sea level rise in five-year increments through the 50-year period of analysis for each case. Figure 5.2 shows the estimated sea level rise for each case.

Table 5.3. Summary of Five-year Sea Level Rise for Each Case (USACE, 2009, Estimated Sea level Rise for Amite River Diversion and Convent/Blind River Diversion LCA Projects)

Project year	Low Rate (feet)	Intermediate Rate (feet)	High Rate (feet)
2012	0.0	0.0	0.0
2017	0.2	0.2	0.2
2022	0.3	0.3	0.5
2027	0.5	0.5	0.8
2032	0.6	0.7	1.1
2037	0.8	0.9	1.4
2042	0.9	1.1	1.7
2047	1.1	1.3	2.0
2052	1.2	1.5	2.4
2057	1.4	1.7	2.8
2062	1.5	1.9	3.2

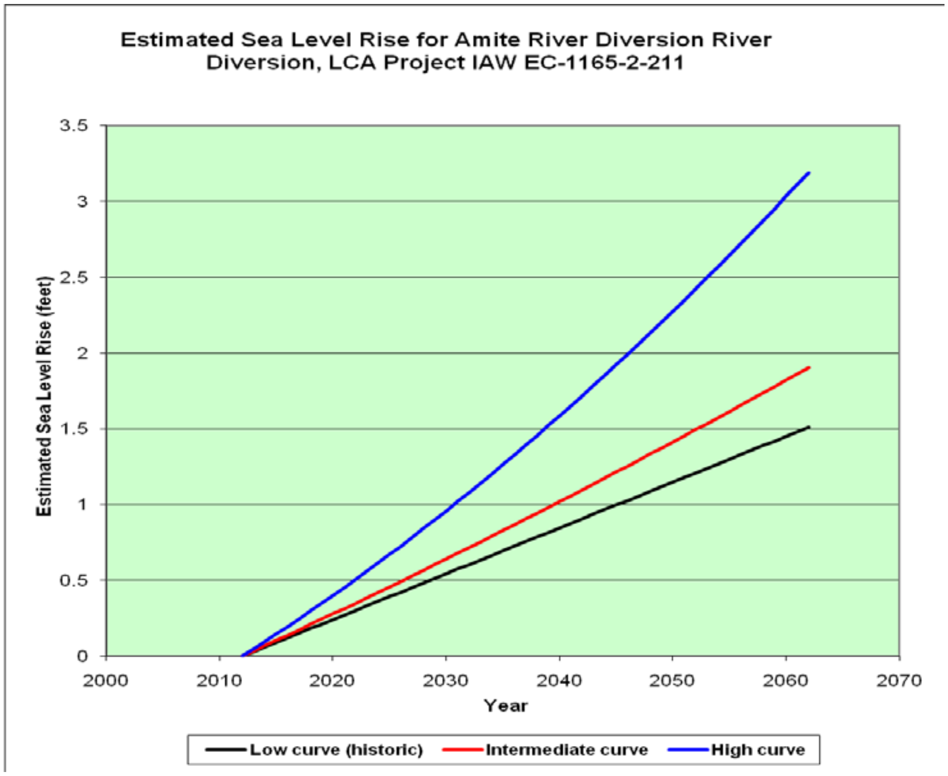

Figure 5.2. Plot of Sea Level Rise for Each Case (USACE, 2009, Estimated Sea level Rise for Amite River Diversion)

Impact of RSLR - The HEC-RAS models for the No-Action Alternative and the With Project Alternative for 2062 (Year-50) were rerun for the three RSLR cases by adding 1.5, 1.9, and 3.2 feet to the Amite River at the Maurepas hydrograph downstream boundary condition. Model results are presented in Tables 5.4, 5.5, and 5.6. The previous results (Year 1) for computed flows in the exchange channels versus computed Year 50 flows for low, intermediate, and high RSLR are included in Table 5.4. Similar comparisons of stage durations for the previously computed Year 1 versus Year 50 low, intermediate, and high RSLR for the No-Action Alternative and With Project Alternative in SE-1 and NE-2, respectively are presented in Tables 5.5 and 5.6 (SE-1 and NE-2 represent the subunits in which the cuts are located). As stages increase in Lake Maurepas due to RSLR, the flow in the proposed new conveyance channels increase (Table 5.4). RSLR would dramatically reduce the stage duration below 1.0 foot with both the No-Action Alternative and the With Project Alternative (Tables 5.5 and 5.6). The percentage of days with water surface elevation below 1.0 foot in the SE-1 and NE-2 areas falls from 37 and 48 percent, respectively, to zero under all three RSLR cases. It was determined that little differences existed between all seven alternatives, when modeled separately and together, therefore the With Project Alternative represents the implementation of all cuts.

Table 5.4. Computed Exchange Channel Flows with RSLR

With project with no RSLR					
Reach (cut)	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	6330	5298	4812	4368	4035
% time of inflow	23%	22%	29%	28%	28%
Volume outflow (ac-ft/yr)	6874	7160	3392	3696	4088
% time of outflow	77%	78%	71%	72%	72%
With Project with 50 years of Low rate of RSLR					
Reach (cut)	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	23175	20734	14522	13503	12903
% time of inflow	35%	34%	54%	53%	52%
Volume outflow (ac-ft/yr)	32635	35202	7291	8187	8894
% time of outflow	65%	66%	46%	47%	48%
With Project with 50 years of Intermediate rate of RSLR					
Reach (cut)	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	28332	25659	15172	14131	13480
% time of inflow	36%	35%	56%	55%	54%
Volume outflow (ac-ft/yr)	41868	45382	7324	8397	9234
% time of outflow	64%	65%	44%	45%	46%
With Project with 50 years of High rate of RSLR					
Reach (cut)	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	36013	33138	15622	14617	14028
% time of inflow	39%	38%	56%	54%	52%
Volume outflow (ac-ft/yr)	57802	63338	74145	9374	11222
% time of outflow	61%	62%	44%	46%	48%

Table 5.5. Stage Duration with RSLR, Storage Area SE-1

	No-Action Plan						With Project Plan					
Without RSLR												
Water Surface Elevation (WSE), feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	213	2283	2742	2935	3059	3151	1352	2390	2770	2950	3070	3160
% time at or below WSE	6%	62%	75%	80%	84%	86%	37%	65%	76%	81%	84%	86%
Consecutive Days at or below WSE	73	120	138	164	203	204	114	121	152	164	203	205
With Project with Low rate of RSLR (50 years)												
Water Surface Elevation (WSE), feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	0	15	60	89	120	0	8	62	104	162	206
% time at or below WSE	0%	0%	0%	2%	2%	3%	0%	0%	2%	3%	4%	6%
Consecutive Days at or below WSE	0	0	2	7	9	12	0	2	7	10	16	22
With Project with Intermediate rate of RSLR (50 years)												
Water Surface Elevation (WSE), feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	0	0	0	3	7	0	0	3	12	24	38
% time at or below WSE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%
Consecutive Days at or below WSE	0	0	0	0	1	2	0	0	1	3	3	3
With Project with High rate of RSLR (50 years)												
Water Surface Elevation (WSE), feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	0	0	0	0	0	0	0	0	0	0	0
% time at or below WSE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Consecutive Days at or below WSE	0	0	0	0	0	0	0	0	0	0	0	0

Table 5.6. Stage Duration with RSLR, Storage Area NE-2

	No-Action Plan						With Project Plan					
Without RSLR												
Water Surface Elevation (WSE), feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	241	2306	2834	3027	3144	3233	1750	2501	2865	3032	3153	3236
% time at or below WSE	7%	63%	78%	83%	86%	88%	48%	68%	78%	83%	86%	89%
Consecutive Days at or below WSE	64	148	184	203	204	205	117	150	185	204	204	205
With Project with Low rate of RSLR (50 years)												
Water Surface Elevation (WSE), feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	2	63	140	205	285	0	11	77	144	214	289
% time at or below WSE	0%	0%	2%	4%	6%	8%	0%	0%	2%	4%	6%	8%
Consecutive Days at or below WSE	0	2	8	12	17	22	0	5	8	12	17	22
With Project with Intermediate rate of RSLR (50 years)												
Water Surface Elevation (WSE), feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	0	1	19	40	60	0	0	4	23	42	66
% time at or below WSE	0%	0%	0%	1%	1%	2%	0%	0%	0%	1%	1%	2%
Consecutive Days at or below WSE	0	0	1	3	3	8	0	0	2	3	3	5
With Project with High rate of RSLR (50 years)												
Water Surface Elevation (WSE), feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	0	0	0	0	0	0	0	0	0	0	0
% time at or below WSE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Consecutive Days at or below WSE	0	0	0	0	0	0	0	0	0	0	0	0

Estimates of the time in years to permanent inundation for the No-Action Alternative and Future with Project Alternative Plans (conditions are nearly the same for both swamp areas) are presented in Table 5.7. These estimates do not consider a rate for biomass and mineral sediment accretion. Biomass and mineral sediment accretion could extend the timeline until permanent inundation. It is estimated that within a healthy freshwater swamp habitat, accretion would result in approximately 8 mm/year within the study area (Bernard Wood, unpublished data, 2005 through 2009). It has also estimated that a net loss of substrate of 1 to 3 mm/year would occur within degraded areas of the Maurepas Swamp; therefore, a net accretion rate of 2.2 to 4.6 mm/year in healthy areas of the Maurepas Swamp (Shaffer and Bernard, unpublished data, 2005 through 2009). The net accretion estimates account for subsidence, but not eustatic sea level rise.

Table 5.7. Years to Permanent Inundation

RSLR Case	RSLR Year 50	No-Action	With Project
Low Rate	1.5 feet	14 years	40 years
Intermediate Rate	1.9 feet	12.5 years	31 years
High Rate	3.2 feet	8 years	17 years

The rates of sea level rise and the rate of accretion relative to the existing elevation of the swamp is depicted for reference in Figures 5.3 through 5.5. These graphs illustrate that under the FWP condition, accretion will not keep up with RSLR for any of the three forecasts. However, the figures do illustrate that a substantial reduction of the RSLR impacts under the FWOP condition is obtained. As stated in Section 3.5.2, benefits will be achieved even after permanent inundation occurs. Therefore, the reduction in the impacts of RSLR observed through biomass accretion would prolong the benefits obtained and increase sustainability for all three estimates.

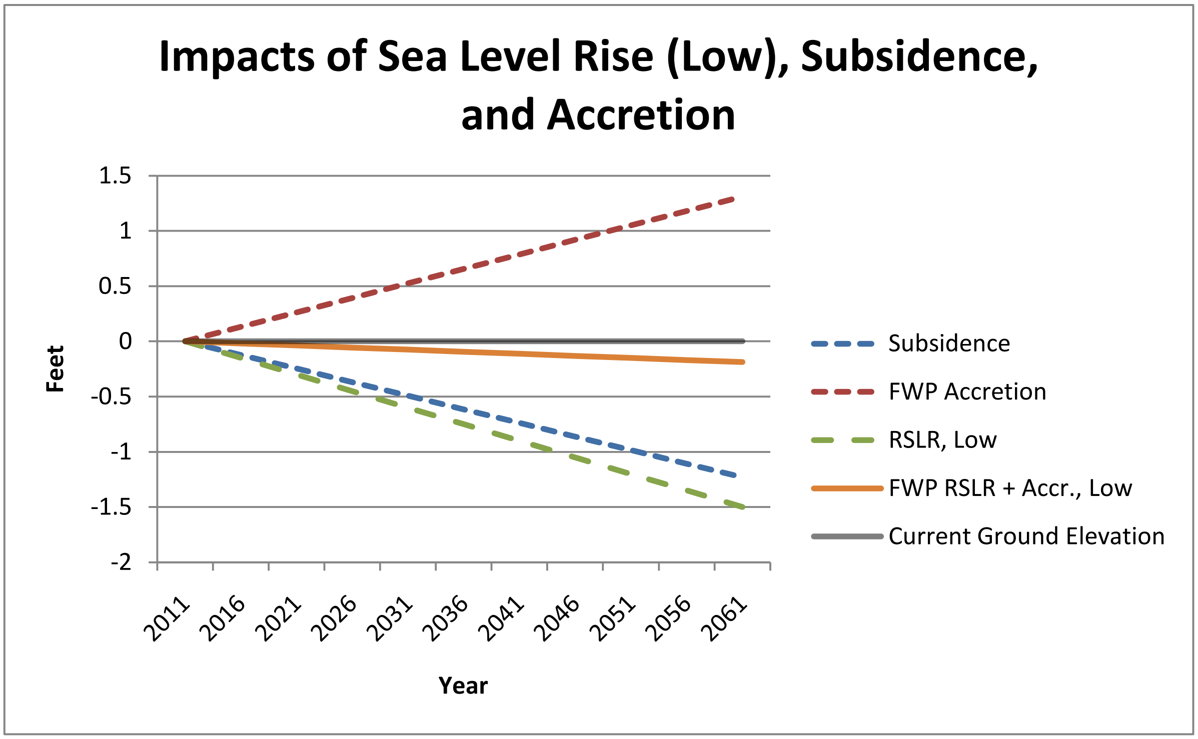

Figure 5.3. Combined Effects of Low RSLR Estimate and Accretion

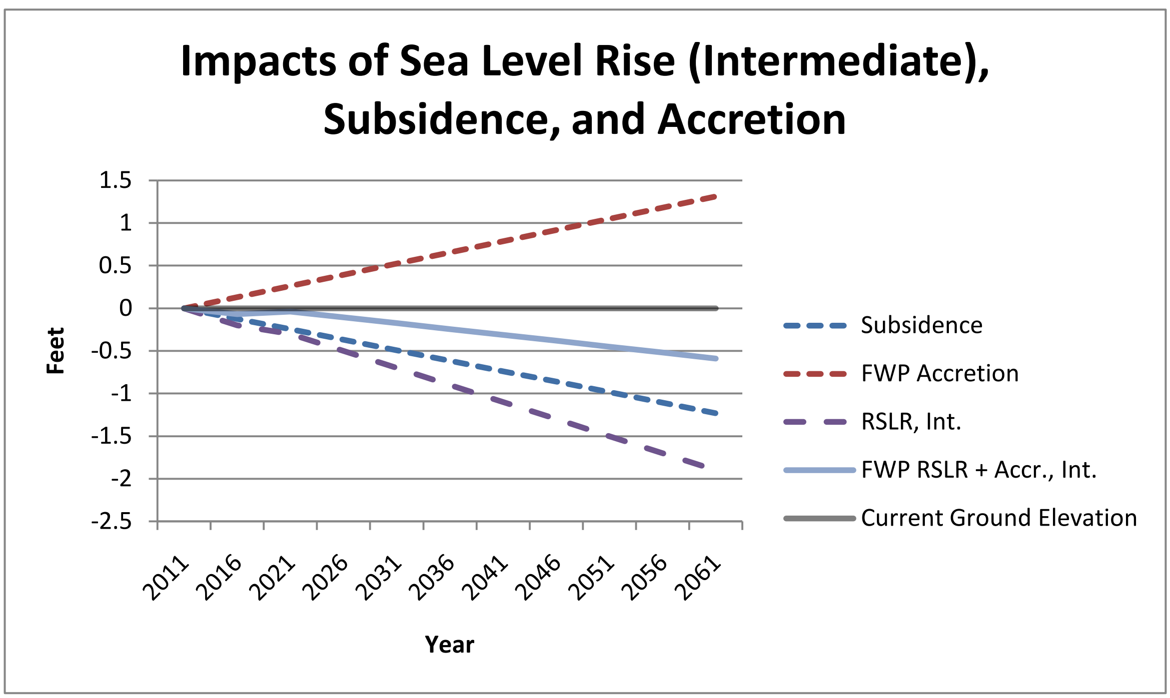

Figure 5.4. Combined Effects of Intermediate RSLR Estimate and Accretion

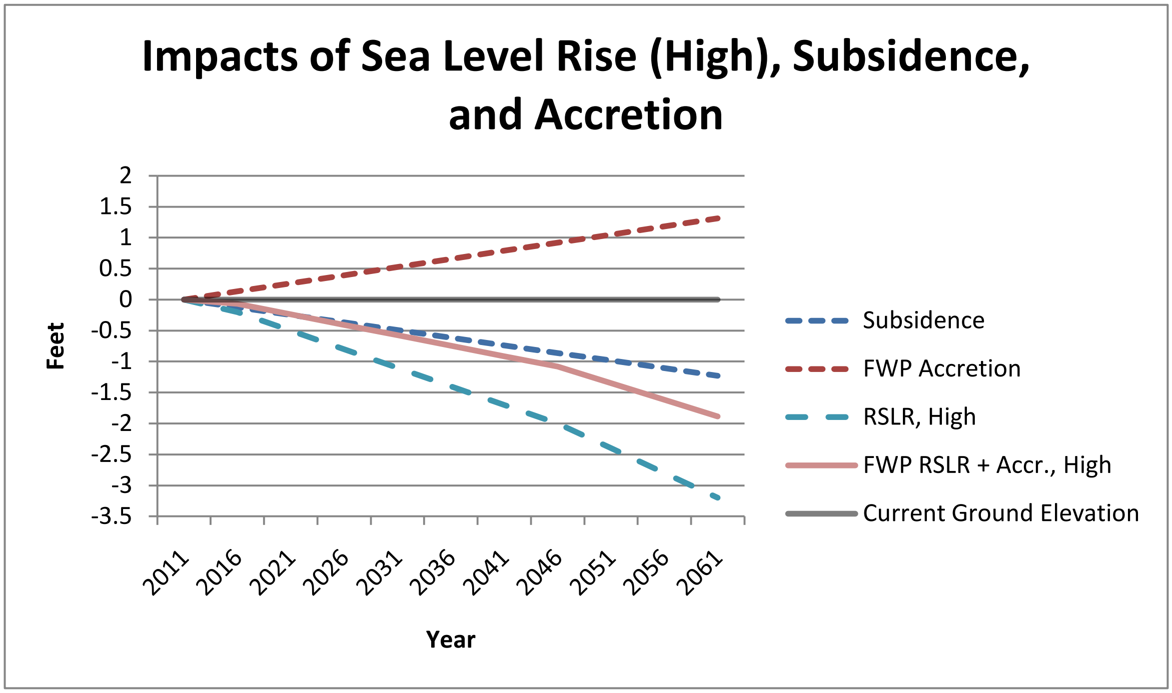

Figure 5.5. Combined Effects of High RSLR Estimate and Accretion

As part of the analysis of RSLR in the Future With Project (FWP) condition, the Wetland Value Analysis model (WVA) was performed on all three scenarios of predicted sea level rise for the NER plan and the Recommended Plan. The results showed a decrease of approximately seven percent when the intermediate estimate was modeled and a decrease of approximately 10 percent with the high estimate. The results of this analysis may be seen in Table 5.8.

Table 5.8. Effect of RSLR on Alternatives

Effect of Relative Sea Level Rise on Alternatives			
Alternative	**Low SLR (AAHUs)**	**Intermediate RSLR (AAHUs)**	**High RSLR (AAHUs)**
33	679	640	610
34	589		
35	334		
36	1,268		
37	922		
38	1,013		
39	1,602	1,516	1,452

Results of Relative Sea Level Rise Analysis - Proposed conveyance channels would meet the hydrodynamic objectives of the project. Proposed conveyance channels would improve the hydrologic connections of the ARDC and the adjacent swamp, as well as facilitating development of a more natural wet-dry cycle within the swamp. The effects of RSLR would reduce the improvements by reducing the dry periods within the associated areas of impact. Increased connectivity for water flow, nutrients, and sediments will still benefit the freshwater swamp, even in the event of permanent inundation. As stated in Section 3.5.2, low oxygen and reducing conditions restrict tree growth in inundated conditions. Improved flow would increase oxygen and improve tree vigor, even in fully inundated conditions (Gary Shaffer, personal communication, October 2009).

It has also been recognized that organic material would accumulate in the ARDC study area, thereby playing a role in reducing the overall effects of relative RSLR. According to studies performed near the study area, organic buildup of approximately 8 mm/yr has been observed near healthy cypress trees over the past 10 years (Bernard Wood, unpublished data, 2005 through 2009). This indicates that accretion, within a healthy swamp with adequate sediment and nutrient exchange, may reduce the potential impacts of RSLR.

The proposed conveyance channels may cause an inconsequential increase in peak flood stages in the swamps near the ARDC, and a minor decrease in peak flood stages in the Amite River and ARDC. The Recommended Plan would not increase the flood risk to houses and developments within the study area.

Any future development along the dredged material berms within the areas of impact would have no effect on the benefits generated by the final array of alternatives, as hydrologic connectivity would still be established between the ARDC and the interior swamp habitat.

5.2.1 Flow and Water Levels

5.2.1.1 No-Action Alternative

Direct. No direct impacts to flow and water levels, except there would be an increase in water levels due to sea level rise.

Indirect. Indirect impacts of not implementing wetland restoration would result in the persistence of existing conditions. Water flow into and out of the swamp would remain inhibited by the dredged material berms, resulting in continued impoundment of, and lack of connectivity to the adjacent swamp habitat. This continued impoundment and lack of connectivity would continue to stress and degrade the swamp habitat, converting from fresh marsh to open water.

Cumulative. Cumulative impacts of not implementing restoration actions and reconnecting hydrologic flows between the Maurepas Swamp and adjacent waters would result in the continued degradation and conversion of 18,204 acres of existing swamp habitat to marsh and shallow open water habitat. Water flows into and out of the swamp would continue to be impeded by the existing dredged material berms along the ARDC. Water levels within the impounded study area would likely increase due to projected rise in sea level. The conversion of 18,204 acres of existing swamp habitat to a shallow open water system would be in addition to other swamp habitat losses and degradation impacts to flows and water levels throughout the region, state and nation (see Figure 5.1 and Table 5.2).

5.2.1.2 Alternative 33 (Recommended Plan)

Direct. Direct impacts would be an increase in water flow into and out of the swamp areas, along with more variable water levels indicative of a more natural wet-dry cycles for 1,602 acres of swamp, depending on ARDC stages and tidal activity. With added conveyance, increases in flow and water level fluctuations would occur within more interior portions of the project area.

Indirect. The addition of three cuts in the ARDC dredged material berm would reconnect the hydrology and increase flows into and out of 1,602 acres of swamp, resulting in positive effects on water levels and flows. There would be an overall net gain of 679 Average Annual Habitat Units (AAHUs).

Cumulative. Cumulative impacts to water flow and water levels would primarily be associated with incremental impacts of similar wetland restoration projects in and near the study area as well as throughout coastal Louisiana (see Figure 5.1 and Table 5.2). Water levels would likely fluctuate in response to ARDC and sea level rises, which would likely have a cumulative effect when considering the overall freshwater swamp degradation in the Lake Maurepas area.

5.2.1.3 Alternative 34

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan) except increased flow and water level variability would occur in 1,459 acres of swamp.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan) except that this alternative would benefit 1,459 acres (589 AAHUs).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan) except 1,459 acres of swamp would be benefited.

5.2.1.4 Alternative 35

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan) except increased flow and water level variability would occur in 820 acres of swamp.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan) except that this alternative would benefit 820 acres (334 AAHUs).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan) except 820 acres of swamp would be benefited.

5.2.1.5 Alternative 36

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan) except increased flow and water level variability would occur in 3,061 acres of swamp.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan) except that this alternative would benefit 3,061 acres (1,268 AAHUs).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan) except 3,061 acres of swamp would be benefited.

5.2.1.6 Alternative 37

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan) except increased flow and water level variability would occur in 2,279 acres of swamp.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan) except that this alternative would benefit 2,279 acres (922 AAHUs).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan) except 2,279 acres of swamp would be benefited.

5.2.1.7 Alternative 38

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan) except increased flow and water level variability would occur in 2,422 acres of swamp.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan) except that this alternative would benefit 2,422 acres (1,013 AAHUs).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan) except 2,422 acres of swamp would be benefited.

5.2.1.8 Alternative 39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan) except increased flow and water level variability would occur in 3,881 acres of swamp.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan) except that this alternative would benefit 3,881 acres (1,602 AAHUs).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan) except 3,881 acres of swamp would be benefited.

5.2.2 Sedimentation and Erosion

5.2.2.1 No-Action Alternative

Direct. There would be no direct impacts to sediment supply to or from the swamp. The sediment in the waters of the ARDC is primarily suspended fines that would be prevented from entering the swamp by the dredged material berms of the ARDC. The sediment would not be able to be supplied to the system, increasing the impacts of erosion, subsidence, and swamp degradation.

Indirect. The swamp health would continue to degrade due to the lack of connectivity and lack of sediment and nutrient input.

Cumulative. Cumulative effects include the continued impaired sediment supply due to urbanization and the resulting degradation of coastal wetlands, as well as the benefits and impacts of other state and Federal projects in the vicinity (see Figure 5.1 and Table 5.2). Subsidence and RSLR would likely continue to occur at a rate greater than sediment deposition, resulting in a net lowering of land surface throughout much of coastal Louisiana. Within the study area, tropical storms may cause some redistribution of sediments to and from the swamp and surrounding waterways, but the ARDC existing dredged material berms would continue to block hydrologic exchange and, therefore, sedimentation. Overall cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system, which would be additive with other swamp losses and degradation impacts to sedimentation and erosion throughout the region and state**.**

5.2.2.2 Alternative 33 (Recommended Plan)

Direct. The direct impact would be the connectivity and sediment accretion from the ARDC into the swamp system on approximately 1,602 acres. The appropriate BMPs would be implemented to limit the introduction of sediments into receiving waters, such as the ARDC, during construction.

Indirect. The indirect benefits would improve swamp health due to the connectivity and placement of sediment on the swamp floor on approximately 1,602 acres.

Cumulative. Cumulative impacts to sediments would primarily be associated with incremental impacts of similar wetland creation and nourishment features. Cumulative impacts would be the effect of the additive combination of impacts and benefits for overall net acres nourished, and protected by other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2). Alternative 33 (Recommended Plan) would interact with these projects to provide an increase in the introduction of sediments for the swamp habitat within the western Maurepas Swamp, thereby benefiting 1,602 acres, which would have a cumulative effect when considering the overall freshwater swamp degradation in the Lake Maurepas area. This would reduce the conversion of the estimated 18,204 acres of swamp to open water. Further development and other factors, such as sea level rise, would continue to have a negative effect, leading to further swamp degradation within coastal Louisiana.

5.2.2.3 Alternative 34

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan), except the settlement of sediment on the swamp floor would occur over approximately 1,459 acres.

Indirect. The indirect impacts would be similar to Alternative 33 (Recommended Plan), except accretion and improved swamp health would occur over approximately 1,459 acres of swamp floor.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except 1,459 acres of swamp would be benefited.

5.2.2.4 Alternative 35

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan), except the settlement of sediment on the swamp floor would occur over approximately 820 acres.

Indirect. The indirect impacts would be similar to Alternative 33 (Recommended Plan), except accretion and improved swamp health would occur over approximately 820 acres of swamp floor.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except 820 acres of swamp would be benefited.

5.2.2.5 Alternative 36

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan), except the settlement of sediment on the swamp floor would occur over approximately 3,061 acres.

Indirect. The indirect impacts would be similar to Alternative 33 (Recommended Plan), except accretion and improved swamp health would occur over approximately 3,061 acres of swamp floor.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except 3,061 acres of swamp would be benefited.

5.2.2.6 Alternative 37

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan), except the settlement of sediment on the swamp floor would occur over approximately 2,279 acres.

Indirect. The indirect impacts would be similar to Alternative 33 (Recommended Plan), except accretion and improved swamp health would occur over approximately 2,279 acres of swamp floor.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except 2,279 acres of swamp would be benefited.

5.2.2.7 Alternative 38

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan), except the settlement of sediment on the swamp floor would occur over approximately 2,422 acres.

Indirect. The indirect impacts would be similar to Alternative 33 (Recommended Plan), except accretion and improved swamp health would occur over approximately 2,422 acres of swamp floor.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except 2,422 acres of swamp would be benefited.

5.2.2.8 Alternative 39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan), except the settlement of sediment on the swamp floor would occur over approximately 3,881 acres.

Indirect. The indirect impacts would be similar to Alternative 33 (Recommended Plan), except accretion and improved swamp health would occur over approximately 3,881 acres of swamp floor.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except 3,881 acres of swamp would be benefited.

5.2.3 Water Use and Supply

5.2.3.1 No-Action Alternative

Direct. There would be no direct impacts to water use and supply.

Indirect. There would be no indirect impacts to water use and supply.

Cumulative. Water use would increase with population growth, placing more demand on the water supply. Other cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system within the study area, which would be additive with other swamp losses and degradation impacts to water use and supply throughout the region and state. This conversion of swamp habitat to open water habitat would likely reduce water purification function of forested wetlands. However, the impacts to water use and supply within the study area and vicinity would be offset to some extent by other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.2.3.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct effects to water use and supply as a result of Alternative 33 (Recommended Plan).

Indirect. There would be no indirect effects to water use and supply as a result of Alternative 33 (Recommended Plan).

Cumulative. Water use and supply would likely continue to increase throughout the country and region, while implementation of Alternative 33 (Recommended Plan) and the corresponding reconnected hydrology of swamp would likely result in improved water purification function within the study area. The impacts to water use and supply within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.2.3.3 Alternatives 34-39

Direct. There would be no direct effects to water use and supply.

Indirect. There would be no indirect effects to water use and supply.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.2.4 Groundwater

5.2.4.1 No-Action Alternative

Direct. There would be no direct impacts to groundwater.

Indirect. Indirect adverse impacts include decreases in groundwater resources as a result of increased demand for groundwater as a water supply source due to the increasing populations of Ascension and Livingston Parishes.

Cumulative. Cumulative impacts would include the overall reduction of groundwater due to population, agriculture and industry increases throughout coastal Louisiana. Increasing populations in Ascension and Livingston Parishes are expected to stress groundwater resources by increased demands for groundwater as a water supply. Overall cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system, which would be additive with other swamp losses and degradation impacts to groundwater throughout the region and state. However, the impacts to groundwater within the study area and vicinity would be offset to some extent by other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.2.4.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct effects on groundwater.

Indirect. There would be no indirect effects on groundwater.

Cumulative. Rising populations in Ascension and Livingston Parishes are expected to stress groundwater resources by increased demands for groundwater as a water supply. No groundwater impacts would likely result upon implementation of Alternative 33 (Recommended Plan) within the study area as groundwater is supplied by the Chicot Equivalent aquifer. The impacts to groundwater within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.2.4.3 Alternatives 34-39

Direct. There would be no direct effects on groundwater.

Indirect. There would be no indirect effects on groundwater.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.3 WATER QUALITY AND SALINITY

A draft Total Maximum Daily Load (TMDL) has been submitted by the Louisiana Department of Environmental Quality (LDEQ) and proposes a 60 percent reduction in non-point source (NPS) load within the ARDC in order to achieve current water quality standards. However, the LDEQ is in the process of conducting an ecoregional use attainability analysis that they suspect will modify the water quality standard such that the required NPS load reduction will be reduced to 25 percent.

5.3.1 Water Quality

5.3.1.1 No-Action Alternative

Direct. There would be no direct impacts to water quality.

Indirect. Potential indirect impacts include further degradation of the cypress-tupelo swamp due to the lack of water exchange. Current water quality conditions would persist in surface waters in the impounded swamp habitat adjacent to the ARDC and within the flowing systems. Conversion of the forested swamp to fresh marsh and ultimately open water would cause changes to surface water chemistry, including a seasonal increase in salinity as salt water moves more easily upstream from Lake Maurepas, and the potential for the release of nutrients that are currently retained in the swamp soils. The water quality within the swamp would contribute to the continued degradation of the swamp due to the increased stress on the plants because of the lack of connectivity and to the conversion of the swamp, initially to fresh marsh, and ultimately to open water.

Cumulative. While the impending implementation of the TMDLs in the study area would likely offset any new impacts from an increased human presence in the region, the No-Action Alternative would likely result in changes to water quality as the forested swamp continues to degrade to fresh marsh and ultimately open water. Continued conversion of swamp habitat to marsh and open water throughout the region would reduce the natural filtration of water. Overall cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system, which would be additive with other swamp losses and degradation impacts to water quality throughout the region and state. However, the impacts to water quality within the study area and vicinity would be offset to some extent by other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

Draft TMDLs have been received for the two LDEQ subsegments that encompass the study area and are scheduled to be completed in 2011 for the current causes of the Fish and Wildlife Propagation use impairment, including mercury, chloride, and total dissolved solids (TDS). Water quality conditions in the study area and vicinity could possibly improve the implementation of the TMDLs in conjunction with other existing water quality programs. However, the potential increase in human activities that could have adverse effects on water quality would also continue to occur in the future, such as increased wastewater and polluted stormwater runoff generated by increased development in the Pontchartrain Basin, and the potential discharge of untreated or poorly-treated sewerage.

5.3.1.2 Alternative 33 (Recommended Plan)

Direct. Implementation of Alternative 33 (Recommended Plan) would directly impact water quality by introducing sediments into both the ARDC and into the swamps. Water introduction would temporarily increase total suspended and dissolved solids and turbidity in the swamp. Appropriate BMPs should be used to minimize the amount of sediment entering the ARDC and receiving waterbodies, both during and after construction, until dredged material berms are vegetated. There would also be some minor and temporary adverse direct impacts to water quality due to increased turbidity during and immediately following the construction phase.

Restoring hydraulic connectivity would temporarily and periodically allow impounded swamp waters that are potentially low in dissolved oxygen (DO), and high in biological oxygen demand (BOD), chlorides and nutrient content to enter the ARDC and receiving waterbodies. The introduction of waters of poorer quality from the swamp may impair the water quality in the receiving waters. Alternatively, water with presumably higher DO and lower BOD, chlorides and nutrient content would be allowed to flow into the forested swamp areas, thus improving the water quality within the swamp. These higher quality waters, in conjunction with the other benefits of this project, are expected to improve the health of the forested swamp.

Indirect. Indirect impacts include the improvement of water quality conditions within the forested swamp, thereby indirectly improving the growth and health of the cypress-tupelo forest. There would also be some minor and temporary adverse impacts to water quality due to increased turbidity during and immediately following the construction phase.

Cumulative. Increases in demand corresponding with increased human population and industrialization within the region would likely create a potential for water quality problems within the U.S. and Louisiana. The cumulative impacts of implementing Alternative 33 (Recommended Plan) may include temporary and periodic impacts to the water quality in the receiving waters within the study area, but ultimately should improve water quality conditions, and the overall health of the forested swamp, with the additional benefits that the healthy and intact forested wetland environment would provide for 1,602 acres. The impacts to water quality within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.3.1.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.3.2 Salinity

5.3.2.1 No-Action Alternative

Direct. Storm surges from tropical cyclone events would increase salinity levels within the study area. The existing impoundments would retain higher salinity water within the study area and cause it to absorb into the substrate. The frequency of saltwater inundation is expected to increase with RSLR.

Indirect. Vegetation within the impounded forested swamp areas would be subject to salt stress when saline waters are not freely flushed from the system. Flora and fauna species may change over time as salt-tolerant species replace fresh water species as the swamp turns to marsh and open water.

Cumulative. Cumulative impacts would include the negative impacts of increased salinity levels moving further inland along coastal Louisiana, which leads to the degradation of wetland vegetation and furthers coastal and bottomland habitat loss, together with the benefits and impacts of other state and Federal projects in the vicinity. The regional effects of RSLR may also play a role in increasing salinity levels within the region. Within the study area, the continual impoundment and lack of hydrologic connectivity would likely result in higher residence times and higher salinity levels. Overall cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system, which would be additive with other swamp losses and degradation throughout the region and state. However, the impacts to salinity levels within the study area and vicinity would be offset to some extent by other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.3.2.2 Alternative 33 (Recommended Plan)

Direct. Direct impacts of Alternative 33 (Recommended Plan) would include the introduction of fresh water into 1,602 acres of forested swamp, reducing the salinity, chloride, and total dissolved solids concentrations within the impacted areas.

Indirect. Existing vegetation within the impounded forested swamp areas should benefit by the input of fresh water to the system. The implementation of Alternative 33 (Recommended Plan) would partially restore the cycle of inundation and drying of the swamp that halted with the construction of dredged material berms. The periodic introduction of freshwater would help to decrease salt water retention or absorption in the study area, thus helping to prevent the continued degradation of the forested wetland.

Cumulative. The regional effects of RSLR may play a role in increasing salinity levels within the surrounding areas of coastal Louisiana. The cumulative impacts of implementing Alternative 33 (Recommended Plan) may include the reduction of salinity levels within the study area due to the restored hydrologic connectivity of 1,602 acres of swamp habitat. The impacts to salinity levels within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.3.2.3 Alternative 34

Direct. Direct impacts would be similar to that in Alternative 33 (Recommended Plan), although slightly reduced in scale because fewer cuts are proposed in Alternative 34 and a smaller area of swamp would be impacted.

Indirect. Indirect impacts would be similar to that in Alternative 33 (Recommended Plan), although slightly reduced in scale because fewer cuts are proposed in Alternative 34 and a smaller area of swamp would be impacted.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except 1,459 acres of swamp habitat would benefit from restored hydrologic connectivity.

5.3.2.4 Alternative 35

Direct. Direct impacts would be similar to that in Alternative 33 (Recommended Plan), although greatly reduced in scale because only one cut is proposed in Alternative 35 and a smaller area of swamp would be impacted.

Indirect. Indirect impacts would be similar to that in Alternative 33 (Recommended Plan), although greatly reduced in scale because only one cut is proposed in Alternative 35 and a smaller area of swamp would be impacted.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except 820 acres of swamp habitat would benefit from restored hydrologic connectivity.

5.3.2.5 Alternative 36

Direct. Direct impacts would be similar to that in Alternative 33 (Recommended Plan), although increased in scale because one additional cut is proposed in Alternative 36 and a larger area of swamp would be impacted.

Indirect. Indirect impacts would be similar to that in Alternative 33 (Recommended Plan), although increased in scale because one additional cut is proposed in Alternative 36 and a larger area of swamp would be impacted.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except 3,061 acres of swamp habitat would benefit from restored hydrologic connectivity.

5.3.2.6 Alternative 37

Direct. Direct impacts would be similar to that in Alternative 33 (Recommended Plan), although reduced in scale, because one less cut is proposed in Alternative 37; however a larger area of swamp would be impacted.

Indirect. Indirect impacts would be similar to that in Alternative 33 (Recommended Plan), although reduced in scale because one less cut is proposed in Alternative 37; however a larger area of swamp would be impacted.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except 2,279 acres of swamp habitat would benefit from restored hydrologic connectivity.

5.3.2.7 Alternative 38

Direct. Direct impacts would be similar to that in Alternative 33 (Recommended Plan), although slightly increased in scale because one additional cut is proposed in Alternative 38 and a larger area of swamp would be impacted.

Indirect. Indirect impacts would be similar to that in Alternative 33 (Recommended Plan), although slightly increased in scale because one additional cut is proposed in Alternative 38 and a larger area of swamp would be impacted.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except 2,422 acres of swamp habitat would benefit from restored hydrologic connectivity.

5.3.2.8 Alternative 39

Direct. Direct impacts would be similar to that in Alternative 33 (Recommended Plan), although greatly increased in scale because two additional cuts are proposed and a larger area of swamp would be impacted.

Indirect. Indirect impacts would be similar to that in Alternative 33 (Recommended Plan), although greatly increased in scale because two additional cuts are proposed and a larger area of swamp would be impacted.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except 3,881 acres of swamp habitat would benefit from restored hydrologic connectivity.

5.4 AIR QUALITY

5.4.1 No-Action Alternative

Direct. There would be no direct adverse impacts on air quality.

Indirect. There would be no indirect impacts of not implementing hydrologic connectivity within the study area, which would result in the persistence of existing conditions. Most of the study area consists of remote, uninhabited swamp.

Cumulative. Continued institutional recognition, along with the continued deterioration of air quality throughout the nation and region, due to increases in population and industrialization, would likely occur. Other cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system within the study area, which would be additive with other swamp losses and degradation impacts to air quality throughout the region and state, because of reductions in function of swamp vegetation to act as natural filters for air pollution. However, the impacts to air quality within the study area and vicinity would be offset to some extent by other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.4.2 Alternative 33 (Recommended Plan)

Direct. Direct impacts to ambient air quality would be temporary and localized, resulting primarily from the emissions of construction equipment within the study area. Direct impacts to air quality, specifically emission levels for nitrous oxide (NOx) and volatile organic compounds (VOCs) are quantified in Tables 5.9 and 5.10.

Indirect. Over the 50-year period of analysis, Alternative 33 (Recommended Plan) would likely result in the restoration of 1,602 acres of swamp vegetation, increasing the habitat's ability to filter the air and improve local air quality by reducing particulates and gaseous air pollutants.

Cumulative. Continued deterioration of air quality throughout the nation and region, due to increases in population and industrialization, would likely occur. These impacts to air quality within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.4.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.5 NOISE

5.5.1 No-Action Alternative

Direct. There would be no direct impacts on noise.

Indirect. There would be no indirect impacts on noise.

Cumulative. There would be no cumulative impacts of the No-Action Alternative on noise.

5.5.2 Alternative 33 (Recommended Plan)

Direct. Construction activities associated with implementing Alternative 33 (Recommended Plan) would temporarily increase the noise levels in the construction areas. However, the areas of impact are remote and unpopulated, so the noise level would not affect any nearby human communities. In some instances, noise impacts may directly impact fish and wildlife species temporarily. These organisms would generally avoid the construction area; returning once construction activities cease. Potential noise impacts from construction activities, although construction equipment is limited in the level of noise that can be emitted. Institutional recognition of noise, such as provided by the regulation for Occupational Noise Exposure 929 CFR Part 1910.95) under the Occupational Safety and Health Act of 1970, as amended, would continue. This section mandates that noise levels emitted from construction equipment be below 90 dB for exposures of eight hours per day or more. Once construction activities are completed, noise levels would return to preconstruction conditions.

Table 5.9. Air Quality Emission Analysis for Nitrous Oxide

This table lists the equipment that will be used for the earth moving phase of this project, and details an estimate of the amount of expected emission of Nitrous Oxide for the duration of the project.

Air Quality Emission Analysis for Nitrous Oxide										
Units	**Equipment Item**	**Total Work Hours**	**Work House Per Unit**	**Fuel Type Gas**	**Diesel**	**hp**	**Multiplying Factor % hp**	**Time**	**Total hp Hours**	**Annual hp Hours**
1	Crew Boat	880	880		D	874	0.83	0.8	510695.68	510695.68
1	Dozer D-6	400	400		D	100	0.83	0.7	23240	23240
1	Log Skidder 517	400	400		D	120	0.83	0.7	27888	27888
1	Marsh Backhoe/CAT 330	1680	1680		D	222	0.83	0.7	216689.76	216689.76
1	Tugboat 900 horsepower (hp)	160	160		D	900	0.83	0.8	95616	95616
1	Barge	840	840			0			0	0
	TOTAL GASOLINE (hp hours)									
	TOTAL DIESEL (hp hours)								874129.44	874129.44
	[1]Nox Emission Factors (lbs/hp hours)	Gas	Diesel							
		0.011	0.031							
							Emissions			Tons
							Gas			0.00
							[2]Diesel			13.55
							Subtotal			13.55

[1]Nox emission factors were obtained per guidance AP 42. Additional information may be obtained at www.epa.gov/ttnchie1/ap42/.

[2]Estimated Nox emissions were calculated by multiplying total diesel hp hours by the diesel Nox emission factor (lbs/hp hours), divided by 2000 to obtain tons (874129.44*0.031/2000).

5.10. Air Quality Emission Analysis for Volatile Organic Compounds

This table lists the equipment that will be used for the earth moving phase of this project, and details an estimate of the amount of expected emission of Volatile Organic Compounds for the duration of the project.

Air Quality Emission Analysis for Volatile Organic Compounds

Units	Equipment Item	Total Work Hours	Work House Per Unit	Fuel Type Gas	Diesel	hp	Multiplying Factor % hp	Time	Total hp Hours	Annual hp Hours
1	Crew Boat	880	880		D	874	0.83	0.8	510695.68	510695.68
1	Dozer D-6	400	400		D	100	0.83	0.7	23240	23240
1	Log Skidder 517	400	400		D	120	0.83	0.7	27888	27888
1	Marsh Backhoe/CAT 330	1680	1680		D	222	0.83	0.7	216689.76	216689.76
1	Tugboat 900 hp	160	160		D	900	0.83	0.8	95616	95616
1	Barge	840	840			0			0	0
									874129.44	874129.44
	[1]VOC Emission Factors (lbs/hp hours)	Gas	Diesel							
	Exhaust	0.015	0.00247							
	Evaporation	0.000661	0				Emissions			Tons
	Crankcase	0.00485	0.0000441				Gas			0.00
	Refueling	0.00108	0				[2]Diesel			1.10
	Total	0.021591	0.0025141				**Subtotal**			1.10

[1]VOC emission factors were obtained per guidance AP 42. Additional information may be obtained at www.epa.gov/ttnchie1/ap42/.
[2]Estimated VOC emissions were calculated by multiplying total diesel hp hours by the total diesel VOC emission factors (lbs/hp hours), divided by 2000 to obtain tons (874129.44*0.0025141/2000).

Indirect. Localized and temporary noise impacts would likely result in wildlife and fishery resources, temporarily leaving the areas of impact during construction activities, reducing the wildlife viewing opportunities. However, indirect impacts due to noise are expected to be localized, temporary, and minor.

Cumulative. The cumulative impacts would principally be related to the potential short-term disruption of fish and wildlife species. The continued increases in noise throughout the nation and region, due to increases in population and industrialization, would likely occur. Ambient noise from boats, airboats, and other human activities would continue to cause some minimal and temporary disturbances in the study area. Long-term adverse cumulative impacts within the study area due to noise levels are not expected.

5.5.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.6 VEGETATION RESOURCES

5.6.1 Riparian Vegetation Resources

5.6.1.1 No-Action Alternative

Direct. There would be no direct impacts to riparian vegetation.

Indirect. There would essentially be no impact to riparian vegetation.

Cumulative. Riparian vegetation along ARDC berms likely unchanged over 50-year period of analysis. However, the impacts to riparian vegetation resources within the study area and vicinity would be offset to some extent by other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.6.1.2 Alternative 33 (Recommended Plan)

Direct. Direct impacts would include the loss of riparian vegetation resources located along the ARDC dredged material berms to open water habitat due to the construction of the conveyance channel (Figure 3.4). There would be approximately 16,101 linear feet of conveyance channel created and approximately 7.4 acres of riparian habitat created adjacent to the channel. All riparian habitats temporarily impacted or created would be replanted for the improvement of this habitat. The dredged material placement berms would be replanted with the appropriate BLH species, and the rest of the area impacted by the construction of the conveyance channel and dredged material placement would be planted with freshwater swamp species.

Indirect. There would be minor indirect impacts to riparian habitat due to effects of the construction.

Cumulative. This alternative would have positive effects on riparian vegetation when combined with other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2). There would be creation of riparian habitat along conveyance channels. Riparian vegetation on dredged material berms would be impacted by construction

5.6.1.3 Alternative 34

Direct. Direct impacts would include the conversion of riparian vegetation resources located along the ARDC dredged material berms due to the construction of the conveyance channel (Figure 3.10). There would be approximately 8,483 linear feet on conveyance channel created and approximately 3.9 acres of riparian habitat created adjacent to the channel. All riparian habitats temporarily impacted or created would be replanted for the improvement of this habitat. The dredged material placement berms would be replanted with the appropriate BLH species, and the rest of the area impacted by the construction of the conveyance channel and dredged material placement would be planted with freshwater swamp species.

Indirect. There would be minor indirect impacts to riparian habitat.

Cumulative. Cumulative impacts would include the direct minor loss of riparian habitat due to construction of the conveyance channel and the conversion of 3.9 acres of freshwater swamp to riparian habitat. Overall cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.6.1.4 Alternative 35

Direct. Direct impacts would include the conversion of riparian vegetation resources located along the ARDC dredged material berms due to the construction of the conveyance channel (Figure 3.11). There would be approximately 5,930 linear feet on conveyance channel created and approximately 2.7 acres of riparian habitat created adjacent to the channel. All riparian habitats temporarily impacted or created would be replanted for the improvement of this habitat. The dredged material placement berms would be replanted with the appropriate BLH species, and the rest of the area impacted by the construction of the conveyance channel and dredged material placement would be planted with freshwater swamp species.

Indirect. There would be minor indirect impacts to riparian habitat.

Cumulative. Cumulative impacts would include the direct minor loss of riparian habitat due to construction of the conveyance channels and the conversion of 2.7 acres of freshwater swamp to riparian habitat. Overall cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.6.1.5 Alternative 36

Direct. Direct impacts would include the conversion of riparian vegetation resources located along the ARDC dredged material berms due to the construction of the conveyance channel (Figure 3.12). There would be approximately 24,493 linear feet on conveyance channel created and approximately 11.3 acres of riparian habitat created adjacent to the channel. All riparian habitats temporarily impacted or created would be replanted for the improvement of this habitat. The dredged material placement berms would be replanted with the appropriate BLH species, and the rest of the area impacted by the construction of the conveyance channel and dredged material placement would be planted with freshwater swamp species.

Indirect. There would be minor indirect impacts to riparian habitat.

Cumulative. Cumulative impacts would include the direct minor loss of riparian habitat due to construction of the conveyance channels and the conversion of 11.3 acres of freshwater swamp to riparian habitat. Overall cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.6.1.6 Alternative 37

Direct. Direct impacts would include the conversion of riparian vegetation resources located along the ARDC dredged material berms due to the construction of the conveyance channel (Figure 3.13). Approximately 10.1 acres of freshwater swamp would be converted into riparian habitat; approximately 4.9 would be converted dredged material placement and 5.2 acres would be cleared work areas (Table 3.4). There would be approximately 14,413 linear feet on conveyance channel created and approximately 6.7 acres of riparian habitat created adjacent to the channel. All riparian habitats temporarily impacted or created would be replanted for the improvement of this habitat. The dredged material placement berms would be replanted with the appropriate BLH species, and the rest of the area impacted by the construction of the conveyance channel and dredged material placement would be planted with freshwater swamp species.

Indirect. There would be minor indirect impacts to riparian habitat.

Cumulative. Cumulative impacts would include the direct minor loss of riparian habitat due to construction of the conveyance channels and the conversion of 6.7 acres of freshwater swamp to riparian habitat. Overall cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.6.1.7 Alternative 38

Direct. Direct impacts would include the conversion of riparian vegetation resources located along the ARDC dredged material berms due to the construction of the conveyance channel (Figure 3.14). There would be approximately 21,940 linear feet on conveyance channel created and approximately 10.1 acres of riparian habitat created adjacent to the channel. All riparian habitats temporarily impacted or created would be replanted for the improvement of this habitat. The dredged material placement berms would be replanted with the appropriate BLH species, and the rest of the area impacted by the construction of the conveyance channel and dredged material placement would be planted with freshwater swamp species.

Indirect. There would be minor indirect impacts to riparian habitat.

Cumulative. Cumulative impacts would include the direct minor loss of riparian habitat due to construction of the conveyance channel and the conversion of 15.2 acres of freshwater swamp to riparian habitat and the conversion of 10.1 acres of freshwater swamp to riparian habitat. Overall cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.6.1.8 Alternative 39

Direct. Direct impacts would include the conversion of riparian vegetation resources located along the ARDC dredged material berms would be permanently lost due to the construction of the conveyance channel (Figure 3.15). There would be approximately 30,423 linear feet on conveyance channel created and approximately 14.0 acres of riparian habitat created adjacent to the channel. All riparian habitats temporarily impacted or created would be replanted for the improvement of this habitat. The dredged material placement berms would be replanted with the appropriate BLH species, and the rest of the area impacted by the construction of the conveyance channel and dredged material placement would be planted with freshwater swamp species.

Indirect. There would be minor indirect impacts to riparian habitat.

Cumulative. Cumulative impacts would include the direct minor loss of riparian habitat due to construction of the conveyance channel and the conversion of 14 acres of freshwater swamp to riparian habitat and the conversion of 7.4 acres of freshwater swamp to riparian habitat. Overall cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.6.2 Wetland Vegetation Resources

The acres of vegetative degradation resulting from the No-Action alternative and the acres of freshwater swamp and bottomland hardwood habitat benefited through implementation of the final array are found in Table 5.11.

Table 5.11. Degradation and Benefits for Final Array

Years to Marsh	Study Area Degradation (Acres)	Benefits Achieved from Final Array (Acres)						
	No-Action	33	34	35	36	37	38	39
Existing Marsh	300	144	146	0	290	146	144	290
10 Years to Marsh	1,723	241	775	0	1,016	775	241	1,016
20 - 3- Years to Marsh	7,979	975	299	542	1,274	841	1,518	1,816
30 - 50 Years to Marsh	8,202	242	239	278	481	517	519	759
Total Acres	**18,204**	**1,602**	**1,459**	**820**	**3,061**	**2,279**	**2,422**	**3,881**

5.6.2.1 No-Action Alternative

Direct. There would be no direct impacts to wetland vegetation resources.

Indirect. The lack of connectivity for freshwater, nutrient, and sediment exchange would continue to degrade the wetland habitat. Additionally, impoundment caused by the dredged material berms would continue to cause degradation to the freshwater swamp habitat. The freshwater swamp would degrade to freshwater marsh and eventually to open water. Functions lost include habitat for wildlife and aquatic species, recreational opportunities, aesthetics, and storm surge protection. Upon severe degradation, the swamp will convert to freshwater marsh, then to open water. The freshwater marsh does offer some of the functions of the freshwater swamp, but certain functions are lost, such as habitat for avian species and storm surge protection.

Cumulative. Cumulative impacts would be the continued degradation effects of coastal land loss due to hydrologic impairment, development, subsidence, sea level rise, and saltwater intrusion. Other cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system within the study area, which would be additive with other swamp losses and degradation impacts to wetland vegetation throughout the region and state. However, the impacts to wetland vegetation resources within the study area and vicinity would be offset to some extent by other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.6.2.2 Alternative 33 (Recommended Plan)

Direct. Direct impacts would include the conversion of approximately 31.2 acres of existing cypress/tupelo swamp and dredged material berm habitat vegetated by upland plants to open water conveyance channel habitat and BLH habitat (Figure 3.4). Approximately 18.6 acres would be converted to conveyance channel, 5.0 acres would be converted to dredged material placement berm habitat, and 7.6 acres would be temporarily impacted by the construction (Table 3.4). Temporary work areas would be replanted with freshwater swamp species, and the dredged material berms would be planted with appropriate BLH species. The vegetative plantings on 438 acres would be conducted by hand and would have no significant direct impacts on existing wetland vegetation, but would contribute to the improved health of the freshwater swamp system.

Indirect. This alternative would improve the hydrologic connectivity between the ARDC and 1,602 acres in both the primary and secondary impact areas (Figure 3.4), creating approximately 679 AAHUs of freshwater swamp. Restored hydrologic connections would increase the nutrient and sediment loads to 646 acres within the primary impact area. Additional indirect impacts would include increased acreage of swamp wetland vegetation habitats used by fish and wildlife for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements; increased vegetation growth and productivity; and reduced inter- and intra- specific competition between resident and migratory fish and wildlife species for limited coastal swamp wetland vegetation resources. Compared to the No-Action Alternative, implementing this alternative would prevent the conversion of 1,602 acres of existing swamp wetland vegetation habitats to marsh and shallow open water habitats. Increased connectivity for water flow, nutrients, and sediments will benefit the freshwater swamp, even in the event of permanent inundation. Low oxygen and reducing conditions restrict tree growth in inundated conditions. Improved flow would increase oxygen and improve tree vigor, even in fully inundated conditions (Gary Shaffer, personal communication, October 2009).

Cumulative. Alternative 33 (Recommended Plan) would restore approximately 1,602 acres with a total of 679 AAHUs compared to the No-Action Alternative. However, throughout the region, state and nation, the continued deterioration and loss of wetland vegetation resources would likely continue due to natural and human-induced processes. The impacts to wetland vegetation resources within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.6.2.3 Alternative 34

Direct. Direct impacts would include the conversion of approximately 18.8 acres of existing cypress/tupelo swamp and dredged material berm habitat vegetated by upland plants to open water conveyance channel habitat and BLH habitat (Figure 3.10). Approximately 10.5 acres would be converted to conveyance channel, 2.7 acres would be converted to dredged material placement berm habitat, and 5.6 acres would be temporarily impacted by the construction. The acreages associated with direct impacts are found in Table 3.5. Temporary work areas would be replanted with freshwater swamp species, and the dredged material berms would be planted with appropriate BLH species. The vegetative plantings on 487 acres would be conducted by hand and would have no significant direct impacts on existing wetland vegetation, but would contribute to the improved health of the freshwater swamp system.

Indirect. This alternative would improve the hydrologic connectivity between the ARDC and 1,459 acres in both the primary and secondary impact areas (Figure 3.10), creating approximately 589 AAHUs of freshwater swamp. Restored hydrologic connections would increase the nutrient and sediment loads to 426 acres within the primary impact area.

Cumulative. Alternative 34 would restore approximately 1,459 acres with a total of 589 AAHUs compared to the No-Action Alternative. However, throughout the region, state and nation, the continued deterioration and loss of wetland vegetation resources would likely continue due to natural and human-induced processes.

5.6.2.4 Alternative 35

Direct. Direct impacts would include the conversion of approximately 13.3 acres of existing cypress/tupelo swamp and dredged material berm habitat vegetated by upland plants to open water conveyance channel habitat and BLH habitat (Figure 3.11). Approximately 7.2 acres would be converted to conveyance channel, 2.2 acres would be converted to dredged material placement berm habitat, and 3.9 acres would be temporarily impacted by the construction. The acreages associated with direct impacts are found in Table 3.5. Temporary work areas would be replanted with freshwater swamp species, and the dredged material berms would be planted with appropriate BLH species. There would be no vegetative plantings.

Indirect. This alternative would improve the hydrologic connectivity between the ARDC and 820 acres in both the primary and secondary impact areas (Figure 3.11), creating approximately 334 AAHUs of freshwater swamp. Restored hydrologic connections would increase the nutrient and sediment loads to 443 acres within the primary impact area.

Cumulative. Alternative 35 would restore approximately 820 acres with a total of 334 AAHUs compared to the No-Action Alternative. However, throughout the region, state and nation, the continued deterioration and loss of wetland vegetation resources would likely continue due to natural and human-induced processes.

5.6.2.5 Alternative 36

Direct. Direct impacts would include the conversion of approximately 50.0 acres of existing cypress/tupelo swamp and dredged material berm habitat vegetated by upland plants to open water conveyance channel habitat and BLH habitat (Figure 3.12). Approximately 29.1 acres would be converted to conveyance channel, 7.8 acres would be converted to dredged material placement berm habitat, and 13.1 acres would be temporarily impacted by the construction. The acreages associated with direct impacts are found in Table 3.5. Temporary work areas would be replanted with freshwater swamp species, and the dredged material berms would be planted with appropriate BLH species. The vegetative plantings on 925 acres would be conducted by hand and would have no significant direct impacts on existing wetland vegetation, but would contribute to the improved health of the freshwater swamp system.

Indirect. This alternative would improve the hydrologic connectivity between the ARDC and 3,061 acres in both the primary and secondary impact areas (Figure 3.12), creating approximately 1,268 AAHUs. Restored hydrologic connections would increase the nutrient and sediment loads to 1,072 acres within the primary impact area.

Cumulative. Alternative 36 would restore approximately 3,061 acres with a total of 1,268 AAHUs compared to the No-Action Alternative. However, throughout the region, state and nation, the continued deterioration and loss of wetland vegetation resources would likely continue due to natural and human-induced processes.

5.6.2.6 Alternative 37

Direct. Direct impacts would include the conversion of approximately 32.1 acres of existing cypress/tupelo swamp and dredged material berm habitat vegetated by upland plants to open water conveyance channel habitat and BLH habitat (Figure 3.13). Approximately 17.7 acres would be converted to conveyance channel, 4.9 acres would be converted to dredged material placement berm habitat, and 9.5 acres would be temporarily impacted by the construction. Temporary work areas would be replanted with freshwater swamp species, and the dredged material berms would be planted with appropriate BLH species. The vegetative plantings on 487 acres would be conducted by hand and would have no significant direct impacts on existing wetland vegetation, but would contribute to the improved health of the freshwater swamp system.

Indirect. This alternative would improve the hydrologic connectivity between the ARDC and 2,279 acres in both the primary and secondary impact areas (Figure 3.13), creating approximately 922 AAHUs of freshwater swamp. Restored hydrologic connections would increase the nutrient and sediment loads to 869 acres within the primary impact area.

Cumulative. Alternative 37 would restore approximately 2,279 acres with a total of 922 AAHUs compared to the No-Action Alternative. However, throughout the region, state and nation, the continued deterioration and loss of wetland vegetation resources would likely continue due to natural and human-induced processes.

5.6.2.7 Alternative 38

Direct. Direct impacts would include the conversion of approximately 44.5 acres of existing cypress/tupelo swamp and dredged material berm habitat vegetated by upland plants to open water conveyance channel habitat and BLH habitat (Figure 3.14). Approximately 25.8 acres would be converted to conveyance channel, 7.2 acres would be converted to dredged material placement berm habitat, and 11.5 acres would be temporarily impacted by the construction. The acreages associated with direct impacts are found in Table 3.5. Temporary work areas would be replanted with freshwater swamp species, and the dredged material berms would be planted with appropriate BLH species. The vegetative plantings on 438 acres would be conducted by hand and would have no significant direct impacts on existing wetland vegetation, but would contribute to the improved health of the freshwater swamp system.

Indirect. This alternative would improve the hydrologic connectivity between the ARDC and 2,422 acres in both the primary and secondary impact areas, creating approximately 1.013 AAHUs of freshwater swamp (Figure 3.14). Restored hydrologic connections would increase the nutrient and sediment loads to 1,088 acres within the primary impact area.

Cumulative. Alternative 38 would restore approximately 2,422 acres with a total of 1,013 AAHUs compared to the No-Action Alternative. However, throughout the region, state and nation, the continued deterioration and loss of wetland vegetation resources would likely continue due to natural and human-induced processes.

5.6.2.8 Alternative 39

Direct. Direct impacts would include the conversion of approximately 63.3 acres of existing cypress/tupelo swamp and dredged material berm habitat vegetated by upland plants to open water conveyance channel habitat and BLH habitat (Figure 3.15). Approximately 36.3 acres would be converted to conveyance channel, 9.9 acres would be converted to dredged material placement berm habitat, and 17.1 acres would be temporarily impacted by the construction. The acreages associated with direct impacts are found in Table 3.5. Temporary work areas would be replanted with freshwater swamp species, and the dredged material berms would be planted with appropriate BLH species. The vegetative plantings on 925 acres would be conducted by hand and would have no significant direct impacts on existing wetland vegetation, but would contribute to the improved health of the freshwater swamp system.

Indirect. This alternative would improve the hydrologic connectivity between the ARDC and 3,881 acres in both the primary and secondary impact areas (Figure 3.15), creating approximately 1,602 AAHUs of freshwater swamp. Restored hydrologic connections would increase the nutrient and sediment loads to 1,515 acres within the primary impact area.

Cumulative. Alternative 39 would restore approximately 3,881 acres with a total of 1,602 AAHUs compared to the No-Action Alternative. However, throughout the region, state and nation, the continued deterioration and loss of wetland vegetation resources would likely continue due to natural and human-induced processes.

5.6.3 Upland Vegetation Resources

5.6.3.1 No-Action Alternative

Direct. There would be no direct impacts to upland vegetation.

Indirect. The significant amount of upland vegetation existing in the study area is on the existing spoil bank and would likely remain even as the surrounding swamp converts to open water. Therefore there would be no indirect impact to the No-Action alternative.

Cumulative. The significant amount of upland vegetation existing in the study area is on the existing spoil bank and would likely remain even as the surrounding swamp converts to open water. Therefore there would be no cumulative effect with the No-Action alternative.

5.6.3.2 Alternative 33 (Recommended Plan)

Direct. Direct impacts to upland vegetation would result from the construction activities associated with the dredging of new conveyance channels through the existing dredged material berm, as well as the placement of dredged material to create upland islands along these conveyance channels. Approximately 0.8 acre of existing berm would be permanently impacted to create part of the conveyance channel, while approximately 1.8 acres would be temporarily impacted for the construction of cuts through existing berms. The acreages associated with direct impacts are found in Table 3.5. Vegetative plantings under this alternative would encompass 5.0 acres of newly created upland habitat.

Indirect. No indirect impacts to upland vegetation as a result of Alternative 33 (Recommended Plan) are expected. Existing upland communities within the areas of impact are stable and would not be significantly altered.

Cumulative. Changes to cumulative impacts within existing upland vegetation would be minimal for this alternative. The impacts to upland vegetation resources within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.6.3.3 Alternative 34

Direct. The direct impact of this alternative would be similar to Alternative 33 (Recommended Plan). Alternative 34 would permanently impact approximately 0.9 acre of upland habitat for the construction of the conveyance channels. In addition, approximately 2.5 acres of existing berm would be temporarily impacted for the construction of cuts in existing berms. Vegetative plantings under this alternative would encompass 2.7 acres of newly created upland habitat.

Indirect. No indirect impacts to upland vegetation are expected. Existing upland communities within the areas of impact are stable and would not be significantly altered during construction.

Cumulative. Changes to cumulative impacts within existing upland vegetation would be minimal for this alternative**.** Overall cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.6.3.4 Alternative 35

Direct. The direct impact of this alternative would be similar to Alternative 33 (Recommended Plan). Alternative 35 would permanently impact approximately 0.6 acre of upland habitat for the construction of the conveyance channels. In addition, approximately 1.8 acres of existing berm would be temporarily impacted for the construction of cuts in existing berms. The acreages associated with direct impacts are found in Table 3.5. Vegetative plantings under this alternative would encompass 2.2 acres of newly created upland habitat.

Indirect. No indirect impacts to upland vegetation are expected. Existing upland communities within the areas of impact are stable and would not be significantly altered.

Cumulative. Changes to cumulative impacts within existing upland vegetation would be minimal for this alternative**.** Overall cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.6.3.5 Alternative 36

Direct. The direct impact of this alternative would be similar to Alternative 33 (Recommended Plan). Alternative 36 would permanently impact approximately 1.7 acres of upland habitat for the construction of the conveyance channels. In addition, approximately 4.3 acres of existing berm would be temporarily impacted for the construction of cuts in existing berms. The acreages associated with direct impacts are found in Table 3.5. Vegetative plantings under this alternative would encompass 7.8 acres of newly created upland habitat.

Indirect. No indirect impacts to upland vegetation are expected. Existing upland communities within the areas of impact are stable and would not be significantly altered.

Cumulative. Changes to cumulative impacts within existing upland vegetation would be minimal for this alternative**.** Overall cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.6.3.6 Alternative 37

Direct. The direct impact of this alternative would be similar to Alternative 33 (Recommended Plan). Alternative 37 would permanently impact approximately 1.5 acres of upland habitat for the construction of the conveyance channels. In addition, approximately 4.3 acres of existing berm would be temporarily impacted for the construction of cuts in existing berms. The acreages associated with direct impacts are found in Table 3.5. Vegetative plantings under this alternative would encompass 4.9 acres of newly created upland habitat.

Indirect. No indirect impacts to upland vegetation are expected. Existing upland communities within the areas of impact are stable and would not be significantly altered.

Cumulative. Changes to cumulative impacts within existing upland vegetation would be minimal for this alternative. Overall cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.6.3.7 Alternative 38

Direct. The direct impact of this alternative would be similar to Alternative 33 (Recommended Plan), with the following exceptions. Alternative 38 would permanently impact approximately 1.4 acre of upland habitat for the construction of the conveyance channels. The acreages associated with direct impacts are found in Table 3.5. In addition, approximately 3.6 acres of existing berm would be temporarily impacted for the construction of cuts in existing berms. Vegetative plantings under this alternative would encompass 7.2 acres of newly created upland habitat.

Indirect. No indirect impacts to upland vegetation as a result of Alternative 38 are expected. Existing upland communities within the areas of impact are stable and would not be significantly altered.

Cumulative. Changes to cumulative impacts within existing upland vegetation would be minimal for this alternative. Overall cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.6.3.8 Alternative 39

Direct. The direct impact of this alternative would be similar to Alternative 33 (Recommended Plan). Alternative 39 would permanently impact approximately 2.3 acres of upland habitat for the construction of the conveyance channels. In addition, approximately 6.1 acres of existing berm would be temporarily impacted for the construction of cuts in existing berms. The acreages associated with direct impacts are found in Table 3.5. Vegetative plantings under this alternative would encompass 9.9 acres of newly created upland habitat.

Indirect. No indirect impacts to upland vegetation are expected. Existing upland communities within the areas of impact are stable and would not be significantly altered during construction.

Cumulative. Changes to cumulative impacts within existing upland vegetation would be minimal for this alternative. Overall cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.6.4 Submerged Aquatic Vegetation (SAV)

5.6.4.1 No-Action Alternative

Direct. There would be no direct impacts to the SAV community.

Indirect. The submerged aquatic community would continue to change as the swamp changes to marsh and open water.

Cumulative. Cumulative impacts would be the effects from wetland loss and degradation throughout coastal Louisiana. However, the impacts to SAV within the study area and vicinity would be offset to some extent by other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.6.4.2 Alternative 33 (Recommended Plan)

Direct. Alternative 33 (Recommended Plan) would directly impact any SAV communities along the ARDC by mechanical crushing during construction. These impacts would be temporary and the vegetative community would quickly rebound. Most SAV communities would receive no direct impact as a result of proposed management activities.

Indirect. Cutting through existing berms and creating conveyance channels would indirectly affect SAV habitat by creating additional habitat.

Cumulative. Cumulative impacts would be the effects from wetland loss and degradation throughout coastal Louisiana. The impacts to SAV within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.6.4.3 Alternatives 34-39

Direct. The direct impact would be similar to Alternative 33 (Recommended Plan).

Indirect. The indirect impact would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.6.5 Invasive Species Vegetation

5.6.5.1 No-Action Alternative

Direct. There would be no direct impacts to invasive vegetation.

Indirect. Invasive species would continue to spread, as the swamp converts to marsh and open water.

Cumulative. Invasive vegetation would continue to increase, as it would in south Louisiana, the region, and the country. However, the impacts to invasive vegetation species within the study area and vicinity would be offset to some extent by other Federal, state, local, and private invasive species control efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.6.5.2 Alternative 33 (Recommended Plan)

Direct. Invasive vegetation within the construction zones may be negatively affected by construction activities by direct removal, crushing or burial. In all three cases, these impacts are expected to be temporary and the remaining plants would likely regenerate quickly in the disturbed areas of the study area.

Indirect. Restored connectivity and the planting of native vegetation would somewhat reduce the proliferation of invasive species.

Cumulative. Invasive species would continue to proliferate within the study area and Alternative 33 (Recommended Plan) would help to reduce this spread because of the restored connectivity and planting of native vegetation. The invasive species spread in the study area would be additive with the invasive species spread throughout coastal Louisiana and the Nation. The positive impacts to invasive vegetation species within the study area and vicinity would be additive to some extent with other Federal, state, local, and private invasive species control efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.6.5.3 Alternatives 34-39

Direct. The direct impact would be similar to Alternative 33 (Recommended Plan).

Indirect. The indirect impact would be similar to Alternative 33 (Recommended Plan).

Cumulative. The cumulative impact would be similar to Alternative 33 (Recommended Plan).

5.7 WILDLIFE HABITAT

5.7.1 No-Action Alternative

Direct. There would be no direct impacts to wildlife resources.

Indirect. Adverse indirect impacts on wildlife resources would result from the continued conversion of 18,204 acres of primarily swamp habitat to marsh and shallow open water habitats. Swamp areas used for foraging, nesting, and over-wintering habitat would convert initially to fresh marsh, and ultimately to shallow open water habitat. Swamp habitat quality would continue to decline as the swamp continues to deteriorate. As the swamp areas convert to open water, species richness would likely decline. The loss of swamp habitat and continued degradation would likely result in competition for dwindling swamp resources and a localized decrease in wildlife use of the area and movement of more mobile wildlife to more suitable areas. With the continued degradation of the swamp and the eventual conversion to open water, feeding opportunities for bald eagles will decline. The loss of freshwater swamp trees will decrease bald eagle nesting habitat. Similarly, nesting trees available for colonial nesting wading bird colonies would also decline.

Cumulative. Cumulative impacts would include the conversion of 18,204 acres of existing swamp habitat to a shallow open water system within the study area, which would be additive with other swamp losses and degradation impacts locally, regionally, statewide and nationwide. However, these negative impacts to wildlife habitat within the study area and vicinity would be offset to some extent by the positive effects of other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.7.2 Alternative 33 (Recommended Plan)

Direct. Construction activities associated with implementation of Alternative 33 (Recommended Plan) may disrupt or displace wildlife resources. However, any such impacts would be localized and temporary, and most wildlife species would temporarily relocate to nearby areas. No permanent displacement would be expected from restoration activities as wildlife is expected to return when project construction is completed. Conveyance channels would be constructed, providing deepwater habitat in the swamp and allowing exchange of water, nutrients, and sediments between the swamp and the ARDC and creation of habitat for SAV, fish, and wildlife. Upland habitat created by the placement of the dredged material will provide additional refuge for various wildlife species during high water events. As a result of the public review process, the USFWS has requested that a qualified biologist inspect the proposed worksite for the presence of undocumented colonial wading bird nesting colonies and bald eagles during the nesting season (i.e., February 16 through October 31 for colonial wading bird nesting colonies and October through mid-May for bald eagles). In addition, it has been recommended by the USFWS that construction activities and/or land clearing be conducted during the fall or winter to minimize impacts to nesting migratory birds, when practicable.

Indirect. Indirect impacts to wildlife resources would include the restoration and creation of a net total of 1,602 acres of swamp and bottomland hardwood "island" habitats, with a total of 679 AAHUs that would be utilized by resident and migrant wildlife species for nesting, rearing of young, resting, and foraging activities. Swamp creation/nourishment would also help to increase and preserve important stopover habitat for neotropical migrants as well as wintering habitat for waterfowl. The increase in tree canopy would improve bald eagle and colonial waterbird nesting habitat. In addition, the quality of habitat would be improved, which would increase the abundance of prey items for wildlife.

Cumulative. Cumulative impacts would be the additive effects restoring 1,602 acres of important fish and wildlife in combination with the impacts for overall net acres restored, created, nourished, and protected by other Federal, state, local, and private restoration efforts. The positive impacts to wildlife habitat within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.7.3 Alternative 34

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan),
except approximately 1,459 acres of freshwater swamp habitat would be restored and 589 AAHUs would be created.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except Alternative 34 would restore a net total of 1,459 acres of freshwater swamp habitat with 589 AAHUs compared to the No-Action Alternative.

5.7.4 Alternative 35

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Impacts would be similar to Alternative 33 (Recommended Plan), except approximately 820 acres of freshwater swamp habitat would be restored and 334 AAHUs would be created.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except Alternative 35 would restore a net total of 820 acres of freshwater swamp habitat with 334 AAHUs compared to the No-Action Alternative.

5.7.5 Alternative 36

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan), except approximately 3,061 acres of freshwater swamp habitat would be restored and 1,268 AAHUs would be created.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except Alternative 36 would restore a net total of 3,061 acres of freshwater swamp habitat with 1,268 AAHUs compared to the No-Action Alternative

5.7.6 Alternative 37

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan), except approximately 2,279 acres of freshwater swamp habitat would be restored and 922 AAHUs would be created.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except Alternative 37 would restore a net total of 2,279 acres of freshwater swamp habitat with 922 AAHUs compared to the No-Action Alternative.

5.7.7 Alternative 38

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan), except approximately 2,422 acres of freshwater swamp habitat would be restored and 1,013 AAHUs would be created.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except Alternative 38 would restore a net total of 2,422 acres of freshwater swamp habitat with 1,013 AAHUs compared to the No-Action Alternative.

5.7.8 Alternative 39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan), except approximately 3,881 acres of freshwater swamp habitat would be restored and 1,602 AAHUs would be created.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan), except Alternative 39 would restore a net total of 3,881 acres of freshwater swamp
habitat with 1,602 AAHUs compared to the No-Action Alternative.

5.8 AQUATIC RESOURCES

5.8.1 Benthic

5.8.1.1 No-Action Alternative

Direct. Under the No-Action Alternative no direct adverse impacts to benthic organisms would occur.

Indirect. Over time, indirect impacts of impoundment, limited hydrologic connections between the interior swamp wetlands and the ARDC, swamp habitat degradation and conversion to open water habitat would continue under the No-Action Alternative. These impacts would indirectly result in a decrease in the quality of benthic habitat within the study area, thereby reducing the area's ability to support benthic species. The persistence of existing conditions would result in the continued conversion of 18,204 acres of existing swamp habitat to shallow water habitat that would provide additional albeit poor quality benthic habitat. Other indirect impacts would include a decrease of available nutrients and detritus. Habitat quality would likely continue to degrade, creating a stressful environment for those benthic and other aquatic species presently utilizing the area. Some populations of benthic organisms would likely decrease, impacting other species in the food web.

Cumulative. Cumulative impacts of the No-Action Alternative would primarily be related to conversion of 18,204 acres of swamp and associated benthic habitat to a shallow open water system. These impacts to benthic resources would be in addition to other regional and Louisiana coast-wide swamp and benthic habitat losses and degradation. The LCA Near-term Ecosystem Restoration Plan (USACE, 2004) estimated a net loss of 328,000 acres of coastal wetland habitat would occur by 2050. This is nearly 10 percent of Louisiana's remaining coastal wetlands, which are utilized by various benthic species for shelter, foraging, cover, nursery, and other life requirements. Benthic populations within Louisiana in general and the study area in particular would likely continue to shift towards more saline-oriented species as land loss and saltwater intrusion continue to affect Louisiana's interior regions. These adverse cumulative impacts would be offset, to some degree by the positive impacts associated with swamp and benthic habitats restored created, nourished, and protected by other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2).

5.8.1.2 Alternative 33 (Recommended Plan)

Direct. Direct impacts to benthic resources would generally be associated with conveyance channel construction activities, including conversion of 0.8 acres of ARDC dredged material berms and 17.8 acres of existing swamp habitat to conveyance channel waterbottoms that would provide potential benthic habitat. Approximately 18.6 acres of benthic habitat would be created by the conveyance channel construction. These actions would directly impact and destroy any slow-moving or sessile benthic organisms found within the proposed excavation and berm creation areas. More mobile benthic species utilizing the area would likely be displaced. Other direct impacts to the benthos would be localized and confined to construction areas. However, the prolific nature of the benthic community is expected to result in rapid re-colonization of substrates once construction is completed. In addition, benthic resources occur seasonally in the swamp and are more abundant during winter months. Therefore, direct effects may vary depending on the time of the year construction occurs.

Indirect. Indirect impacts to benthic resources would be related primarily to disturbance of waterbottoms during placement of dredged material and dredging. Short-term disturbance to benthic species would likely occur from increased turbidity, temperature, and BOD; and decreased dissolved oxygen due to dredging and dredged material berm creation. Some smothering of benthic organisms may also occur from dredge plume resettlement, but these impacts would be minimized through the use of silt curtains or other construction measures to minimize dredging impacts. Some indirect impacts would be localized and temporary; however, the construction of conveyance channels and the decrease in habitat degradation would alter the benthic community structure. A total of 1,602 acres of swamp habitat would be restored by this alternative. Swamp habitat benefitted by Alternative 33 (Recommended Plan) would indirectly benefit benthic resources by providing increased dissolved organic compounds and detritus that would, in turn, provide food and energy resources for benthic organisms.

Cumulative. Cumulative impacts would be the additive effects of restoring 1,602 acres of primarily swamp habitat resulting in greater resources for benthic organisms due to the export of dissolved organic compounds and detritus from the swamp. The net beneficial impacts would be in combination with the impacts for overall net acres of swamp and benthic habitat restored created, nourished, and protected by other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2).

5.8.1.3 Alternative 34

Direct. Direct impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan), except approximately 0.9 acre of berm and 9.6 acres of swamp will be converted to conveyance channel.

Indirect. Indirect impacts would be similar to those described for Alternative 33 (Recommended Plan), except 10.5 acres of conveyance channel bottoms would be created and approximately 1,459 acres of freshwater swamp would be benefited.

Cumulative. Cumulative effects of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.8.1.4 Alternative 35

Direct. Direct impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan), except approximately 0.6 acre of berm and 6.6 acres of swamp will be converted to conveyance channel.

Indirect. Indirect impacts would be similar to those described for Alternative 33 (Recommended Plan), except 7.2 acres of conveyance channel bottoms would be created and approximately 820 acres of freshwater swamp would be benefited.

Cumulative. Cumulative effects of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.8.1.5 Alternative 36

Direct. Direct impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan), except approximately 1.7 acres of berm and 27.4 acres of swamp will be converted to conveyance channel.

Indirect. Indirect impacts would be similar to those described for Alternative 33 (Recommended Plan), except 29.1 acres of conveyance channel bottoms would be created and approximately 3,061 acres of freshwater swamp would be benefited.

Cumulative. Cumulative effects of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.8.1.6 Alternative 37

Direct. Direct impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan), except approximately 1.5 acres of berm and 16.2 acres of swamp will be converted to conveyance channel.

Indirect. Indirect impacts would be similar to those described for Alternative 33 (Recommended Plan), except 17.7 acres of conveyance channel bottoms would be created and approximately 2,279 acres of freshwater swamp would be benefited.

Cumulative. Cumulative effects of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.8.1.7 Alternative 38

Direct. Direct impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan), except approximately 1.4 acres of berm and 24.4 acres of swamp will be converted to conveyance channel.

Indirect. Indirect impacts would be similar to those described for Alternative 33 (Recommended Plan), except 25.8 acres of conveyance channel bottoms would be created and approximately 2,420 acres of freshwater swamp would be benefited.

Cumulative. Cumulative effects of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.8.1.8 Alternative 39

Direct. Direct impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan), except approximately 2.3 acres of berm and 34 acres of swamp will be converted to conveyance channel.

Indirect. Indirect impacts would be similar to those described for Alternative 33 (Recommended Plan), except 36.3 acres of conveyance channel bottoms would be created and approximately 3,881 acres of freshwater swamp would be benefited.

Cumulative. Cumulative effects of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.8.2 Plankton

5.8.2.1 No-Action Alternative

Direct. There would be no direct adverse impacts to plankton resources.

Indirect. Adverse indirect impacts would result from the continued conversion of swamp habitat, initially to fresh marsh, and ultimately to open water. The projected habitat conversion would ultimately create unstable environment for plankton resources.

Cumulative. Algal blooms would continue in the open waters within the swamp as a result of the release of phosphorus sequestered in swamp sediments into surface waters. Within coastal areas of Louisiana, plankton populations are experiencing a shift towards more saline-oriented species as land loss and saltwater intrusion continues. Other cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system within the study area, which would be additive with other swamp losses and degradation impacts to plankton resources throughout the region and state (see Figure 5.1 and Table 5.2).

5.8.2.2 Alternative 33 (Recommended Plan)

Direct. Direct impacts to plankton resources would generally be associated with construction activities. Some species could suffer mortality or injury during dredging and placement of borrow material. Construction activities would negatively impact plankton populations by temporarily increase turbidity, temperatures, and BOD; and decrease DO.

Indirect. Construction would create conveyance channels, providing deepwater habitat in the swamp. The negative increases in turbidity and temperature and a decrease in DO associated with these actions would be temporary and localized. These conveyance channels would allow plankton access into the interior swamp and create a more normal nutrient exchange between the swamp and outside waters. Increased productivity, as a result of the 1,602 acres of swamp habitat benefited by this alternative, would provide indirect benefits to plankton by increasing nutrients and detritus.

Cumulative. Plankton resources would continue to be adversely impacted by the coastal land loss and swamp degradation.

5.8.2.3 Alternatives 34-39

Direct. Direct impacts would be similar to those described for Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to those described for Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to those described for Alternative 33 (Recommended Plan).

5.9 FISHERY RESOURCES

5.9.1 No-Action Alternative

Direct. There would be no direct impacts to fishery resources.

Indirect. Over time, indirect impacts of impoundment, limited hydrologic connections between the interior swamp wetlands and the ARDC, swamp habitat degradation, and conversion to open water would continue. These impacts would indirectly result in a decrease in the quality of aquatic habitat within the study area, thereby reducing the area's ability to support fishery organisms. Some populations of aquatic organisms would likely decrease, impacting other species in the food web. The reduction in swamp wetlands habitat would also result in shifts in predator/prey relationships as well as a potential decline in fishery productivity. Recreational fishing opportunities would continue to be limited. Ingress and egress access of fishery organisms to interior portions of the swamp would continue to be limited due to dredged material berms along ARDC which block access. Swamp habitat used by fishery organisms for shelter, nesting, feeding, cover, nursery, and other life history requirements would continue to degrade and convert to shallow open water habitat. Although the continued conversion of swamp habitat to open water habitat would increase the amount of aquatic habitat available to fishery resources, the quality of the aquatic habitat would likely continue to degrade, creating a lower quality environment for fishery and other aquatic species.

Cumulative. Cumulative impacts of the No-Action Alternative would primarily be related to the conversion of 18,204 acres of swamp habitat to a shallow open water system. These impacts would be in addition to other Louisiana coast-wide fishery habitat losses and degradation, as well as the impacts of other state and Federal projects in the vicinity (see Figure 5.1 and Table 5.2). The LCA Near-term Ecosystem Restoration Plan (USACE, 2004) estimated a net loss of 328,000 acres of coastal wetland habitat would occur by 2050. This is nearly 10 percent of Louisiana's remaining coastal wetlands, which are utilized by various fish species for shelter, foraging, cover, nursery, and other life requirements. However, fishery populations within Louisiana in general and the study area in particular would likely continue to shift towards more saline-oriented species as land loss and saltwater intrusion continue to affect Louisiana's interior regions.

5.9.2 Alternative 33 (Recommended Plan)

Direct. Direct impacts of implementing Alternative 33 (Recommended Plan) on fishery organisms would generally be associated with construction activities, including creation of 16,010 linear feet long of conveyance channel habitat. Additional direct impacts would be the creation of 18.6 acres conveyance channel habitat. Any sessile or slow moving fisheries species present could suffer mortality or injury during the dredging and placement of borrow material. Construction activities would temporarily increase turbidity, temperatures, and BOD; and decrease DO. These temporary conditions could displace more mobile fisheries species from the construction area. Following construction, displaced fisheries species would likely return to the areas of impact. Overall, the direct impacts to fishery resources are temporary and minor.

Indirect. Indirect impacts include the increased productivity, as a result of hydrologic restoration of 1,602 acres of swamp habitat, and would provide an increase in the energy inputs into the local food web. Sediment and nutrient transport into the interior swamp areas would improve fishery productivity. Increasing the health of the study area swamp and bottomland hardwood habitat would support not only local fishery resources but would also contribute to increasing the flow of detritus and other important components of the aquatic food web from the interior wetland habitats to estuarine areas closer to the Gulf of Mexico.

Cumulative. Cumulative impacts would be the additive effect of restoring 1,602 acres of primarily cypress/tupelo swamp habitat, with the combination of impacts and benefits for the overall net acres benefitted by other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2). Swamp restoration and reconnected hydrology would result in greater resources for aquatic and fishery resources due to the increased export of dissolved organic compounds and detritus from wetlands.

5.9.3 Alternative 34

Direct. Direct impacts would be similar to those described for Alternative 33 (Recommended Plan), except Alternative 34 would create 8,483 linear feet of conveyance channel habitat for at total of 10.5 acres of deepwater aquatic habitat.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.9.4 Alternative 35

Direct. Direct impacts would be similar to those described for Alternative 33 (Recommended Plan), except Alternative 35 would create 5,930 linear feet of conveyance channel habitat for at total of 7.2 acres of deepwater aquatic habitat.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.9.5 Alternative 36

Direct. Direct impacts would be similar to those described for Alternative 33 (Recommended Plan), except Alternative 36 would create 24,493 linear feet of conveyance channel habitat for at total of 29.1 acres of deepwater aquatic habitat.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.9.6 Alternative 37

Direct. Direct impacts would be similar to those described for Alternative 33 (Recommended Plan), except Alternative 36 would create 14,413 linear feet of conveyance channel habitat for at total of 17.7 acres of deepwater aquatic habitat.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.9.7 Alternative 38

Direct. Direct impacts would be similar to those described for Alternative 33 (Recommended Plan), except Alternative 38 would create 21,940 linear feet of conveyance channel habitat for at total of 25.8 acres of deepwater aquatic habitat.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.9.8 Alternative 39

Direct. Direct impacts would be similar to those described for Alternative 33 (Recommended Plan), except Alternative 39 would create 30,423 linear feet of conveyance channel habitat for at total of 36.3 acres of deepwater aquatic habitat.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts of this alternative would be similar to those described for Alternative 33 (Recommended Plan).

5.10 ESSENTIAL FISH HABITAT (EFH)

5.10.1 No-Action Alternative

Direct. There would be no direct impacts to EFH.

Indirect. There is no EFH in the study area and there would be no indirect impacts.

Cumulative. Cumulative impacts would be 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 (see Figure 5.1 and Table 5.2).

5.10.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct impacts to EFH.

Indirect. There would be no indirect impacts to EFH.

Cumulative. There would be no cumulative impacts to EFH.

5.10.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.11 THREATENED AND ENDANGERED SPECIES

5.11.1 No-Action Alternative

Direct. There would be no direct effects on threatened and endangered species or their habitat.

Indirect. General habitat loss for the study area would continue. Important nesting, feeding, roosting, and nursery habitat within the study area would continue to erode and convert to shallow open water

Cumulative. There would be a continued degradation and loss of fish and wildlife habitat for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements in coastal Louisiana. Cumulative impacts would be 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 (see Figure 5.1 and Table 5.2).

5.11.2 Alternative 33 (Recommended Plan)

Direct. There is no critical habitat for the Gulf sturgeon in the study area. The proposed action would not jeopardize the continued existence of the Gulf sturgeon. Hence, the USACE has determined the proposed action is Not Likely to Adversely Affect (NLAA) Gulf sturgeon or its critical habitat. Appendix A presents a Biological Assessment that describes those factors used in determining the potential impacts of the proposed action on the Gulf sturgeon.

Any effects to the West Indian manatee from implementing the proposed action would be related to possible collision with service vessels during the construction activities. All USACE personnel and all contractors would be informed of the need to abide by the following procedures to avoid and minimize any impacts to the manatees.

Special Operating Conditions If Manatees Are Present in the Project Area:
(1) If a manatee(s) is sighted within 100 yards (91 m) of the project area, all appropriate precautions shall be implemented by the Contractor to ensure protection of the manatee. These precautions shall include the operation of all moving equipment no closer than 50 ft (15.2 m) of a manatee. If a manatee is closer than 50 ft (15.2 m) to moving equipment or the project area, the equipment will be shut down and all construction activities will cease to ensure protection of the manatee.

Construction activities will not resume until the manatee has departed and the 50-foot (15.2 m) buffer has been re-established.

(2) If a manatee(s) is sighted in the project area, all vessels associated with the project shall operate at "no wake/idle" speeds at all times while in waters where the draft of the vessel provides less than a four-foot (1.2 m) clearance from the bottom, and vessels will follow routes of deep water whenever possible. Boats used to transport personnel shall be shallow-draft vessels, preferably of the light-displacement category, where navigational safety permits.

(3) If siltation barriers are used, they will be made of material in which manatees cannot become entangled, are properly secured, and are regularly monitored to avoid manatee entrapment.

(4) Manatee Signs. Prior to commencement of construction, each vessel involved in construction activities shall display at the vessel control station or in a prominent location, visible to all employees operating the vessel, a temporary sign

at least 8-1/2" x 11" (21.6 x 27.9 cm) reading, "CAUTION: MANATEE HABITAT/IDLE SPEED IS REQUIRED IN CONSTRUCTION AREA." In the absence of a vessel, a temporary 3' x 4' (0.9 x 1.2 m) sign reading "CAUTION: MANATEE AREA" will be posted adjacent to the issued construction permit. A second temporary sign measuring 8-1/2" x 11" (21.6 x 27.9 cm) reading "CAUTION: MANATEE HABITAT. EQUIPMENT MUST BE SHUT DOWN IMMEDIATELY IF A MANATEE COMES WITHIN 50 FEET OF OPERATION" will be posted at the dredge operator control station and at a location prominently adjacent to the issued construction permit. The Contractor shall remove the signs upon completion of construction.

Given the rare occurrence of manatees within the areas of impact, along with the implementation of the above operational precautions, no collision fatalities are expected.

Indirect. There would be no adverse indirect impacts of implementing Alternative 33 (Recommended Plan) to any listed species. Rather, proposed marsh nourishment would provide a net increase of transitional coastal wetland habitat by increasing the quality of habitat; increasing species usage and diversity; and providing for a net increase in habitats used for forage, breeding, spawning, and cover. The increase in wetland acreage would provide increased detritus that would be exported to ARDC water bottoms, thereby providing additional resources for the benthic food chain that would in turn increase the availability of prey items for Gulf sturgeon.

Indirect impacts to listed species would primarily be positive resulting from the wetland nourishment features, which would provide a net creation and nourishment of 1,602 acres of transitional swamp, compared to the No-Action Alternative. However, there may be some temporary and localized minor effects on the food supply for Gulf sturgeon as some of the ARDC water bottom would be dredged to construct the conveyance channels. Any such impacts to the benthic food supply are anticipated to be minor, as only a small fraction of the total ARDC water bottom would be impacted, and the benthos would re-colonize dredged locations rapidly following construction. There is no critical habitat for Gulf sturgeon in the study area.

Cumulative. Cumulative impacts would be the additive effect with the combination of impacts and benefits for overall net acres created and nourished by other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2). Alternative 33 (Recommended Plan) would create and nourish a net total of 1,602 acres of freshwater swamp. Although unlikely to impact populations on a continental scale, those listed species that utilize the areas of impact would also benefit from the cumulative effects of Alternative 33 (Recommended Plan) and other restoration efforts in the area.

5.11.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.12 CULTURAL AND HISTORIC RESOURCES

5.12.1 No-Action Alternative

Direct. There would be no direct impacts on historic and cultural resources.

Indirect. The eventual land loss within the study threatens the existence and integrity of all cultural resources found within the study area.

Cumulative. Within the country and coastal Louisiana, the institutional recognition of all cultural resources as a significant resource would likely continue, along with their potential loss due to natural and human causes. The land loss within the study area and throughout coastal Louisiana threatens the existence and integrity of these resources. However, the impacts to cultural resources within the study area and vicinity would be offset to some extent by other Federal, state, local, and private restoration efforts preventing coastal erosion and protecting cultural resources across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.12.2 Alternative 33 (Recommended Plan)

Direct. Alternative 33 (Recommended Plan), would have no direct impacts on historic and cultural resources as there are no National Register of Historic Places (NRHP) eligible or listed sites within the project area. Measures (see the Programmatic Agreement located in Appendix F) would be put into place in the case that any cultural resources are discovered during construction.

Indirect. Ecosystem restoration measures would prevent further land loss and erosion in the areas of impact. This would benefit cultural and historic resources in the study area by preventing the erosion that threatens their existence.

Cumulative. Cumulative impacts of the proposed action are related to the increased stability of the wetland resources throughout the region. The reduction in land loss and subsequent preservation of cultural resources within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts preventing coastal erosion and protecting cultural resources across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.12.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.13 AESTHETICS

5.13.1 No-Action Alternative

Direct. There would be no direct beneficial or adverse impacts to aesthetic resources.

Indirect. Conversion of existing bald cypress-tupelo swamp to fresh marsh and ultimately to open water habitat would continue, possibly resulting in degraded viewscapes for those traveling within the study area (along the ARDC). Habitat degradation and conversion under the No-Action Alternative would also likely impair the viewshed of the Blind River, a designated Scenic River.

Cumulative. Cumulative impacts would be the continued aesthetic losses associated with the degradation of freshwater swamps throughout coastal Louisiana, with the additive combination of similar impacts from wetland loss and degradation throughout coastal Louisiana.

5.13.2 Alternative 33 (Recommended Plan)

Direct. Viewscapes would be minimally and temporarily disturbed by construction activities. The immediate effects of construction activities, such as grading and clearing of vegetation, would temporarily reduce the aesthetic value of sections of the study area. Initially some of the study area would become unvegetated. These minor impacts would be localized and temporary. The areas of impact should quickly stabilize, and the newly created, nourished, and protected wetlands would provide new high quality viewscapes as well as protect existing ones. Plantings, along with existing wetland vegetation, would recolonize the area, thereby increasing the scenic value of the areas of impact and surroundings through increased visual complexity.

Indirect. The indirect impacts would primarily result from newly created high quality emergent wetlands that would provide long term visual enhancement of an area that is presently experiencing a decline in visual complexity.

Cumulative. The continued degradation of coastal Louisiana would lead to degraded aesthetic resources. The implementation of Alternative 33 (Recommended Plan) would have a positive cumulative impact. The impact to aesthetics within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration effects across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.13.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).
Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).
Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.14 RECREATION

5.14.1 No-Action Alternative

Direct. There would be no direct effect on recreation within the study area.
Indirect. There would be a continued loss and degradation of habitat in the study area resulting in lost recreational opportunities, including fishing, wildlife viewing, and hunting.
Cumulative. There would be a continued loss in Coastal Louisiana of habitat resulting in lost recreational opportunities. The impacts to recreation resources within the study area and vicinity would be offset to some extent by other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.14.2 Alternative 33 (Recommended Plan)

Direct. There would be minor, temporary, direct impacts to recreation. Recreational boaters would have to slow and avoid some of the marine equipment during construction.
Indirect. This alternative would have little effect on the level of boating activity. The cuts in the dredged material berms of the ARDC and the conveyance channels reaching into the interior of the swamps would provide spawning opportunities for species of recreational importance. However, the improvement to fisheries would be minimal and would not affect the level of fishing activity. Alternative 33 (Recommended Plan) would have a minor positive effect on the quality of hunting because of improvements to the aesthetics of the swamp and an increase in the quality of the deer. However, the quantification of value is minor because little hunting is done in the area that would be affected by the alternative. There may be a minimal change in the level of hunting activity in the study area. Hunting is limited to leaseholders and is not available to the general public.
Cumulative. The annual value of recreation would not increase to any measurable extent under Alternative 33 (Recommended Plan). Approximately 1,602 acres of important stopover habitat (freshwater swamp) would be improved

for migratory neotropical songbirds and waterfowl. The net positive impacts to recreation resources within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.14.3 Alternatives 33-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15 SOCIOECONOMIC AND HUMAN RESOURCES

5.15.1 Population and Housing

5.15.1.1 No-Action Alternative

Direct. There would be no direct impact on population and housing in the study area.

Indirect. There would be little to no indirect effect on population and housing within the study area.

Cumulative. Populations within Ascension and Livingston Parishes would continue their projected increases. The study area is not located in a highly populated area. The impacts to population and housing within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.15.1.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct impacts on population and housing within the study area.

Indirect. There would be little to no indirect effect on population and housing within the study area.

Cumulative. Populations within Ascension and Livingston Parishes would continue their projected increases. The study area is not located in a highly populated area; therefore, swamp nourishment and creation activities would likely have no beneficial or adverse effects on population and housing. The impacts to population and housing within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.15.1.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.2 Employment and Income

5.15.2.1 No-Action Alternative

Direct. There would be no direct effect on employment and income.

Indirect. There would be no indirect effect on employment and income.

Cumulative. Employment and income level would continue to increase or decline in coastal Louisiana according to the national and regional economic health. The impacts to employment and income within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.15.2.2 Alternative 33 (Recommended Plan)

Direct. There would be a minor positive effect on temporary jobs and income as a result on the implementation of Alternative 33 (Recommended Plan).

Indirect. There would be a temporary and minor positive effect on services (goods, fuel, food, equipment rentals, etc.) from construction expenses related to implementation of Alternative 33 (Recommended Plan).

Cumulative. There would be very little change in the cumulative effects. Employment and income level would continue to increase or decline in coastal Louisiana according to the national and regional economic health. The impacts to employment and income within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.15.2.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.3 Community Cohesion

5.15.3.1 No-Action Alternative

Direct. The No-Action Alternative would have no beneficial or adverse direct impacts on community cohesion within the study area.

Indirect. The No-Action Alternative would have no beneficial or adverse indirect impacts on community cohesion within the study area.

Cumulative. Cumulative impacts would be the additive combination of similar impacts from wetland loss and degradation throughout coastal Louisiana. Assuming existing proposed permits were completed, several of the current subdivisions would expand, and a proposed bridge over the ARDC would improve community cohesion. The impacts to community cohesion within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.15.3.2 Alternative 33 (Recommended Plan)

Direct. Alternative 33 (Recommended Plan) would have no beneficial or adverse direct impacts on community cohesion within the study area.

Indirect. Alternative 33 (Recommended Plan) would have no beneficial or adverse indirect impacts on community cohesion within the study area.

Cumulative. There would be no effect on the cumulative impacts on community cohesion. The impacts to community cohesion within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.15.3.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.4 Environmental Justice

5.15.4.1 The No-Action Alternative

Direct. No minority and/or low-income communities have been identified in the study area that would be adversely impacted by the No-Action Alternative. Therefore, no disproportionately high or adverse human health or environmental effects on minority or low-income populations would occur.

Indirect. General habitat loss for the study area would continue; however, no disproportionately high or adverse human health or environmental indirect impacts on minority or low-income populations would occur as there are none identified within the study area.

Cumulative. There would be no cumulative impacts on minority and/or low-income communities, as none have been identified within the study area per 2000 U.S. Census information and requirements of Executive Order (E.O.) 12898. Increasing populations worldwide. Increasing opportunity for the development of minority communities and the expansion of low-income populations worldwide.

5.15.4.2 Alternative 33 (Recommended Plan)

Direct. No direct impacts on human health or environmental effects within the study area would occur with the implementation of Alternative 33 (Recommended Plan).

Indirect. No indirect impacts on human health or environmental effects within the study area would occur with the implementation of Alternative 33 (Recommended Plan).

Cumulative. There would be no adverse cumulative impacts on minority and/or low-income communities as none have been identified within the study area per 2000 U.S. Census information and requirements of E.O. 12898. Environmental justice issues are unlikely to occur when combined with other Federal, state, local, and private restoration efforts.

5.15.4.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.5 Infrastructure

5.15.5.1 No-Action Alternative

Direct. There would be no direct impacts to infrastructure.

Indirect. Existing and future infrastructure present within the study area would be indirectly affected due to the land loss created from the deterioration and conversion of existing swamp habitat to shallow open water habitat.

Cumulative. Cumulative effects would continue as land loss would increase erosion on infrastructure, similar to impacts from wetland loss and degradation throughout coastal Louisiana. Conversion of swamp vegetation to fresh marsh or open water habitat may affect relocations and maintenance of infrastructure within the study area.

5.15.5.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct effect on infrastructure.

Indirect. Existing and future infrastructure present within the study area would be indirectly benefitted. Restoration and preservation of the swamp system would support the sustainability of existing infrastructure by reducing inundation, wave action, and erosion.

Cumulative. Cumulative impacts would be the beneficial effects of restoration which supports infrastructure with other coastal restoration protection projects. This alternative would have positive effects on infrastructure when combined with other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2). There would be a reduced level of infrastructure damages and relocations compared to the No-Action Alternative.

5.15.5.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.6 Business and Industry

5.15.6.1 No-Action Alternative

Direct. There would be no direct impacts on business and industry.

Indirect. There would be no indirect impacts to business and industry.

Cumulative. Continued population growth and supporting business and industry development contributes to degradation and loss of coastal and other wetlands. Degradation and loss of wetlands would contribute to potential losses of businesses.

5.15.6.2 Alternative 33 (Recommended Plan)

Direct. There would be minor direct benefits due to the temporary jobs and services required for the construction and monitoring of Alternative 33 (Recommended Plan).

Indirect. There would be minor indirect benefits related to the continued support of business and industry by reducing the degradation and loss of wetlands that could contribute to the potential losses of businesses.

Cumulative. Cumulative impacts would continue to be controlled primarily by the national and regional economy. This alternative would have little effects on business and industry when combined with other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2). The study area does not appear to provide many opportunities for future business growth.

5.15.6.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.7 Traffic and Transportation

5.15.7.1 No-Action Alternative

Direct. There would be no direct impacts to traffic and transportation, including highways or golf cart paths within the study area.

Indirect. Wetland land loss threatens the stability of roads passing through the area, resulting in increased maintenance.

Cumulative. Wetland land loss threatens the stability of roads passing through the area, resulting in increased maintenance. Assuming existing permitted projects are completed, several of the current subdivisions would expand, creating additional roads, bridges, and traffic.

5.15.7.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct impacts on traffic and transportation.

Indirect. This alternative would have little effect on traffic and transportation. There would be a reduced level of road damages and relocations due to wetland loss.

Cumulative. This alternative would have little effect on traffic and transportation when combined with other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2). There would be a reduced level of road damages and relocations due to wetland loss.

5.15.7.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.8 Public Facilities and Services

5.15.8.1 No-Action Alternative

Direct. There would be no direct impacts on public facilities and services, such as sewerage, wastewater treatment, or electrical facilities.

Indirect. Wetland land loss potentially threatens public facilities and services and increases maintenance.

Cumulative. Wetland land loss potentially threatens public facilities and services and increases maintenance. Several of the current subdivisions would expand, creating additional needs for public facilities and services.

5.15.8.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct impacts on public facilities and services.

Indirect. This alternative would have little effect on public facilities and services. There would be a reduced level of damages and relocations of public facilities and services and increased maintenance due to wetland loss.

Cumulative. This alternative would have little effect on public facilities and services when combined with other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2). There would be a reduced level of public facilities and services damages and relocations due to wetland loss.

5.15.8.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.9 Local Government Finance

5.15.9.1 No-Action Alternative

Direct. There would be no direct impacts on local government finance, since there are no incorporated towns within the study area.

Indirect. Increasing population growth would increase the funding for local government.

Cumulative. There is no potential for new town development, and none would be developed in the future. Expansion of the current subdivisions would increase the tax base, thus increasing local government finances.

5.15.9.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct impacts on local government finance.

Indirect. There would be no indirect impacts on local government finance.

Cumulative. Cumulative impacts would continue as controlled by the local population. This alternative would have little effect on local government finances when combined with other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2). There is no potential for new town development within or contiguous to the area impacted by this alternative, and none would be developed in the future. Expansion of the current subdivisions would increase the tax base, thus increasing local government finances.

5.15.9.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.10 Tax Revenue and Property Values

5.15.10.1 No-Action Alternative

Direct. There would be no direct impacts on tax revenue and property values.

Indirect. Additional increases in property values and tax revenues would be sustained through the filling of lots in the existing and proposed subdivisions. At the same time, property values may drop from lowering aesthetics due to swamp degradation.

Cumulative. Cumulative impacts would continue as controlled by the local population growth and tax base.

5.15.10.2 Alternative 33 (Recommended Plan)

Direct. There would be minor direct increases in tax revenue due to the goods and services required for the construction and monitoring associated with the implementation of Alternative 33 (Recommended Plan). There would be little to no direct effects on overall property values within the study area.

Indirect. Additional increases in property values and tax revenues would be sustained through the filling of lots in the existing and proposed subdivisions as well as due to increased aesthetics. Minor indirect increases in tax revenue due to the goods and services associated with the construction of Alternative 33 (Recommended Plan) and the preservation and improvement due to the project.

Cumulative. Cumulative effects would continue as controlled by the national and regional economy. This alternative would have little effect on tax revenue and property values when combined with other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2). Additional increases in property values and tax revenues would be sustained through the filling of lots in the existing and proposed subdivisions as well as due to increased aesthetics.

5.15.10.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.11 Community and Regional Growth

5.15.11.1 No-Action Alternative

Direct. There would be no direct impacts on community and regional growth.

Indirect. There would be little indirect impacts on community and regional growth. Little additional infilling would occur in Berthelot's Campground, Waterfront East, and Three Rivers Island since those communities are nearly fully developed or fully inhabited. Assuming the existing permitted projects are constructed, additional growth would occur with the extension of the Three Rivers Island campsites to the east and the establishment of Waterfront East-Sanctuary South. These projects would continue to contribute to the growth of the southern portion of Livingston Parish. After these developments are completed, the possibilities of the study area would have been largely exhausted because of the lack of developable land.

Cumulative. Minor additional increases in community and regional growth would be sustained through the infilling of lots in the existing and proposed subdivisions. Cumulative effects would continue to be controlled by the national, regional, and local economy.

5.15.11.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct impacts on community and regional growth due to the implementation of Alternative 33 (Recommended Plan).

Indirect. There would be little indirect impacts on community and regional growth due to the implementation of Alternative 33 (Recommended Plan). Little additional infilling would occur in Berthelot's Campground, Waterfront East, and Three Rivers Island since those communities are nearly fully developed or fully inhabited. Assuming the existing permitted projects are constructed, additional growth would occur with the extension of the Three Rivers Island campsites to the east and the establishment of Waterfront East-Sanctuary South. These projects would continue to contribute to the growth of the southern portion of Livingston Parish. After these developments are completed, the possibilities of the study area would have been largely exhausted because of the lack of developable land.

Cumulative. This alternative would have little effect on community and regional growth when combined with other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2). Additional increases in community and regional growth would be sustained through the filling of lots in the existing and proposed subdivisions.

5.15.11.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.12 Land Use Socioeconomics

5.15.12.1 Agriculture

5.15.12.1.1 No-Action Alternative

Direct. There would be no direct impacts to agriculture or pasture acreage since no such acreage is present within the study area.

Indirect. There would be no indirect impacts to agriculture or pasture acreage.

Cumulative. Cumulative effects on agriculture would continue to be controlled by the national, regional, and local economy. Agricultural lands, primarily livestock pastures, within the study area would continue to be used and may be adversely impacted by habitat conversion and land loss.

5.15.12.1.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct impacts to agriculture or pasture acreage since no such acreage is present within the study area.

Indirect. There would be no indirect impacts to agriculture or pasture acreage.

Cumulative. This alternative would have positive effects on agriculture when combined with other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2). There would be a reduced level of agriculture land habitat conversion and land loss compared to the No-Action Alternative.

5.15.12.1.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.12.2 Forestry

5.15.12.2.1 No-Action Alternative

Direct. There would be no direct effects to forestry, including timber harvesting.

Indirect. There would be continued degradation in the quality and quantity of the trees within the study area and vicinity, greatly reducing the potential for forestry activities, such as timber harvesting. It is anticipated that timber resources within the study area would not reach merchantable size over the 50-year period of analysis. Existing tree stands would not be regenerated because of continued substrate degradation.

Cumulative. Cumulative impacts would be additive to the impacts from wetland loss and degradation throughout coastal Louisiana. Other cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system within the study area, which would be additive with other swamp losses and degradation impacts to forestry throughout the region and state (see Figure 5.1 and Table 5.2).

5.15.12.2.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct impacts to forestry, including timber harvesting.

Indirect. Channel Improvement, Flowage and Deposition, and Wetland Creation and Restoration easements would be placed within the primary and secondary areas of impact for Alternative 33 (Recommended Plan), effectively restricting timber harvesting within portions of the study area over an indefinite period of time. Therefore this alternative would have negative impacts on timber harvesting within portions of the study area. The Real Estate Plan in Appendix J provides descriptions of the easements which will be placed within the areas of impact.

Cumulative. This alternative would have negative additive effects on timber harvesting. Timber harvesting would be very limited, if not completely reduced, in the benefit areas. Cumulative impacts would be additive to other impacts to forestry throughout the region and state

5.15.12.2.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.12.3 Public Lands

5.15.12.3.1 No-Action Alternative

Direct. There would be no direct impacts to public lands, such as Maurepas Swamp Wildlife Management Area (WMA).

Indirect. Adverse indirect impacts could occur to nearby public lands as a result of swamp degradation and conversion to fresh marsh and open water. Impacts could also result from the consequent loss of storm damage benefits currently provided by the existing nearby swamp habitat. A portion of the Maurepas WMA is the only public lands present in the study area.

Cumulative. Cumulative impacts would be additive to the wetland loss and degradation throughout coastal Louisiana. A portion of the Maurepas Wildlife Management Area (WMA) is the only public lands present within the study area. These lands may be adversely affected by future sea level rise and continued habitat conversion and land loss. Other cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system within the study area, which would be additive with other swamp losses and degradation impacts to public lands throughout the region and state (see Figure 5.1 and Table 5.2).

5.15.12.3.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct impacts to public lands, such as Maurepas Swamp Wildlife Management Area since Alternative 33 (Recommended Plan) project components are not located or being implemented near or within the WMA.

Indirect. There would be minor beneficial indirect impacts by restoring the swamp adjacent to the public lands because the forested habitat within the project footprint will provide storm surge and windfall protection to nearby public lands.

Cumulative. Cumulative impacts would be additive to the wetland loss and degradation throughout coastal Louisiana. A portion of the Maurepas WMA is the only public lands present within the study area. These lands may be adversely affected by future sea level rise and continued habitat conversion and land loss. Other cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system within the study area, which would be additive with other swamp losses and degradation impacts to public lands throughout the region and state (see Figure 5.1 and Table 5.2).

5.15.12.3.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.13 Navigation

5.15.13.1 No-Action Alternative

Direct. There would be no direct impacts to navigation, commercially since there is little commercial fisheries within the study area, or recreationally.

Indirect. The degradation and loss of wetlands contribute to increased maintenance costs of navigation infrastructure.

Cumulative. Cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system within the study area. As Louisiana's coastal wetlands continue to fragment and convert to open water, the protection wetlands provide to inland waterways from wind-driven waves would likely be reduced. Amite River and Bayou Manchac Federal navigation channel and AR&T flood control channel are likely to continue to be used primarily for recreational navigation. Inland vessels, such as barge traffic, would be subjected to more open water marine-like conditions.

5.15.13.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct impacts to navigation, commercially or recreationally.

Indirect. Beneficial indirect impacts could occur as a result of wetland restoration, such as the sustainability of portions of the ARDC and other navigation channels in the area.

Cumulative. This alternative would have positive effects on navigation when combined with other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2). Cumulative impacts would be the protection of navigation channels.

5.15.13.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.14 Man-Made Resources

5.15.14.1 Oil, Gas, Utilities and Pipelines

5.15.14.1.1 No-Action Alternative

Direct. There would be no direct impacts to oil and gas utilities or pipelines as a result of the No-Action alternative.

Indirect. Wetland land loss increases the vulnerability of pipelines and other infrastructure.

Cumulative. 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. Wells are likely to remain and active pipelines likely to be present.

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 22, 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.

- 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.

5.15.14.1.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct beneficial or adverse impacts to oil and gas utilities or pipelines.

Indirect. There would be no indirect beneficial or adverse impacts to oil and gas utilities or pipelines.

Cumulative. This alternative would have positive effects on the protection of oil, gas, utilities, and pipelines when combined with other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2). These facilities would be less susceptible to storm surges and other damage due to wetland loss.

5.15.14.1.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.14.2 Flood Control and Hurricane Protection

5.15.14.2.1 No-Action Alternative

Direct. There would be no direct impacts to flood control, such as the ARDC or the Chinaquapin Canal, or hurricane protection levee projects since there are none located within the study area.

Indirect. There would be a continued degradation of forested habitat within the study area, which provides valuable storm-surge and windfall protection from tropical storms. Therefore, 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 be increased flood damages from hurricane events, and land loss and degradation throughout coastal Louisiana. Other cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system within the study area, which would be additive with other swamp losses and degradation impacts to flood control and hurricane protection throughout the region and state. However, the negative impacts of wetland loss to flood control and hurricane protection within the study area and vicinity would be offset to some extent by other Federal, state, local, and private restoration efforts across coastal Louisiana, including the West Lake Shore Pontchartrain Hurricane Protection Project (see Figure 5.1 and Table 5.2).

5.15.14.2.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct impacts to flood control and hurricane protection levee projects. Implementation of Alternative 33 (Recommended Plan) would have an insignificant reduction in the stage on the Amite River and on the ARDC. As a result, there would not be an increased risk of flooding for nearby businesses and residences. An insignificant increase in stage height within the swamp area, near the proposed openings in the ARDC dredged material berms, would occur. There are no hurricane protection levee projects within the study area; therefore, there will be no direct impacts to hurricane protection projects.

Indirect. There would be a restoration of forested habitat within the study area, which provides valuable storm surge and windfall protection from tropical cyclone events. Consequently, there could be an increase in storm surge protection and decrease in flooding risk with coastal land retention. 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. This alternative would have a positive additive effect on hurricane protection. The proposed action would nourish existing swamp habitat and create swamp habitat that is currently converting and has converted to open water. The reduction of conversion of swamp to open water would provide for some protection from storm surges and wave action. Cumulative impacts include the increased sustainability of portions of the ARDC, a flood control channel. The impacts to flood control and hurricane protection levee projects within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana, including the West Lake Shore Pontchartrain Hurricane Protection Project (see Figure 5.1 and Table 5.2).

5.15.14.2.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).
Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).
Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.15.15 Natural Resources

5.15.15.1 Commercial Fisheries

5.15.15.1.1 No-Action Alternative

Direct. There would be no direct impacts on commercial fisheries, including catfish harvesting within the Blind River or Petite Amite River. There are no oyster leases within the study area; therefore, no direct impacts would occur.

Indirect. Indirect impacts would result in the persistence of existing conditions including the continued conversion of existing wetlands to open water habitat, continued bankline erosion, and sloughing of the existing shoreline.

Cumulative. Cumulative impacts would be the continued effects on commercial fisheries from wetland loss and degradation throughout coastal Louisiana. Globally, overfishing and habitat change has resulted in the depletion of 90 percent of the world's seafood resources, with 38 percent of the species studied experiencing greater than 90 percent depletion, and 7 percent becoming extinct (Worm *et al.*, 2006). This trend is expected to continue under the No-Action Alternative. Throughout Louisiana and the study area, the loss of commercial fishery habitat due to the loss of essential wetland habitat and salinity changes is likely to occur. Other cumulative impacts include the conversion of 18,204 acres of swamp to a shallow open water system within the study area, which would be additive with other swamp losses and degradation impacts to commercial fisheries throughout the region and state. The positive impacts of restoration to commercial fisheries within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.15.15.1.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct impact on commercial fisheries, including catfish harvesting within the Blind River or Petite Amite River. There are no oysters within the study area; therefore, no direct impacts would occur.

Indirect. Wetland restoration would indirectly create and restore fisheries habitat. This would support populations of fishery species and enhance commercial fishing opportunities, including catfish harvesting and crabbing, within the study area and vicinity.

Cumulative. Habitat loss for commercial fisheries would continue due to the land loss and wetland deterioration in coastal Louisiana. A net total of 1,602 acres of swamp habitat would be restored and nourished. The positive impacts of restoration to commercial fisheries within the study area and vicinity would be additive to some extent with other Federal, state, local, and private restoration efforts across coastal Louisiana (see Figure 5.1 and Table 5.2).

5.15.15.1.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan).

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan).

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.16 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

The Phase I Environmental Site Assessment (ESA) for the study area identified two Recognized Environmental Concerns (RECs) that may have adversely impacted, or may potentially impact, environmental conditions in the study area: Underground Storage Tanks (USTs) at the former Chinquapin Grocery, and Aboveground Storage Tanks (ASTs) at Val's Marina. Although there are no records in the LDEQ's database regarding leaks from the two RECs, no soil and/or groundwater samples were collected to confirm that leaks did or did not occur. There is no visible evidence of spills or leaks in the vicinity of the RECs. Although located within the study area boundaries, neither of the two identified RECs are in close proximity to the portions of the study area projected to be impacted by the implementation of any of the final array of alternatives under consideration. Therefore, neither of the RECs located within the study area would likely expose the public or construction workers to HTRW or to adversely affect the project. If the project area changes, however, then additional investigation may be necessary. The HTRW report is provided in Appendix M.

5.16.1 No-Action Alternative

Direct. There would be no direct impacts to HTRW.

Indirect. There would be no indirect impacts to HTRW.

Cumulative. Within the study area, increasing human populations and industrialization are likely to result in increased potential for HTRW problems.

5.16.2 Alternative 33 (Recommended Plan)

Direct. There would be no direct impacts to HTRW since neither REC is in close proximity to the portions of the study area projected to be impacted by the implementation of Alternative 33 (Recommended Plan).

Indirect. There would be no indirect impacts to HTRW since neither REC is in close proximity to the portions of the study area projected to be impacted by the implementation of Alternative 33 (Recommended Plan).

Cumulative. There would be no cumulative impacts on HTRW. HTRW issues are unlikely to occur when combined with other Federal, state, local, and private restoration efforts (see Figure 5.1 and Table 5.2).

5.16.3 Alternatives 34-39

Direct. Direct impacts would be similar to Alternative 33 (Recommended Plan) since neither REC is in close proximity to the portions of the study area projected to be impacted by the implementation of any of the final array of alternatives under consideration.

Indirect. Indirect impacts would be similar to Alternative 33 (Recommended Plan) since neither REC is in close proximity to the portions of the study area projected to be impacted by the implementation of any of the final array of alternatives under consideration.

Cumulative. Cumulative impacts would be similar to Alternative 33 (Recommended Plan).

5.17 UNAVOIDABLE ADVERSE IMPACTS

The unavoidable adverse impacts resulting from implementation of any one of the seven proposed actions within the final array of alternatives would be the temporary impacts associated with construction, such as the loss of some trees within the project footprint, noise impacts due to the operation of large equipment, and the initial loss of some habitat during the clearing phase of the construction process. All of these impacts are considered temporary and have no impact on the long-term environmental impacts resulting from the proposed actions.

5.18 RELATIONSHIP OF SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

All seven proposed actions within the final array of alternatives, including the Recommended Plan would increase the long-term productivity of healthy freshwater swamp regeneration within the study area. Added hydrologic connectivity and reductions in impoundment would play a critical role in supplying the swamp habitat with nutrient and sediments on a seasonal basis. The addition of vegetative plantings would also serve as a means of initiating the regeneration and germination of cypress/tupelo swamp habitat within the most highly-degraded areas.

5.19 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Of all seven proposed actions within the final array of alternatives, excluding the No-Action Alternative, the irreversible and irretrievable commitments of resources would include the opening of the dredged material berms and the loss of existing vegetative resources during construction. All of these commitments would result in increased benefits for the study area and therefore, would not be viewed as a long-term negative impact.

5.20 MITIGATION

All seven alternatives, including the Recommended Plan, would generate a net gain in benefits; therefore, no mitigation would be required for implementation and construction of this proposed action. The Recommended Plan would result in a net gain of 679 AAHUs.

5.21 ENVIRONMENTAL CONSEQUENCES SUMMARY

The continued swamp degradation and conversion to marsh and open water leads to increased competition between wetland-dependent wildlife populations, displacement to other more suitable swamp wetland areas, and localized decline in wildlife populations. The loss of forest canopy would select against many species, such as neotropical migrants and nesting birds. The conversion to open water would select against small and large mammals, but may offer some more habitat for dabbling ducks.

The overall effect of all proposed actions within the final array of alternatives, excluding the No-Action Alternative, would be a net increase in benefits for the environmental resources within the study area with little to no negative impacts. The Recommended Plan would create a net gain of 679 AAHUs for the areas of impact. The No-Action Alternative would result in the continued degradation of the cypress/tupelo swamp habitat along with the wildlife and aquatic resources within the study area. The long-term effects of no Federal action would be the eventual conversion of thousands of acres of freshwater swamp to open water within the next 50 years.

6.0 PUBLIC INVOLVEMENT

6.1 NEPA SCOPING

A Notice of Intent (NOI) to prepare a Draft Supplemental EIS (DSEIS) for the LCA ARDC Modification Feasibility Study was published on December 22, 2008 in the Federal Register (Volume 73, Number 246). It was subsequently determined that an SEIS would be included in an Integrated Feasibility Report as a supplement to the 2004 LCA ARDC report.

The public scoping meeting was held on February 12, 2009, in French Settlement, Louisiana. A total of 30 multi-part comments were received during the comment period. A total of 86 specific comments were expressed. The comments received were incorporated into the planning formulation process in the identification of goals, objectives, study area problems and the management measures considered.

Comments were evaluated for recurring themes to gain an understanding of the key issues to address in the SEIS. Primary concerns uncovered in the comments were:

- Weir at French Settlement does not function properly and diverts excessive flow to ARDC, impairing lower Amite River.
- Project should incorporate weir construction at downstream end of ARDC.
- ARDC construction has disrupted natural hydrologic regime and damaged properties.
- Endangered/protected species are present in the study area and vicinity.
- Scope of project should address wildlife and fisheries habitat.
- Hydrology and Hydraulics modeling should be expansive, incorporate conditions from other projects, and/or involve stage data collection.

The scoping comments were documented in a Scoping Report and describe the public's concerns about the restoration effort and strategies for restoration efforts. 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 was posted on the study website at http://www.lca.gov. Scoping comments received to date are summarized in Tables 6.1 and 6.2. All public comments received on the draft FS/SEIS are summarized in Appendix G.

Table 6.1. Public Scoping Comment Themes by Percentages of Occurrence

Ranking	Theme	Number of Comments	Percent Occurrence
1	Weir at French Settlement does not function properly and diverts excessive flow to ARDC, impairing lower Amite River.	10	12.2%
2	Project should incorporate weir construction at downstream end of ARDC.	7	8.5%
3	ARDC construction has disrupted natural hydrologic regime and damaged properties.	6	7.3%
4	Endangered/protected species are present in the study area and vicinity.	6	7.3%
5	Scope of project should address wildlife and fisheries habitat.	6	7.3%
6	H&H modeling should be expansive, incorporate conditions from other projects, and/or involve stage data collection.	6	7.3%
7	Project should incorporate rehabilitation of weir at French Settlement.	5	6.1%
8	Southwestern boundary of study area should be expanded.	5	6.1%
9	Boat trips to reconnaissance study area are needed.	4	4.9%
10	Diversion canal stages are primarily influenced by Lake Maurepas.	4	4.9%
11	Gap placement is an issue because of development on dredged material berms.	4	4.9%
12	Swamps south of Bayou Pierre are impaired from acidity caused by lack of hydrologic exchange.	3	3.7%
13	Project is greatly needed and should be completed on an expedited schedule.	3	3.7%
14	Project should include vegetative planting or nature control.	3	3.7%
15	Create hydrologic exchange between Bayou Pierre and ARDC on south canal bank.	2	2.4%
16	Colonial nesting waterbird rookeries are present in the study area.	2	2.4%
17	Draining swamp waters may impair water quality in ARDC and downstream.	2	2.4%
18	Project should operate under flood events, not merely normal flow or high flow conditions.	1	1.2%
19	Dredged material berm gapping has been implemented as part of waterfront development projects in study area.	1	1.2%
20	Avoidance or minimization of forest habitat impacts should be considered during gap location.	1	1.2%
21	Project scope should include restoration of lower Amite River	1	1.2%
Total:		**82**	**100%**

Note: The number of occurrences totals 82 because a given comment can be associated with more than one theme. The percentages are based on dividing the number of occurrences of a given theme by the total number of occurrences and multiplying by 100.

Table 6.2. Public Scoping Comments Considered

Rank	Theme	Comment Incorporation or Consideration
1	Weir at French Settlement does not function properly and diverts excessive flow to ARDC, impairing lower Amite River.	Weir rehabilitation was considered as a measure in Section 3 of this study (WR-01). While we recognize that rehabilitation to the weir might be necessary, it was determined that the performance of the weir would have little to no effect to restoring the degraded portions of the study area. During the preliminary phases of the plan formulation process, rehabilitation of the weir was considered and subsequently screened out due to a lack of restoration opportunities this measure would provide.
2	Project should incorporate weir construction at downstream end of ARDC.	Weirs were considered as potential measures, but were screened out. This process is described in detail in Section 3 of the report (WC-01 through WC-08).
3	ARDC construction has disrupted natural hydrologic regime and damaged properties.	The objective of this project is to restore hydrologic connectivity to the area.
4	Endangered/protected species are present in the study area and vicinity.	Environmental consequences are discussed in detail in Section 5 of this report.
5	Scope of project should address wildlife and fisheries habitat.	Environmental consequences are discussed in detail in Section 5 of this report.
6	H&H modeling should be expansive, incorporate conditions from other projects, and/or involve stage data collection.	The LCA Blind River/Hope Canal Diversion projects were considered in the Hydrology and Hydraulics analysis, and the study area chosen was considered adequate for the purposes of the analysis needed. The H&H analysis is included in Appendix L, Section 2.
7	Project should incorporate rehabilitation of weir at French Settlement.	Rehabilitation does not efficiently contribute to the accomplishment of the goals for this project. This was considered as a measure in section 3 of this study (WR-01)
8	Southwestern boundary of study area should be expanded.	The study area subunit SW-2 was expanded to cover additional area to the south and west of the outline proposed during the public scoping meeting.
9	Boat trips to reconnaissance study area are needed.	Several reconnaissance boat trips were made.
10	Diversion canal stages are primarily influenced by Lake Maurepas.	Modeling shows that this is true.
11	Gap placement is an issue because of development on dredged material berms.	This was considered as a part of the project, and it was determined that the maximum benefit could be achieved without locating the gaps in developed areas.
12	Swamps south of Bayou Pierre are impaired from acidity caused by lack of	Measures describing consideration given to Bayou Pierre are described in Section 3 (BO-

Rank	Theme	Comment Incorporation or Consideration
	hydrologic exchange.	01, BO-02, CD-02, CS-02, CS-03, CS-04, SR-02)
13	Project is greatly needed and should be completed on an expedited schedule.	We concur.
14	Project should include vegetative planting or nature control.	These measures are included as a part of the Recommended Plan and are described in Section 3 (VP-01, VP-02).
15	Create hydrologic exchange between Bayou Pierre and ARDC on south canal bank.	Measures describing consideration given to Bayou Pierre are described in Section 3 (BO-01, BO-02, CD-02, CS-02, CS-03, CS-04, SR-02)
16	Colonial nesting waterbird rookeries are present in the study area.	Environmental consequences are discussed in detail in Section 5 of this report.
17	Draining swamp waters may impair water quality in ARDC and downstream.	No long-term water quality impacts are expected downstream of this project. Water quality impacts are discussed in detail in Section 5.3 of this report.
18	Project should operate under flood events, not merely normal flow or high flow conditions.	Design will operate in said conditions.
19	Dredged material berm gapping has been implemented as part of waterfront development projects in study area.	Analysis was conducted including existing gaps as a part of this study, and the recommended plan of action was to create larger gaps to increase hydrologic connectivity.
20	Avoidance or minimization of forest habitat impacts should be considered during gap location.	The alternatives were chosen based on the maximum net benefit possible, therefore minimization of impacts was considered.
21	Project scope should include restoration of lower Amite River	Lower Amite River is outside the scope of the project and will not be included.

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.

- Livingston Parish - August 6, 2008
- Ascension Parish - July 30, 2008
- Public Scoping Meeting - February 12, 2009
- Louisiana Department of Wildlife and Fisheries - June 15, 2009
- LCA Science Board Presentation - July 16, 2009
- Livingston Parish- August 6, 2009
- Ascension Parish- August 6, 2009

- Landowner - August 31, 2009
- Conservation Fund - November 2, 2009
- Conservation Fund - February 4, 2010
- Conservation Fund - February 9, 2010
- Livingston Parish- February 23, 2010
- Public Feasibility Scoping Meeting - June 24, 2010

6.2.1 Land Owner Involvement

Mr. Glen Martin, part owner of Blind River Properties Inc. and majority land owner within the ADRC study area, has been granted a permit to develop the southern bank of the ARDC in a manner similar to the development constructed on the northern shore. Several meetings have been held with Mr. Martin in which proposed project alternatives were presented. Mr. Martin supports restoration in the study area.

6.2.2 Non-Governmental Organization (NGO) Involvement

Both the Lake Pontchartrain Basin Foundation and the Coalition to Restore Coastal Louisiana provided support and suggestions about the ARDC modification project through a joint letter dated February 20th, 2009 to the commander of the New Orleans office of the USACE. On November 2, 2009, February 4, 2010 and February 9, 2010, meetings were held with the Louisiana Conservation Fund (LCF) along with the Audubon Society to collaborate future LCA ARDC efforts with LCF goals.

6.2.3 Parish Involvement

The study area for the LCA ARDC modification project is located within Ascension and Livingston Parishes. Separate meetings were held between representatives of Ascension and Livingston Parish, in order to solicit feedback on the project objectives and to report on the progress to date. Continual coordination between the LCA ARDC Project Delivery Team (PDT) and Parish representatives has occurred, Additional meetings have been held with Livingston Parish to prepare for the potential coordination between the Hydrologic Restoration in Swamps West of Lake Maurepas CIAP and the LCA ARDC projects.

6.3 PUBLIC COMMENTS ON THE DSEIS

The Integrated Feasibility Report and Supplemental Environmental Impact Study (SEIS) was released to the public on May 21, 2010, and was followed by a 45-day public review period ending on July 6, 2010. Additionally, a public meeting was held on June 24, 2010 in French Settlement Louisiana. Comments received and the responses to them are included in Appendix G.

7.0 COORDINATION AND COMPLIANCE

7.1 U. S. ARMY CORPS OF ENGINEERS (USACE) PRINCIPLES AND GUIDELINES (P&G)

This section documents the coordination and compliance efforts regarding statutory authorities including: environmental laws, regulations, executive orders, policies, rules, and guidance. Consistency of the TSP/Recommended Plan with other Louisiana coastal restoration efforts is also described.

7.2 ENVIRONMENTAL COORDINATION AND COMPLIANCE

Following completion of the Supplemental Environmental Impact Study (SEIS), 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. Relevant Federal statutory authorities and executive orders are listed in Table 7.1 of the SEIS. Relevant State of Louisiana statutory authorities are listed in Table 7.2 of the SEIS. Full compliance with statutory authorities will be accomplished upon review of the Final Feasibility Report and SEIS by appropriate agencies and the signing of a ROD, in compliance with the Fish and Wildlife Coordination Act (1958).

If a proposed project feature within the Recommended Plan is changed significantly or is not implemented within one year of the USFWS Final Coordination Act Report, the USACE will reinitiate coordination with the USFWS to insure that the proposed action would not adversely affect any Federally-listed threatened or endangered species or their critical habitat. Additionally, all further detailed planning of project features (e.g., Design Documentation Report, Engineering Documentation Report, Plans and Specifications, or other similar documentation) will be coordinated with the USFWS and other state and Federal natural resource agencies, and those agencies would be provided an opportunity to review and submit recommendations on all the work addressed in those reports.

Table 7.1. Relevant Federal Statutory Authorities and Executive Orders (Note: This list is not complete or exhaustive)

Abandoned Shipwreck Act of 1987 American Indian Religious Freedom Act of 1978 Anadromous Fish Conservation Act of 1965 Archaeological Resources Protection Act of 1979 Archaeological and Historical Preservation Act of	Marine Mammal Protection Act of 1972 Marine Protected Areas (EO 13158) of 2000 Marine Protection, Research, and Sanctuaries Act of 1972 Migratory Bird Conservation Act of 1929

1974 Bald Eagle Protection Act of 1940 Clean Air Act of 1970 Clean Water Act of 1977 Coastal Barrier Improvement Act of 1990 Coastal Barrier Resources Act of 1982 Coastal Wetlands Planning, Protection, and Restoration Act of 1990 Coastal Zone Management Act of 1972 Coastal Zone Protection Act of 1996 Comprehensive Environmental Response, Compensation, and Liability Act of 1980 Consultation and Coordination with Indian Tribal Governments (EO 13175) of 2000 Deepwater Port Act of 1974 Emergency Planning and Community Right-to-Know Act of 1986 Emergency Wetlands Restoration Act of 1986 Endangered Species Act of 1973 Environmental Quality Improvement Act of 1970 Estuaries and Clean Waters Act of 2000 Estuary Protection Act of 1968 Estuary Restoration Act of 2000 Exotic Organisms (EO 11987) of 1977 Farmland Protection Policy Act of 1981 Federal Actions to Address Environmental Justice in Minority Populations & Low-Income Populations (EO 12898, 12948) of 1994, as amended Federal Compliance with Pollution Control Standards (EO 12088) of 1978 Federal Emergency Management (EO 12148) of 1979 Federal Water Pollution Control Act of 1972 Federal Water Project Recreation Act of 1965 Fish and Wildlife Conservation Act of 1980 Fish and Wildlife Coordination Act of 1958 Flood Control Act of 1944 Floodplain Management (EO 11988) of 1977 Food Security Act of 1985 Greening of the Government Through Leadership in Environmental Management (EO 13148) of 2000 Historic Sites Act of 1935 Historical and Archaeological Data-Preservation Act of 1974 Indian Sacred Sites (EO 13007) of 1996 Invasive Species (EO 13112) of 1999 Land & Water Conservation Fund Act of 1965 Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended	Migratory Bird Treaty Act of 1918 Migratory Bird Habitat Protection (EO 13186) of 2001 National Environmental Policy Act of 1969 National Historic Preservation Act of 1966 National Invasive Species Act of 1996 Native American Graves Protection and Repatriation Act of 1990 Neotropical Migratory Bird Conservation Act of 2000 Noise Control Act of 1972 Nonindigenous Aquatic Nuisance Prevention and Control Act of 1996 North American Wetlands Conservation Act of 1989 Oil Pollution Act of 1990 Outer Continental Shelf Lands Act of 1953 Pollution Prevention Act of 1990 Prime or Unique Farmlands, 1980 CEQ Memorandum Protection and Enhancement of the Cultural Environment (EO 11593) of 1971 Protection and Enhancement of Environmental Quality (EO 11991) of 1977 Protection of Children from Environmental Health Risks and Safety Issues (EO 13045) of 1997 Protection of Cultural Property (EO 12555) of 1986 Protection of Wetlands (EO 11990) of 1977 Reclamation Projects Authorization and Adjustments Act of 1992 Recreational Fisheries (EO 12962) of 1995 Resource Conservation and Recovery Act of 1976 Responsibilities of Federal Agencies to Protect Migratory Birds (EO 13186) of 2001 Rivers and Harbors Acts of 1899, 1956 River and Harbor and Flood Control Act of 1970 Safe Drinking Water Act of 1974 Submerged Land Act of 1953 Sustainable Fisheries Act of 1996 Title VI, Section 601 of the Civil Rights Act of 1964 Toxic Substances Control Act of 1976 Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646) Water Resources Development Acts of 1976, 1986, 1990, 1992, and 2007 Water Resources Planning Act of 1965 Watershed Protection & Flood Prevention Act of 1954 Water Pollution Control Act Amendments of 1961 Wild and Scenic River Act of 1968 Wilderness Act of 1964

Table 7.2. Relevant State Statutory Authorities
(Note: This list is not complete or exhaustive)

Air Control Act Archeological Treasury Act of 1974 Louisiana Coastal Resources Program Louisiana Natural and Scenic Rivers	Louisiana Threatened and Endangered Species and Rare & Unique Habitats Protection of Cypress Trees Water Control Act

7.2.1 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 into shallow open water areas to create wetlands have been evaluated in compliance with Section 404(b)(1) of the Clean Water Act (Appendix D). All relevant Federal and state authorities and Executive Orders are found in Tables 7.1 and 7.2. The evaluation of potential impacts to water quality indicated that, on the basis of the guidelines, the proposed disposal sites for the discharge of dredged material comply with the requirement of these guidelines, with the inclusion of appropriate and practicable methods to minimize adverse effects to the aquatic ecosystem. Water Quality Certification was received on September 20, 2010 and is included in Appendix D.

7.2.2 Section 122 of the Rivers and Harbors Act

Section 122 of the Rivers and Harbors Act of 1970 (Public Law 91-611, 84 STAT. 1823) requires that consideration be given to possible adverse economic, social and environmental effects. It also requires that final decisions on the project be made in the best overall public interest, taking into consideration the need for flood control, navigation and associated purposes; and the associated costs of eliminating or minimizing the following adverse affects:

Air, water and noise pollution;
Destruction or disruption of man-made and natural resources, aesthetic values, community cohesion, and availability of public facilities and services;
Adverse employment effects;
Tax and property value losses;
Injurious displacement of people, businesses and farms; and
Disruption of desirable community and regional growth.

7.2.3 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, to assure that those activities or projects are consistent, to the maximum extent practicable, with the approved state coastal zone management program. A Coastal Zone Consistency Determination will be included with this report has been submitted to Louisiana Department of Natural Resources (LDNR) for consistency review. A Consistency Determination received on August 9, 2010 and is included in Appendix E. Implementation of the Recommended Plan is considered consistent, to the maximum extent practicable, with the approved Louisiana state coastal management program.

7.2.4 Endangered Species Act of 1973

Compliance with the Endangered Species Act (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 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 USACE would 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 and West Indian manatee may be Recommended Plan to these species are unlikely (see also Section 5.11 Threatened and Endangered Species). A Biological Assessment is included in this report (Appendix A). Comments and concurrence from the USFWS on the proposed action are included in Appendix G.

7.2.5 Magnuson-Stevens Fishery Conservation and Management Act of 1996; and the Magnuson-Stevens Act Reauthorization of 2006 Essential Fish Habitat (EFH)

As directed by the Magnuson-Stevens Fishery Conservation and Management Act (Public Law 104-297), the USACE has coordinated with NMFS and that agency's experts on various marine organisms as well as EFH. NMFS indicated that the study area may contain some habitat for euryhaline species such as Gulf menhaden and striped mullet, but that EFH is not present within the study area (see also Section 5.10 EFH).

7.2.6 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 Louisiana Department of Environmental Quality (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 was made for the Recommended Plan. This included 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 has been calculated, based upon direct and indirect air emissions (Section 5.4). 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 was 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 VOCs 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 Volatile Organic Compounds (VOC) emissions for the proposed construction would be classified as de minimus and no further action would be required.

7.2.7 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 any significant historic property, district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places. 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 Office (SHPO) and tribes a reasonable opportunity to comment before decisions are made. Accordingly, the proposed action has been coordinated with the SHPO and tribes. The coordination letter received from the SHPO, as well as the Programmatic Agreement, are included in Appendix F. The LCA ARDC Integrated Feasibility Report and SEIS was provided to the SHPO and tribes, as well as other interested parties for comment (see also Section 5.12).

7.2.8 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. There are no prime and unique farmlands within the study area. Hence, there would be no unnecessary or irreversible conversion of prime and unique farmland to non-agricultural uses.

7.2.9 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 (Section 5.7). This Executive Order requires environmental analyses of Federal actions required by the NEPA or other established environmental review processes 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. Implementation of the Recommended Plan would result in a net increase in migratory bird habitat.

7.2.10 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 would 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. Comments did not identify any potential environmental justice issues. The USACE is committed to ensuring that any potential environmental justice issues are addressed as the study proceeds. The proposed ecosystem restoration measures would equally impact all potential users in the area. There would be no potential environmental justice issues from implementing the Recommended Plan (Section 5.15.4).

7.2.11 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. Alternative 33 (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. Alternative 33 (Recommended Plan) would 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 would be taken in conjunction with the actions (Section 5.6.5).

7.2.12 Executive Order 11990 – Protection of Wetlands

President Jimmy Carter issued Executive Order 11990: Protection of Wetlands on May 24, 1977 (42 FR 26961, 3 CFR, 1977 Comp., p. 121) in order to avoid, to the extent possible, the long and short term adverse impacts associated with the destruction or modification of wetlands. Executive Order 11990 directs that each Federal agency shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. Consistent with Executive Order 11990, the following factors have been considered as part of the alternative plan formulation process in developing the Recommended Plan for ecosystem restoration and avoiding potential effects on the survival and quality of wetlands (Appendix D):

a) Public health, safety, and welfare, including water supply, quality, recharge and discharge; pollution; flood and storm hazards; and sediment and erosion;
b) Maintenance of natural systems, including conservation and long term productivity of existing flora and fauna, species and habitat diversity and stability, hydrologic utility, fish, wildlife, timber, and food and fiber resources; and
c) Other uses of wetlands in the public interest, including recreational, scientific, and cultural uses.

7.2.13 Executive Order 11988 – Floodplain Management

Executive Order 11988 - Floodplain Management directs all Federal agencies to avoid, if possible, development and other activities in the 100-year base floodplain. Where the base floodplain cannot be avoided, special considerations and studies for new facilities and structures are needed.

Design and siting are to be based on scientific, engineering, and architectural studies; consideration of human life, natural processes, and cultural resources; and the planned period of analysis of the project. Federal agencies are required to:

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

The proposed action area is located in Zone A (no base flood elevation determined) of the Special Flood Hazard Areas inundated by 100-year flood (Source: National Flood Insurance Program, Firm Flood Insurance Rate Map, Livingston Parish, Louisiana, Unincorporated Areas, Panel 250 of 275, Community-Panel Number 220113 0250 B, effective date September 30, 1988, Federal Emergency Management Agency). Consistent with Executive Order 11988, implementing the Recommended Plan would have no significant impacts on the risk of flood loss. Furthermore, implementing the Recommended Plan would have no significant flooding impacts on human safety, health and welfare. Implementing the Recommended Plan, ecosystem restoration of portions of the Maurepas Swamp, would contribute to restoring and preserving the natural and beneficial values served by floodplains (Section 5.15.14.2).

7.2.14 Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646)

All real estate interests acquired for construction of the Recommended Plan would 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 (Appendix J).

7.2.15 Louisiana State Rare, Threatened, and Endangered Species, and Natural Communities Coordination

The USACE reviewed the database maintained by the Louisiana Natural Heritage Program (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 is not likely to adversely affect any rare, threatened or endangered species, or unique natural communities. The proposed action would increase the extent of bald cypress-tupelo swamp within portions of the study area, which are identified as rare natural communities for certain regions of the state (see also Section 5.6 Vegetation Resources and 5.11 Threatened and Endangered Species).

7.2.16 Clean Water Act – Section 401 Water Quality

Under provisions of the Clean Water Act (33 U.S.C. § 1251), any project that involved 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 LDEQ, Office of Environmental Services. A SEIS addressing impacts of all activities associated with the proposed LCA ARDC Modification project has been prepared. The document includes an assessment of impacts of excavation, dredging, and disposal operations. Application for certification has been submitted by the U.S. Army Engineer District, New Orleans, to the LDEQ, Office of Environmental Services, in accordance with statutory authority contained in LRS: 30:2074 A(3) and provisions of Section 401 of the Clean Water Act (P.L. 92-500, as amended) (Appendix D). A Water Quality Certification was received on September 20, 2010 and is included in Appendix D.

7.2.17 U.S. Fish and Wildlife Coordination Act Report

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 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*), Gulf sturgeon (*Acipenser oxyrhynchus desotoi*), bald eagle (*Haliaeetus leucocephalus*), and colonial nesting waterbirds. The U.S. Fish and Wildlife Coordination Letter and Report are provided in Appendix B. We received concurrence on the Biological Assessment and recommendations in a draft Coordination Act Report (CAR) in a letter from the USFWS, dated June 29, 2010. The final CAR was received on September 2, 2010.

Additionally, USACE has coordinated with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and the Louisiana Department of Wildlife and Fisheries as per the Fish and Wildlife Coordination Act (16 U.S.C. 661-667e; the Act of March 10, 1934; Ch. 55; 48 Stat. 401), as amended by the Act of June 24, 1936. A Final coordination act letter report (Appendix B) has been received the services position and recommendations are as follows:

The TSP will benefit the fish and wildlife resources of the LCA-ARDC area 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 679 AAHUs and 1,602 net acres of swamp habitats would benefit by the proposed project at the end of the project life. The Service supports implementation of Alternative 33 provided the following fish and wildlife recommendations are implemented concurrently with project implementation:

1. *If authorized funding limits for this project are increased the Service recommends that Alterative 39 be reconsidered as the potential future TSP.*

2. *Prioritize those measures that are contained in the NER plan that are not included within the TSP based on cost-effectiveness. In addition, advertise the most cost-effective measures in the NER plan that are missing from the TSP as additive alternates if funds for this project are authorized by Congress and the project is advertised for construction bids.*

3. *If a proposed project feature is changed significantly or is not implemented within one year of the Endangered Species Act consultation letter, 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.*

4. *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).

5. *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.*

6. *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.*

7. *Land clearing associated with project features should be conducted during the fall or winter to minimize impacts to nesting migratory birds, when practicable.*

8. *Further detailed planning of project features (e.g., Design Documentation Report, Engineering Documentation Report, Plans and Specifications, or other similar documents) 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.*

9. *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:

- Recommendation 1 is addressed in Sections 1.5.1, 3.7, 3.9.6 and 6.2.3 of this report;
- Recommendation 2 is addressed in Section 3.7 of this report;

- Recommendations 3 and 8 are addressed in Section 7.2 of this report;
- Recommendations 4 and 7 are addressed in Section 5.7.2 of this report;
- Recommendations 5 and 6 are addressed in Section 4.2.7 of this report; and
- Recommendation 9 is addressed in Section 3.7.5 and Appendix I of this report.

8.0 CONCLUSIONS AND DETERMINATIONS

8.1 AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

The State of Louisiana, the U.S. Army Corps of Engineers (USACE), landowners within the study area, and public stakeholders, have agreed on the goals, purpose, and findings of this study, and there are no known 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 33 includes:

- Three dredged material bank openings and three bifurcated conveyance channels in the north bank of the ARDC in NE-2 with the westernmost channel in the north bank extending through the railroad grade into NE-1 to add connectivity between NE-1, NE-2, and the ARDC.
- Dredged material (5.0 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps would be left in the disposal berms so sheet flow is not reduced.
- One cut would be created in the railroad grade approximately 0.9 mile north of the ARDC to improve sheet flow.
- Vegetative plantings of bottomland hardwood/freshwater swamp tree species on 5.0 acres of dredged material berms.
- Vegetative plantings of freshwater swamp tree species within 438 acres of the swamp floor.
- Installation of nutria guards on all newly planted trees to protect against tree loss.

Three natural low areas or relict channels have been identified as potential bank opening and conveyance channel sites. Openings would enable impounded water to be drained from the swamp and provide hydrologic connectivity between the swamp and the ARDC. Additionally, the placement of a cut in the railroad grade would provide further hydrologic connectivity on the north bank. Openings would promote the introduction of freshwater, sediments, and nutrients into the swamp and allow the oxidation of sediments and removal of toxic metabolites. This alternative is anticipated to improve the degraded swamp and decrease the transition to marsh and ultimately, open water. This alternative represents the minimum effort that would meet the goals and objectives of the project.

The implementation of the recommended plan would result in long-term, sustainable ecosystem restoration. Fish, wildlife, and freshwater swamp habitat would be restored and maintained. The project outputs are cost-effective and consistent with the mission of the USACE and the State of Louisiana Coastal Protection and Restoration Authority (CPRA). This plan is acceptable to the public and the State of Louisiana and the Project Delivery Team (PDT). The Non-Federal Sponsor shall, prior to implementation, agree to perform the items of local cooperation as discussed in Section 3.9.

8.3 RECOMMENDATIONS

I recommend that Alternative 33 be constructed under the authority of Section 7006(e)(3)(b) of the Water Resources Development Act (WRDA) 2007. Alternative 33 includes the creation of three conveyance channels through the dredged material berm of the ARDC to improve connectivity that would greatly increase the movement of freshwater, sediments, and nutrients to and from the bald cypress-tupelo swamp. It also includes planting of 438 and 5 acres of the study area with freshwater swamp and bottomland hardwood tree species, respectively. The recommended plan is an implementable increment of the NER plan, has been determined to be cost effective, is within the cost and scope of the authorization, has stand-alone utility, is supported by the non-Federal sponsor, and can be justified based on ecosystem restoration benefits. Alternative 33 would create 679 Average Annual Habitat Units (AAHUs), would benefit approximately 1,602 acres of existing freshwater swamp, recreate 144 acres of freshwater swamp from freshwater marsh, and create 5.0 acres of upland habitat from dredged material placement. The project total first cost, based on October 2010 price levels, is estimated at $8,136,000. The total fully funded project cost is estimated at $8,540,000 Micro-Computer Aided Cost Estimating System (MCACES) and the average annualized cost per AAHUs is $660. This restoration would greatly benefit fish and wildlife resources, freshwater swamp habitat, and improve water quality. This project would be cost shared by the non-Federal sponsor, the State of Louisiana at 35 percent non-Federal and 65 percent Federal. The Non-Federal Sponsor shall, prior to implementation, agree to perform the items of local cooperation as stated in Section 3.9.2.

The recommendations 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. They do 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

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9.0 DISTRIBUTION LIST AND OTHER

9.1 DISTRIBUTION LIST

The LCA ARDC Integrated Feasibility Report and Supplemental Environmental Impact Statement (FS/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

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Many individuals were involved with the completion of this document. Table 9.1 lists those people who assisted in the writing of the LCA ARDC FS/SEIS. Table 9.1 is alphabetized by preparers' last name.

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9.3 LITERATURE CITED

Anderson, K.B., E.F. Benfield, and A.L. Buikema. 1977. Zooplankton of a swamp water ecosystem. Hydrobiologia 55(2):177-185.

American Bird Conservancy. 2009. Saving Migratory Birds for Future Generations: *The Success of the Neotropical Migratory Bird Conservation Act* http://www.abcbirds.org/newsandreports/act_songbirds.pdf

Amite River Basin Drainage and Water Conservation District. 2007. Flow Measurements, Amite River at Entrance of Amite River Diversion Canal, 1/9/07-3/29/07-5/9/07. 15 pp.

Atilla, N., N. Rabalais, W. Morrison, W. Mendenhall, C. Normandeau, Q. Dortch, R.E. Turner. 2007. Phytoplankton Community Composition in Lake Pontchartrain. Abstract, American Society of Limnology and Oceanography.

Bamforth, S.S. 1962. Diurnal changes in shallow aquatic habitats. Limnology and Oceanography 7(3): 348-353.

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 06-1247.

Barras, J.A., P. E. Bourgeois, L. R. Handley. 1994. Land loss in coastal Louisiana 1956-90: National Biological Survey, National Wetlands Research Center Open-File Report 94-01. 4 pp.

Barras, J.A., S. Beville, D. Hartley, S. Hawes, J. Johnston, P. Kemp, Q. Kinler, A. Martucci, J. Porthouse, D. Reed, K. Roy, S. Sapkota, and J. Shayda. 2003. Historical and projected coastal Louisiana land changes: 1978-2050: USGS Open File Report 03-334, 39 pp. (revised Jan. 2004).

Barras, J.A., J.C. Bernier, and R.A. Morton. 2008. Land area change in coastal Louisiana—A multidecadal perspective (from 1956 to 2006): U.S. Geological Survey Scientific Investigations Map 3019, scale 1:250,000, 14 pp. http://pubs.usgs.gov/sim/3019/.

Beville, S. 2002. The Efficacy of a Small Freshwater River Diversion for Restoration of a Swamp in Southeastern Louisiana. M.S. Thesis, Southeastern Louisiana University, Hammond, LA.

Boyd, R. and S. Penland. 1988. Geomorphic model or Mississippi delta evolution. American Association of Petroleum Geologists Bulletin 72/9:1110.

Burnam, J. and M. T. Mengak. 2007. Managing Wildlife Damage: Nutria (*Myocastor coypus*). Wildlife Management Publication Series WMS-07-12. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, Georgia. 6 p.

Chambers, J. L., W.H. Conner, J.W. Day, 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.

Center for Environmental Excellence (CEE). 2009. http://www.environment.transportation.org/environmental_issues/environmental_justice/

Church J.A., J.M. Gregory, P. Huybrechts, M. Kuhn, K. Lambeck, M.T. Nhuan, D. Qin, and P.L. Woodworth. 2001. Changes in Sea Level. *In*: Houghton and Ding (eds.) *Climate Change 2001: The Scientific*. Cambridge University Press. Cambridge, England.

Clason, Terry. Personal Communication, September 2009.

Coastal Protection and Restoration Authority. 2007. Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast Appendix I: Measures Appraised: Alternative Plans 1 and 2.

Coastal Wetland Forest Conservation and Use Science Working Group (CWFCUSWG). 2005. Conservation, Protection and Utilization of Louisiana's Coastal Wetland Forests. Final Report to the Governor of Louisiana. Governor's Office of Coastal Affairs, Capitol Annex,1051 North 3rd Street, Suite 138, Baton Rouge, LA 70804. http://www.coastalforestswg.lsu.edu/SWG_FinalReport.pdf

Coastal Wetlands Planning, Protection, and Restoration Act Task Force. 2002. 12th Priority Project List Report (Appendices).

Coastal Wetlands Planning, Protection, and Restoration Act Task Force. 2007. Powerpoints and Fact Sheets from PPL 17 RPT Meetings. http://www.lacoast.gov/reports/multiproject/PPL/17/RPT_Meetings_final.pdf.

Coastal Wetlands Planning, Protection, and Restoration Act Task Force. 2008. River Reintroduction into Maurepas Swamp. PO-29 Project Status Report March 7, 2008.

Cole, G.A. 1975. Textbook of Limnology. C.V. Mosby Co. 283 pp.

Commission for Racial Justice report. 1987. *Toxic Waste and Race in the United States*. United Church of Christ UCCF 1987). Accessed at: www.ucc.org/about-us/archives/pdfs/toxwrace87.pdf.

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. American Journal of Botany 63:1354-1364.

Conner, W. H. and J. R. Toliver. 1987. Vexar seedling protectors do not reduce nutria damage to planted baldcypress seedlings. Tree Planter's Notes 38:26-29.

Conner, W. H. and J. R. Toliver. 1988. The problem of planting Louisiana swamplands when nutria (Myocastor coypus) are present. Pages 42-49 in N. R. Holler, ed. Proc. Third Eastern Wildlife Damage Control Conference. Ala. Coop. Ext. Serv., Auburn Univ.

Conner, W. H. and J. W. Day, Jr. 1989. Response of coastal wetland forests to man-made and natural changes in the environment with emphasis on hydrology. Pages 34-43 in D. D. Hook and R. Lea, eds. Proc. of the Symposium: Forested Wetlands of the Southern United States. Gen. Tech. Rep. SE-50. Asheville, NC: U.S. Dept. Agric., For. Serv., SE For. Expt. Sta.

Conner, W. H. and K. Flynn. 1989. Growth and survival of baldcypress (*Taxodium distichum* (L.) Rich.) planted across a flooding gradient in a Louisiana bottomland forest. Wetlands 9(2):207-217.

Cowardin, L.M., 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. http://el.erdc.usace.army.mil/emrrp/emris/emrishelp2/cowardin_report.htm.

Day, J.W., Jr., C.A.S. Hall, W.M. Kemp, and A. Yanez-Arancibia. 1989. Estuarine Ecology. John Wiley and Sons, New York. 558 pp.

Day, J.W. and P.H. Templet. 1989. Consequences of Sea Level Rise: Implications from the Mississippi Delta. Coastal Management 17:241-257.

Day, J.W., R.R. Lane, G. P. Kemp, H.S. Mashriqui and J.N. Day. 2001. Attachment F: Nutrients-Mississippi River Diversion into the Maurepas Swamp-Water Quality Analysis-Draft Final Report. *In* Diversion into the Maurepas Swamps, A Complex Project under the Coastal Wetlands Planning, Protection, and Restoration Act. Lee Wilson & Associates, Inc. with G. Shaffer, M. Hester, P. Kemp, H. Mashriqui, J. Day, and R. Lane (eds.). Prepared for: U.S. Environmental Protection Agency, Region 6, Dallas, Texas.

Day, J.W., R.R. Lane, G.P. Kemp, H.S. Mashriqui, and J.N. Day. 2001. Mississippi River diversion into the Maurepas Swamp- water quality analysis (Attachment F). *In*: Lee Wilson and Associates, Diversion into the Maurepas Swamps: A Complex Project under the Coastal Wetlands Planning, Protection, and Restoration Act. Report to USEPA under Contract No. 68-06-0067, WA #5-02.

Day, J.W., G.P. Kemp, H.S. Mashriqui, R.R. Lane, D. Dartez, and R. Cunningham. 2004. Development Plan for a Diversion into Maurepas Swamp Water Quality and Hydrologic Modeling Components. Louisiana State University, Baton Rouge, LA.

DeLaune, R.D., R.J. Buresh, and W.H. Patrick, Jr. 1979. Relationship of soil properties to standing crop biomass of *Spartina alterniflora* in a Louisiana marsh. Estuarine Coastal Marine Science 8: 477-487.

DeLaune, R.D., R.H. Baumann, and J.G. Gosselink. 1983. Relationships among vertical accretion, coastal submergence, and erosion in a Louisiana gulf coast marsh. Journal of Sedimentary Peterology 53(1): 147-157.

Demaree, D. 1932. Submerging Experiments with *Taxodium*. Ecology 13:258-262.

Effler, R.S., R. Goyer, and G.J. Lenhard. 2006. Baldcypress and water tupelo responses to insect defoliation and nutrient augmentation in Maurepas Swamp, Louisiana. USA Forest Ecology and Management Vol. 236(2-3):295-304.

Environmental Systems Research Institute, Inc. (ESRI). 2008. Business Analyst Program: Census 2000 Summary Profile, Census 2000 Detailed Race Profile, 2008/2013 Demographic and Income Profile.

EPA AirData Database, 2009.

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.

Fisk, H.N. 1952. Geological Investigation of the Atchafalaya Basin and Problems of Mississippi River Diversion. Vols. I and II. U.S. Army Corps of Engineers, Mississippi River Commission. Vicksburg, MS.

Fisk, H.N. 1955. Sand facies of recent Mississippi Delta deposits. 4th World Petroleum Congress Proceedings. Rome, Italy. Section 1, pp. 377-398.

Fisk, H.N., and E. McFarlan. 1955. Late Quaternary deposits of the Mississippi River. Crust of the Earth. Special Paper No. 62. Geological Society of America. Boulder, Colorado, pp. 279-302.

Flynn, K.M. 1986. Growth and metabolic response of (*Taxodium distichum* (L.) Rich). (baldcypress) seedlings to different flooding regimes. M.S. Thesis. Louisiana State University, Baton Rouge 67 p.

Frazier, D.E. 1967. Recent deltaic deposits of the Mississippi River, their development and chronology. Transactions Gulf Coast Association of Geological Societies 17:287-315.

Gagliano, S.M. and J.L. van Beek. 1975. An approach to multiuse management in the Mississippi Delta system. *In*: M.L. Broussard (ed.) Deltas, models for exploration. Houston Geological Society, pp. 223-238.

Gagliano, S.M., E.B. Kemp, K.M. Wicker, and K.S. Wiltenmuth. 2003. Active geological faults and land change in southeastern Louisiana. Coastal Environments Inc. Baton Rouge, LA.

Gornitz. J.G., C.C. Cordes, and J.W. Parsons. 1982. Global sea-level trend in the past century. Science 215:1611-1614.

Gosselink, J.G., J. M. Coleman, and R. E. Stewart, Jr. 1998. *In:* Status and trends of the nation's biological resources. 2 vols. Mac, M. J., P. A. Opler, C. E. Puckett Haecker, and P. D. Doran (eds.). U.S. Department of the Interior, U.S. Geological Survey, Reston, Va.

Hamilton, A., and G.P. Shaffer. 2001. Wetland Value Assessment. Diversion into the Maurepas Swamps: A Complex Project under the Coastal Wetlands Planning, Protection, and Restoration Act. Report to EPA under Contract No. 68-06-0067, WA # 5-02. Attachment G. 58 pp.

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., R.D. DeLaune, and W.H. Patrick, Jr. 1983. Sedimentation, accretion and subsidence in marshes of Barataria Basin, Louisiana. Limnol. Oceanogr. 28/3:494-502.

Haydel, Leonce. 1998. Stories from Blind River. Ruhr Valley Publishing, Inc., Lutcher, LA.

Hoeppner, S., G.P. Shaffer, and T.E. Perkins. 2007. Through droughts and hurricanes: The survival and productivity of a coastal swamp in the Mississippi River Deltaic Plain. Forest Ecology & Management.

Hoeppner, S. 2008. Swamp Ecology in a Dynamic Coastal Landscape: An Investigation through Field Study and Simulation Modeling. Ph.D. Dissertation. Louisiana State University, Baton Rouge, LA.

Hsu, S.A., John M. Grymes III and Zhongde Yan. 1997. A Simplified Hydrodynamic Formula for Estimating the Wind-Driven Flooding in the Lake Pontchartrain-Amite River Basin.

Hynes, H.B.N., 1970. The Ecology of Running Waters. University of Toronto Press, 555 pp.

Jessie, Jarvis C. Unpublished data.

Johnson, L.A. and A.L. Foote. 1997. Vertebrate herbivory in managed coastal wetlands: a manipulative experiment. Aquatic Botany 59(1-2):17-32.

Kaller, M.D., J.D. Hudson, E.C. Achberger, and W.E. Kelso. 2007. Feral hog research in western Louisiana: expanding populations and unforeseen consequences. Human-Wildlife Conflicts 1/2: 168-177.

Keddy, P.A., D. Campbell, T. McFalls, G.P. Shaffer, R. Moreau, C. Dranguet, and R. Heleniak. 2007. The Wetlands and Lakes Pontchartrain and Maurepas: Past, Present and Future. Environmental Review 15:43-77.

Kesel, R.H. 1988. The decline in the suspended sediment load of the lower Mississippi River and its influence on adjacent wetlands. Environmental Geology and Water Science 11:271-281.

Kolb, C.R., and J.R. van Lopik. 1958. Geology of the Mississippi Deltaic Plain-Southeastern Louisiana. U.S. Army Corps of Engineers, Waterways Experiment Station, Technical Report 2. 482 pp.

Kozlowski, T.T. 1984. Plant responses to flooding of soil. BioScience 34:162-167.

Kryter, K.D. 1994. The Handbook of Hearing and the Effects of Noise: Physiology, and Public Health. McGraw Hill, New York.

Laiche, G.S. 1980. The fishes of the Amite River Drainage in Mississippi and Louisiana. M.S. Thesis. University of New Orleans, New Orleans, LA.

Lane, R.R., H.S. Mashriqui, G.P. Kemp, J.W. Day, J.N. Day, and A. Hamilton. 2003. Potential Nitrate Removal from a River Diversion Into a Mississippi Delta Forested Wetland. Ecological Engineering 20:237-249.

Lantz, K.E. 1970. An ecological survey of factors affecting fish production in a Louisiana backwater area and river. Louisiana Wildlife and Fisheries Commission. Fisheries Bulletin No. 5. 60 pp.

Lee, C.E. 2000. Global phylogeography of a criptic copepod species complex and reproductive isolation between genetically proximate populations. Evolution 54/6:2014-2027.

Loden, M.S. 1978. Life history and seasonal abundance patterns of aquatic Oligochaeta in four southeastern Louisiana habitats. Ph.D. Dissertation, Louisiana State University, Baton Rouge, LA.

Louisiana Coastal Area. 2004. Louisiana Coastal Area (LCA) Ecosystem Restoration Study. Volume II: Final Programmatic Environmental Impact Statement. New Orleans District, New Orleans, LA. 918 pp.

Louisiana Coastal Protection and Restoration. 2009. USACE Louisiana Coastal Protection and Restoration (LACPR): Final Technical Report.

Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority. 1999. Coast 2050: Toward a Sustainable Coastal Louisiana, The Appendices. Appendix C - Region 1 Supplemental Information. Louisiana Department of Natural Resources. Baton Rouge, LA.

Louisiana Department of Agriculture and Forestry. 2007. 2007 Timber and Pulpwood Production. Office of Forestry. http://www.ldaf.state.la.us/portal/Portals/0/FOR/Reports/LaTimberAndPulpwoodProduction/OriginalReports/2007.pdf.

Louisiana Department of Environmental Quality. 2006. 2006 303(d) List of Impaired Waterbodies: Including EPA's Additions. Internet publication: http://www.deq.louisiana.gov/portal/tabid/130/Default.aspx

Louisiana Department of Environmental Quality. 2007. 2006 Water Quality Integrated Report. Louisiana Department of Environmental Quality, Water Quality Assessment Division, Water Quality Inventory Section 305(b). Baton Rouge, LA.

Louisiana Department of Environmental Quality. 2007. Ground Water Baseline Monitoring Program. Internet publication: http://www.deq.louisiana.gov/portal/default.aspx?tabid=1717.

Louisiana Department of Natural Resources. 2008. Coastal Restoration Status and Schedule Report, June 2008. http://sonlite.dnr.state.la.us/sundown/cart_prod/cart_msp_secretary_rpt.write_rpt.

Louisiana Department of Natural Resources. 2008. Louisiana Department of Natural Resources Strategic Online Natural Resources Information System *SONRIS 2000*: Coastal Restoration Division Biological Database, Data Descriptions. Coastal Restoration and Management Division. February 2008. http://dnr.louisiana.gov/crm/coastres/projectdata/DataDescriptions.pdf.

Louisiana Department of Wildlife and Fisheries (LDWF). 2005. Louisiana Department of Wildlife and Fisheries 2004-2005 Annual Report. Louisiana Department of Wildlife and Fisheries, Baton Rouge, La. 58 pp.

Louisiana Department of Wildlife and Fisheries (LDWF). 2009a. Maurepas Swamp WMA. http://www.wlf.louisiana.gov/hunting/wmas/wmas/list.cfm?wmaid=58.

Louisiana Department of Wildlife and Fisheries (LDWF). 2009b. Wildlife Management Areas and Refuges http://www.wlf.louisiana.gov/experience/wmas/

Louisiana Department of Wildlife and Fisheries (LDWF). 2009c. Scenic Rivers. http://www.wlf.louisiana.gov/experience/scenicrivers/scenicriversoverview/.

Louisiana Department of Wildlife and Fisheries (LDWF). 2010. The feral hog (*Sus scrofa*). 3 pp. http://www.wlf.louisiana.gov/pdfs/education/feral_hogs.pdf.

Louisiana Agricultural Center. 2009. website: http://www.lsuagcenter.com/MCMS/RelatedFiles/%7B1755A5C5-C928-4561-8FAEE711DBD51852%

McCay, S. K. and Fisschenich, C.J. 2009. Sensitivity Analysis of the Barataria Basin Barrier Shoreline Wetland Value Assessment (WVA) Model Prepared for the USACE

McFarlan, E. 1961. Radiocarbon dating of Late Quaternary deposits, South Louisiana. Geological Society of America Bulletin. 72:129-158.

Messina, M.G. and W.H. Conner (eds.). 1998. Southern Forested Wetlands: Ecology and Management. Lewis publishers, New York, NY.

Mishra, P.K. 2005. Sediment TMDL Calculations for Amite River. MS Thesis. Louisiana State University, Baton Rouge, LA. 103 pp.

Mitsch, W. and J. Gosselink. 2000. Wetlands, John Wiley & Sons 3rd edition. New York, New York. 722 pp.

Morton, R.A., N.A. Buster, and D. Krohn. 2002. Subsurface controls on historical subsidence rate and associated wetland loss in South-central Louisiana: Gulf Coast Association of Geological Societies Transactions 52:767-778.

Morton, R., J. Bernier, J. Barras, and N. Fernia. 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, 124 pp.

Myers, R.S., G.P. Shaffer, and D.W. Llewellyn. 1995. Baldcypress (*Taxodium distichum*) restoration in southeast Louisiana: Relative effects of herbivory, flooding, competition, and macronutrients. Wetlands, 15:141-148.

National Oceanic and Atmospheric Administration. 2009. Historical Hurricane Tracks. Coastal Services Center. http://maps.csc.noaa.gov/hurricanes/index.jsp.

National Wetlands Inventory. 2009. National Wetlands Inventory. Internet publication: www.fws.gov/wetlands.

Natural Resources Conservation Service (NRCS). 1976. Soil Survey of Ascension Parish, Louisiana. U.S. Department of Agriculture. 54 pp.

Natural Resources Conservation Service (NRCS). 1991. Soil Survey of Livingston Parish, Louisiana. U.S. Department of Agriculture. 159 pp.

Natural Resources Conservation Service (NRCS). 2010. Wetland Functions and Values Fact Sheet NRCS Website. http://www.nrcs.usda.gov/programs/farmbill/1996/FuncFact.html.

Neill, C. and L.A. Deegan. 1986. The effects of Mississippi River delta lobe development on the habitat composition and diversity of Louisiana coastal wetlands. American Midland Naturalist 116.2:296-303.

Odum, E.P. 1980. The status of three ecosystem-level hypotheses regarding salt marsh estuaries: tidal subsidy, outwelling, and detritus-based food chains. In: V. Kennedy (ed.), Estuarine Perspectives. Academic Press. New York, NY. Pp. 485-495.

Penland, S. and R. Boyd. 1981. Shoreline changes on the Louisiana barrier coast: Oceans, 81: 209-219.

Penland, S. and K.E. Ramsey. 1990. Relative sea-level rise in Louisiana and the Gulf of Mexico: 1908-1988. Journal of Coastal Research 6:323-342.

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. Louisiana Wildlife and Fisheries Commission. New Orleans, LA.

Pezeshki, S.R., W.H. Patrick, Jr., R.D. Delaune, and E.D. Moser. 1989. Effects of waterlogging and salinity interaction on *Nyssa aquatica* seedlings. Forest Ecology and Management 27:41-51.

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 and Management 33/34:287-301.

Reed, D.J. 1995. The response of coastal marshes to sea-level rise: survival or submergence? Earth surface processes and Landforms 20: 39-48.

Reed, D. 2007. Louisiana Wildlife News. 2(1). LSU AgCenter. Louisiana State University, Baton Rouge, LA.

Reid W.V. and M.C. Trexler. 1992. Responding to potential impacts of climate change on U.S. coastal biodiversity. Coastal Management 20/2:117-142.

Roberts, H.H. 1985. A study of sedimentation and subsidence in South-Central Coastal Plain of Louisiana. Final Report to the U. S. Army Corps of Engineers, New Orleans District, New Orleans, Louisiana. Pp. 53.

Roberts, H.H. 1997. Dynamic changes of the Holocene Mississippi River deltaic plain: The delta cycle. Journal of Coastal Research 3/3:605-627.

Rybczyk, J.M., J.W. Day, Jr., and W.H. Conner. 2002. The impact of wastewater effluent on accretion and decomposition in a subsiding forested wetland. Wetlands, 22, 18-32.

Saucier, R.T. 1994. Geomorphology and Quaternary Geologic History of the Lower Mississippi Valley, Volume I. USACE Special Publication. 364 pp.

Seward, N.W., K.C. VerCauteren, G.W. Witmer and R.M. Engeman. 2004. Feral swine impacts on agriculture and the environment. Sheep & Goat Research Journal 19:34-40.

Shaffer, G.P., J. Willis, S.S. Hoeppner, A.C. Parsons, and M. Hester. 2001. Characterization of Ecosystem Health of the Maurepas Swamp, Lake Pontchartrain Basin, Louisiana: Feasibility and Projected Benefits of a Freshwater Diversion. CWPPRA PPL 11.

Shaffer, G.P., T.E. Perkins, S.S. Hoeppner, S. Howell, H. Benard, and A.C. Parsons. 2003. Ecosystem Health of the Maurepas Swamp: Feasibility and Projected Benefits of a Freshwater Diversion. Final Report for the Environmental Protection Agency, Region 6.

Shaffer, G.P., P.C. Stouffer, and M.A. Pourrier. 2006. A Whole System Approach for Restoring the Wetlands of Western Lake Pontchartrain Basin. Lake Pontchartrain Basin Research Program. 2006 Annual Report. 164 pp.

Shaffer, G.P., W.B. Wood, S.S. Hoeppner, S.S. Hoeppner, T.E. Perkins, J. Zoller, and D. Kandalepas. 2009. Degradation of Baldcypress-Water Tupelo Swamp to Marsh and Open Water in Southeastern Louisiana, USA: An Irreversible

Trajectory? *Journal of Coastal Research*, SI(54), 152-165. West Palm Beach (FL), ISSN 0749-0208.

Shaffer, Gary P., Personal Communication, October 2009.

Skrobialowski, S.C. 2002. Trace Elements and Organic Compounds in Bed Sediments from Selected Streams in Southern Louisiana, 1998. National Water-Quality Assessment Program. Water-Resources Investigations Report 02-4089. Baton Rouge, LA. 39 pp.

Snedden, G.A., J.E. Cable, and W.J. Wiseman. 2007. Subtidal sea level variability in a shallow Mississippi River Deltaic estuary, Louisiana. Estuaries and Coasts 30/5: 802-812.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.

Souther, R.F. 2000. Natural regeneration of baldcypress swamp under various freshwater diversion scenarios: defining the boundaries of salinity, submergence and light. Masters Thesis. Southeastern Louisiana University, Hammond, 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(1):697-706.

Stouffer, P.C. and J.A. Zoller. 2006. Use of Lake Maurepas Wetlands by Migrating Birds. PBRP Research Highlight. http://www2.selu.edu/orgs/pbrp/redesign_documents/PBRP_RH_4.pdf

T. Baker Smith, Inc. 2008. Environmental Assessment for Proposed Bridge, Livingston Parish, Louisiana. Baton Rouge, LA. 13 pp.

Terzaghi, K. 1943. Theoretical Soil Mechanics. Wiley, New York, Pp. 510.

Thomson, D.A. 2000. The influence of hydrological alterations upon wetland hydrodynamics and plant growth on the Manchac Landbridge, Southeastern Louisiana, USA. M.S. Thesis. Southeastern Louisiana University, Hammond, LA.

Titus, J. and C. Richman. 2001. Maps of Lands Vulnerable to Sea Level Rise: Modeled Elevations along the U.S. Atlantic and Gulf Coasts. - Climate Research, CR 18:205-228.

Turner, R.E. 1979. Louisiana's fisheries and changing environmental conditions. *In*: .J.W. Day, D.D. Culley, E. Turner, and A. Mumphrey (eds.), Proceedings of the Third Coastal Marsh and Estuary Management Symposium. Center for Continuing Education, Louisiana State University. Baton Rouge, LA. Pp. 363-70.

Turner, R.E. 1990. Landscape development and coastal wetland losses in the Northern Gulf of Mexico. American Zoologist 30(1): 89-105.

URS Corporation. 2007. Final Report, Volume I of VII; Executive Summary. Mississippi River Reintroduction into Maurepas Swamp Project PO-29. March 2007.

U.S. Army Corps of Engineers. 1955. Survey of Amite River and Tributaries, Louisiana. New Orleans District, New Orleans, LA. Pp. 24.

U.S. Army Corps of Engineers. 2004. Section 1135 Preliminary Restoration Plan, Amite River Diversion Dredge material berm Gapping, State of Louisiana, Congressional District 6. New Orleans District, New Orleans, LA. Pp. 12.

U.S. Census Bureau (USCB). 2000 U.S. Census, Summary File 1 (SF1), Summary File 3 (SF3) and Summary File 4 (SF4). Accessed at http://factfinder.census.gov on 28 October 2009.

U.S. Department of Health and Human Services poverty guidelines. 2009. Accessed at http://aspe.hhs.gov/poverty/09poverty.shtml on 28 October 2009.

U.S. Environmental Protection Agency. 1995. The probability of sea level rise. EPA 230-R-95-008. U.S. Environmental Protection Agency. Washington, D.C.

U.S. Geological Survey. 1998. Carbon Storage and Late Holocene Chronostratigraphy of a Mississippi River Deltaic Marsh, St. Bernard Parish, Louisiana, First Report: Mississippi Basin Carbon Project Process Studies. Open-File Report 98-36.

U. S. Geological Survey. 2006. USGS Reports Latest Land-Water Changes for Southeastern Louisiana.

U.S. Geological Survey. 2008. National Water Information System: Web Interface. http://waterdata.usgs.gov/la/nwis/current/?type=flow.

Utah State University. 2008. Utah Climate Center. http://climate.usurf.usu.edu/.

Watson, M.B., C.J. Killebrew, M.H. Schurtz, and J.L. Landry. 1981. A Preliminary Survey of Blind River, Louisiana. In L.A. Krumholtz, ed. The Warmwater Fisheries Symposium, A National Symposium on Fisheries Aspects of Warmwater Streams. American Fisheries Society, Knoxville, TN. Pp. 303-319.

Wicker, K.M. 1980. The Mississippi Deltaic Plain habitat mapping study: U.S. Fish and Wildlife Service, Office of Biological Services, FWS/OBS 79/07, 464 maps.

Wood, Bernard. Personal Communication, October 2009.

Wood, Bernard. Unpublished data on biomass accretion and canopy loss due to degradation within the LCA ARDC study area, 2005-2009.

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 functioning together to address one or more objectives.
Amplitude	The maximum absolute value of a periodically varying quantity.
Anadromous	Species that ascend rivers from the sea to spawn.

Anoxia	Absence of oxygen.
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 found at higher elevations than swamp.
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.
Continental Shelf	The edge of the continent under gulf waters; the shallow Gulf of Mexico fringing the coast.
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.”
Diurnal	Active during the day.
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.
Engineering News Record (ENR)	A magazine that provides news needed by anyone in or from the construction industry.
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.
Federal Principals Group	A collaboration among Federal agencies at the Washington level to facilitate the flow of information, to provide guidance and recommendations to the USACE and OCPR throughout the study process, and to facilitate resolution of any interagency issues that may be identified in the conduct of the study.
Final Array	The final grouping of the most effective 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.
Furbearer	An animal whose skin is covered with fur (mammal), especially fur that is commercially valuable, such as muskrat, nutria, and mink.
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.

Ingress	An entrance or the act of entering.
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.
Leeward	Sheltered from the wind; away from the wind.
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. Levees are used in the New Orleans Hurricane Storm Damage Risk Reduction System.
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.
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.
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.
Supplemental Environmental Impact Statement (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 Gauging 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, ABBREVIATIONS, SYMBOLS, AND INITIALISMS

AAHU	Average Annual Habitat Unit
ACHP	Advisory Council on Historic Preservation
AFB	Alternative Formulation Briefing
AQI	Air Quality Index
ARDC	Amite River Diversion Canal
AR&T	Amite River and Tributaries
ASA (CW)	Assistant Secretary of the Army (for Civil Works)
AST	Aboveground Storage Tank
ASTM	American Society for Testing and Materials
ATR	Agency Technical Review
BGEPA	Bald and Golden Eagle Protection Act
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
BRP	Blind River Properties
CAR	U.S. Fish and Wildlife Service, Coordination Act Report
CE/ICA	Cost Effectiveness/Incremental Cost Analysis
CEM	Conceptual Ecological Model
CEMVN	Corps of Engineers Mississippi Valley New Orleans
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CIAP	Coastal Impact Assistance Program
CO	Carbon Monoxide
COE	Corps of Engineers
CPRA	Coastal Protection and Restoration Authority
CRMS	Coastwide Reference Monitoring System
CS	Clearing and Snagging
CSA	Cost Share Agreement
CWA	Clean Water Act

CWPPRA	Coastal Wetlands Planning, Protection, and Restoration Act
CZM	Coastal Zone Management Act of 1972
DBH	Diameter at Breast Height
DEMCO	Dixie Electric Membership Corporation
DNR	Department of Natural Resources
DO	Dissolved Oxygen
DOA	Department of the Army
DOTD	Department of Transportation and Development
DSEIS	Draft Supplement Environmental Impact Statement
DWC	Division Water Company
EATEL	East Ascension Telephone Company
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Orders
EOP	Environmental Operating Principles
EPA	Environmental Protection Agency
ER	Engineering Regulation
ESA	Endangered Species Act
ESA	Phase I Environmental Site Assessment
FCSA	Feasibility Cost Share Agreement
FMC	Fishery Management Council
FMP	Fishery Management Plan
FSWC	French Settlement Water Company
ft	Feet
FWOP	Future Without Project
FWP	Future With Project
GIS	Geographic Information System
HEC-RAS	Hydraulic Engineering Centers River Analysis
H&H	Hydraulics and Hydrology
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HSI	Habitat Suitability Index
HTRW	Hazardous, Toxic and Radioactive Waste
ICA	Incremental Cost Analysis
ISQG	Interim Sediment Quality Guidelines
ITR	Independent Technical Review
IWR	Institute for Water Resources
LA	Louisiana
LACPR	Louisiana Coastal Protection and Restoration
LCA	Louisiana Conservation Area
LCF	Louisiana Conservation Fund
LCWCR	Louisiana Coastal Wetlands Conservation and Restoration Authority
LCWCRTF	Louisiana Coastal Wetlands Conservation and Restoration Task Force

LDAF	Louisiana Department of Agriculture and Forestry
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
LDWF	Louisiana Department of Wildlife and Fisheries
LERRD	Lands, Easements, Right-of-Way, Relocation, and Disposal Areas
LNHP	Louisiana National Heritage Program
m	Meters
MBTA	Migratory Bird Treaty Act
MCACES	Micro-Computer Aided Cost Engineering System
mm	Millimeter
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MR&T	Mississippi River and Tributaries
MRC	Mississippi River Commission
MSA	Metropolitan Statistical Area
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
msl	Mean Sea Level
MVD	U.S. Army Corps of Engineers, Mississippi Valley Division
MVN	U.S. Army Corps of Engineers, Mississippi Valley Division, New Orleans District
NAAQS	National Ambient Air Quality Standards
NAVD	North American Vertical Datum
NBEM	National Bald Eagle Management Guidelines
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NERP	National Ecosystem Restoration Act
NGO	Non-governmental Organization
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollution Discharge Elimination System
NRC	National Resource Council
NRCS	National Resources Conservation Service
NWI	National Wetlands Inventory
OCPR	Office of Coastal Protection and Restoration
OCS	Outer Continental Shelf
OMRR&R	Operations, Maintenance, Repair, Replacement, and Rehabilitation
ONWR	Outstanding Natural Resource Water
OSHA	Occupational Safety and Health Administration

Pb	Lead
P&G	Principles and Guidelines
PCR	Primary Contact Recreation
PDT	Project Delivery Team
PED	Planning, Engineering, and Design
PGM	Planning Guidance Memo
Pm	Particulate Matter
PMP	Project Management Plan
PPA	Project Partnership Agreement
PPL	Priority Project List
POR	Period of Record
PRP	Preliminary Restoration Plan
ppt	Parts per Thousand
QCP	Quality Control Plan
RCRA	Resource Conservation and Recovery Act
RCRAGN	Resource Conservation and Recovery Act Generator
RCRATSD	Resource Conservation and Recovery Act Treatment, Storage, and Disposal
REC	Recognized Environmental Condition
REP	Real Estate Plan
ROD	Record of Decision
ROE	Rights-of-Entry
RSLR	Relative Sea level Rise
RV	Recreational Vehicle
S&A	Supervision and Administration
SAV	Submerged Aquatic Vegetation
SCR	Secondary Contact Recreation
SEIS	Supplemental Environmental Impact Statement
SET	Surface Elevation Table
SHPO	State Historic Preservation Office
SONRIS	Strategic Online Natural Resources Information System
SOP	Standard Operating Procedure
SPCC	Spill Prevention Control and Countermeasure Plan
S&T	Science and Technology
SWPPP	Storm Water Pollution Prevention Plan
TDS	Total Dissolved Solids
THPO	Tribal Historic Preservation Officer
TM	Landsat Thematic Mapper
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TOD	Tract Ownership Data
TRI	Toxic Release Inventory
TSP	Tentatively Selected Plan
TSS	Total Suspended Solids

um	Micrometers
USDA	United States Department of Agriculture
USACE	U.S. Army Corps of Engineers
USACE-MVM	U.S. Army Corps of Engineers-Mississippi Valley Memphis District
USACE-MVN	U.S. Army Corps of Engineers-Mississippi Valley New Orleans District
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	Underground Storage Tank
VE	Value Engineering
VOC	Volatile Organic Compound
VRAP	Visual Resources Assessment Procedure
WBS	Work Breakdown Structure
WC	Weir Construction
WCRF	Wetland Conservation and Restoration Fund
WR	Weir Rehabilitation
WCRA	Wetland Conservation and Restoration Authority
WRDA	Water Resources Development Act
WMA	Wildlife Management Area
WVA	Wetland Value Assessment
yr	Year

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MAIN REPORT

ATTACHMENT 1

Non-Federal Sponsor's Letter of Intent

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.

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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