SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

ENVIRONMENTAL

SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
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Environmental Report

***Note**: these documents, associated analyses and coordination will be completed during the feasibility-level analysis phase of this study which will occur following release of the Draft Environmental Impact Statement, and will be included in the Final Environmental Impact Statement.

INTRODUCTION

The low elevation and proximity to the Gulf of Mexico put the unique environment and cultural heritage of southwest Louisiana communities at risk from storm surge flooding and coastal erosion. Land subsidence and rising sea level is expected to increase the potential for coastal flooding, shore erosion, saltwater intrusion, and loss of wetlands and chenier habitats.

Purpose of Action and Scope

The study purpose is to evaluate coastal storm flood damages and coastal ecosystem degradation in Cameron, Calcasieu, and Vermilion parishes in Louisiana. The intent is to develop potential solutions to these water resource problems. This is an interim response to the study authority. The impacts described here are programmatic in nature. Subsequent NEPA documents will analyze in detail site specific project(s) impacts prior to implementation.

Federal Objectives

The Federal objective of water and related land resources planning is to provide the greatest net contribution to national economic development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. The ecosystem objective is to contribute to national ecosystem restoration (NER) by restoring function and structure to significant ecological resources

Need for Action

The processes of sea level rise, subsidence, saltwater intrusion, and erosion of wetlands in southwest coastal Louisiana have caused significant adverse impacts, including increased rates of wetland loss and ecosystem degradation. Without action, this highly productive coastal ecosystem, composed of diverse habitats and wildlife, is not sustainable. Infrastructure constructed for access into and across the wetlands has modified the hydrology of the coastal zone, thus facilitating and accelerating saltwater intrusion and fragmentation, and conversion of wetlands to open water. Hurricane surge has formed ponds in stable, contiguous marsh areas and expanded existing, small ponds, as well as removed material in degrading marshes (Barras, 2009). Fresh and intermediate marshes appear to be more susceptible to surge impacts, as observed in Barras (2006).

Land loss and ecosystem degradation threaten the continued productivity of the area's ecosystems, the economic viability of its industries, and the safety of its residents. The following valuable social and economic resources are at risk:

- Commercial harvest of fishery resources
- Rice, crawfish, and cattle farming
- Recreational saltwater and freshwater fisheries
- Ecotourism
- Oil and gas production
- Petrochemical industries
- Strategic petroleum reserve storage sites
- Storm damage risk reduction, including hurricane storm buffers
- Navigation corridors and port facilities for commerce and national defense, and
- Actual and intangible value of land passed down through generations.

During the NEPA scoping process, stakeholders noted the following problems related to saltwater intrusion:

- As the Calcasieu Ship Channel widens and deepens, salinity levels increase after storm surge events and farmers have greater difficulty operating their rice farms.
- In the 2006 growing season, farmers were unable to plant because of high salinity levels caused by Hurricane Rita which overtopped local levees built in the 1940s or early 1950s.
- As a result of salinity encroachment in Calcasieu Lake, the Sabine Refuge is now a large open water area.
- Saltwater intrusion is occurring in the Calcasieu and Mermentau Basins and is in turn negatively impacting the seafood industry. Ship channels in the Calcasieu and Sabine Rivers are allowing saltwater movement into the upper estuaries.

During the past 11 years, the area has been greatly impacted by storm surges associated with three Category 2 or higher hurricanes -- Lili, Rita, and Ike -- which inundated structures and resulted in billions of dollars in damages to southwest coastal Louisiana. Hurricane surge also causes significant damage to wetlands. The breakup of marshes surrounding the towns and communities is allowing storm surge and inundation to more directly impact habitable areas. As a consequence, smaller storms are able to inflict significant flooding damages to residential and non-residential structures. As the coastal ecosystem continues to fragment, flooding losses are expected to increase, thus placing larger populations at risk.

1.0 Affected Environment

Study Area

The Study area (Figure 1-1) is located in southwest Louisiana and includes all of Calcasieu, Cameron and Vermilion parishes and small portions of Beauregard, Jefferson Davis and Iberia parishes encompassing approximately 4,700 square miles.

Cameron Parish is located in the southwest corner of Louisiana. The southern boundary of the parish is the Gulf of Mexico. Eighty-two percent of Cameron Parish are coastal marshes. Geographically, it is one of the largest parishes in Louisiana. The parish is chiefly rural and the largest communities are Cameron and Hackberry. Cameron is located along LA Hwy 82, while Hackberry is located along LA Hwy 27. Other smaller communities include Creole, Johnsons Bayou, and Holly Beach.

Calcasieu Parish is located due north of Cameron Parish. The town of Lake Charles is the parish seat, which is the largest urban area in the study area. Only a small portion of the parish is located in the coastal zone.

Vermilion Parish is located due east of Cameron Parish. The southern boundary of the parish is the Gulf of Mexico. Large expanses of Vermilion Parish area open water (lakes, bays, and streams). Approximately 50 percent of the land is coastal marshes. The parish is chiefly rural and the town of Abbeville is the parish seat as well as the largest urban area in the parish. Other communities include Delcambre, Kaplan, and Gueydan, which are all located along LA Hwy 14 in the northern part of the study area. Pecan Island and Forked Island are smaller communities, both located along LA Hwy 82 in lower Vermilion Parish. Located along LA Hwy 333, Intracoastal City is the nearest access to Vermilion Bay and the Gulf of Mexico in this region and supports the area's oil and shrimp industries

Geomorphic and Physiographic Setting

The study area occupies a portion of the Pleistocene Prairie Terrace (or Prairie Complex) on the northern edge of Cameron, the northern half of Vermilion, as well as the majority of Calcasieu Parishes, and most of the Marginal Plain (or Chenier Plain) on the far southern portions of Calcasieu, most of Cameron and southern half of Vermilion Parishes. The main physiographic zones of the Chenier Plain include the Gulf Coast Marsh, Gulf Coast Prairies, and Forested Terraced Uplands. The Gulf Coast Marsh is at or near sea level and borders the Gulf of Mexico and most of the large lakes in the area. The Gulf Coast Prairie extends from the central part of Vermilion and Cameron Parishes into the southern part of Calcasieu Parish, while the Forested Uplands, which occur at or near 25-foot elevation, are located in the northern part of Vermilion and Calcasieu Parishes. Louisiana's coastal prairies, once encompassing an estimated 2.5 million acres in the Southwest portion of the state, now are considered critically imperiled with less than 600 acres remaining.

The study area formed over the past 7,000 years by the deltaic processes of the Mississippi River and other streams. Fine-grained sediment transported to the Chenier Plain in the mud stream from the Mississippi River was brought into coastal estuaries and marshes and deposited along the shore to form mudflats (Gagliano and van Beek, 1993). The newly formed land was then colonized by wetland vegetation, which further promoted the land-building process. Wave action and occasional storm events also deposited sand and shells onto the newly built land. As the Mississippi River changed course and active delta-building switched to the eastern Deltaic Plain, or extended to the edge of the continental shelf or beyond (current course), the mud stream ceased to carry sediment to the Chenier Plain and the Gulf shore became subject to erosion. Periods of erosion winnowed out fine-grained materials, leaving the deposits of sand and shell to form the Gulf beaches, examples of such in the area are Holly and Rutherford Beaches. Beach deposits were subsequently shaped by waves and coastal currents to form elevated ridge systems. Once the mud stream returned and land-building continued seaward, these elevated ridges or cheniers (forests atop relict beach ridges) were stranded inland where deciduous vegetative growth (e.g., live oak trees) occurred. Example of cheniers in the area include Hackberry, Little Chenier, Grand Chenier, Pecan Island and Cheniere au Tigre ridges to name just a few. These ridges and cheniers blocked drainage and saltwater inflows from the Gulf of Mexico, resulting in the development of large freshwater basins on the landward side of the ridges. Chenier ridges run laterally to the modern shoreline and rise above the surrounding marshes by as little as a few inches or as much as 10 feet (Byrne et al 1959). These ridges can range from two to 15 feet thick and from 100 to 1,500 feet wide with some ridges extending along the coast for a distance of up to 30 miles. On the seaward side of the cheniers, a zone of brackish to saline marshes developed as a result of tidal influences from the Gulf (adapted from Visser et al. (2000), USACE (2004), and LADNR (2009)).

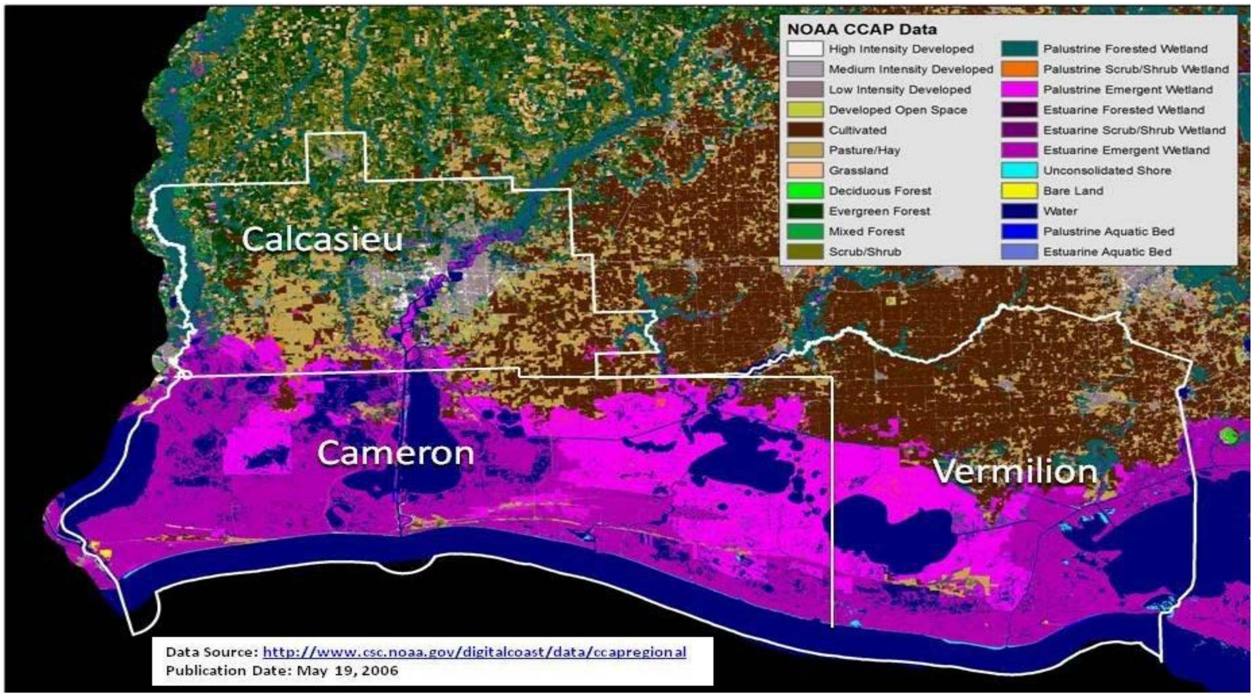

Figure 1-1 Study Area.

Climate

The climate is subtropical marine with long humid summers and short moderate winters. The average temperatures range from 59 to 78°F; with August being the warmest and December the coolest. Average annual rainfall is 57 inches; with June the wettest and April the driest month (Source: http://www.srh.noaa.gov/lch/?n=KLCH, accessed August 30, 2013). During the summer, prevailing southerly winds produce conditions favorable for afternoon thundershowers. In the colder seasons, the area is subjected to frontal movements that produce squalls and sudden temperature drops. River fogs are prevalent in the winter and spring when the temperature of the major waterbodies are somewhat colder than the air temperature. Since 1865 a total of 16 hurricanes have made landfall within 65 nautical miles of Lake Charles (source:http://csc.noaa.gov/hurricanes/#app=6078&7239-selectedIndex=0&3722-selectedIndex=0, accessed August 30, 2013).

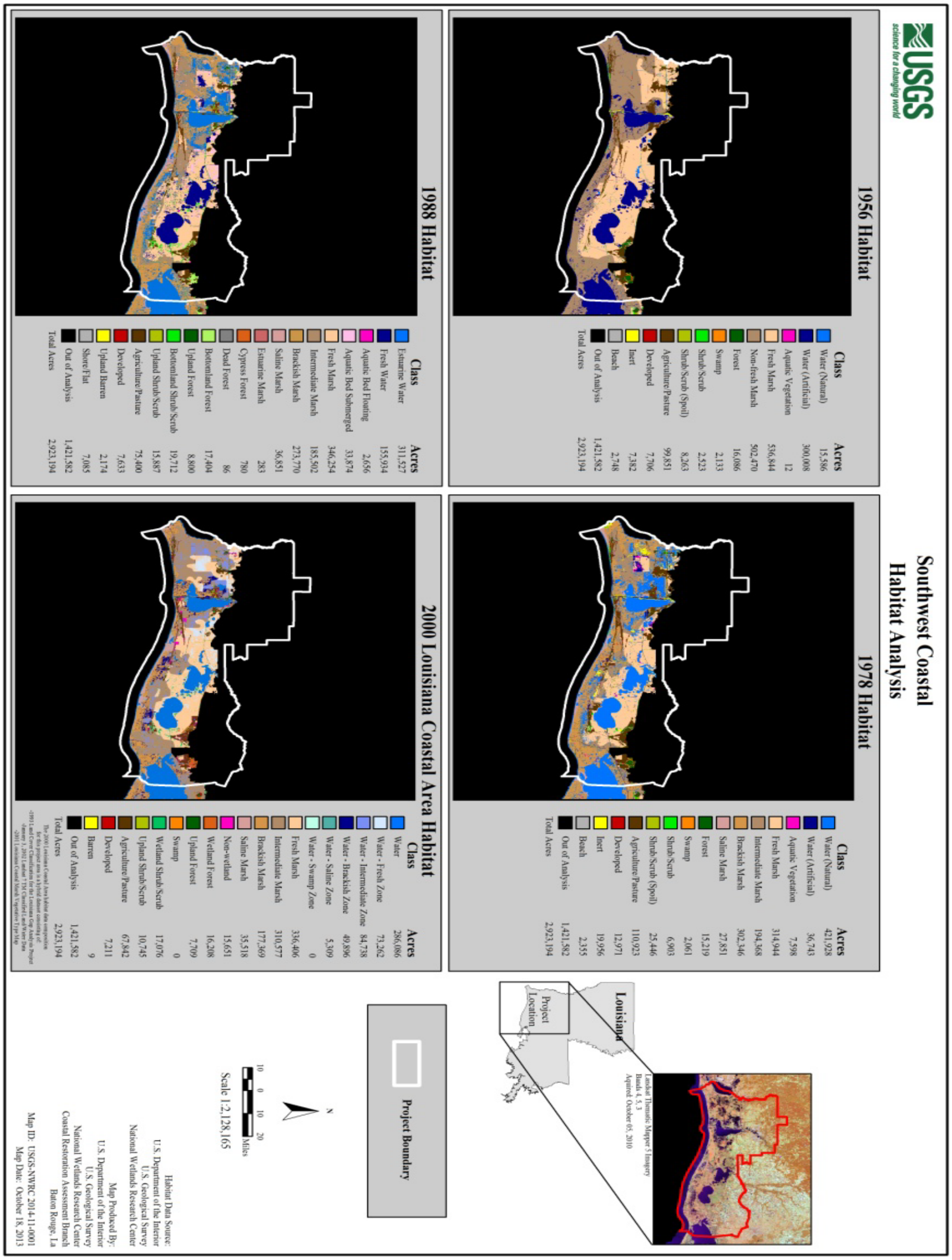

Figure 1-2. Land class (habitat) changes between 1978-2000 (source: USGS 2013).

Table 1-1. Year 2000 Area habitat classification

Habitat Class	Acres	Percent of Project Area
Water	286,086	9.79%
Water - Fresh Zone	73,262	2.51%
Water - Intermediate Zone	84,736	2.90%
Water - Brackish Zone	49,896	1.71%
Water - Saline Zone	5,309	0.18%
Water - Swamp Zone	0	0.00%
Fresh Marsh	336,406	11.51%
Intermediate Marsh	310,577	10.62%
Brackish Marsh	177,369	6.07%
Saline Marsh	35,518	1.22%
Non-wetlands	15,651	0.54%
Wetland Forest	16,208	0.55%
Upland Forest	7,709	0.26%
Swamp	0	0.00%
Wetland Shrub/Scrub	17,076	0.58%
Upland Shrub/Scrub	10,745	0.37%
Agriculture/Pasture	67,842	2.32%
Developed	7,211	0.25%
Barren	9	0.00%
*Out of Analysis	1,421,582	48.63%
Total Acres	2,923,194	

*Out of analysis—this area, primarily north of the Coastal Zone, was not included in the original data set from which the data is derived.
(source: USGS Map ID USGS-NWRC 2014-11-0001 Map Date: October 18, 2013.)

1.2 Human Environment

Communities include the cities of Lake Charles and Sulphur; the towns of Vinton and Iowa in Calcasieu Parish, Cameron, Grand Lake, Hackberry, and Grand Chenier in Cameron Parish; and the city of Abbeville, the towns of Erath, Kaplan, and Pecan Island in Vermilion Parish, and the town of Delcambre in Vermilion and Iberia parishes. These parishes have historically suffered extensive damage from hurricanes and tropical storms due to insufficient hurricane and storm damage risk reduction features. The impact of preparing for, mitigating, and recovering from these damages has placed a significant physical and emotional burden on both individuals and communities. Most recently, Hurricanes Rita (2005) and Ike (2008) caused significant damage to homes and businesses. In this section, socioeconomic and other social effects (OSE) data for Calcasieu, Cameron, and Vermilion Parishes provide a context from which to evaluate potential effects of the proposed action.

1.2.1 Population and Housing

Table 1-3 shows the population trend in the three-parish area from 1970 to 2012. Population increases between 2000 and 2010 reflect similar growth patterns state-wide over this period. Population in the three-parish area in 2012 was 259,918, although there was a decline of population in Cameron Parish from 2000 to 2012.

Table 1-3 Population

PARISH	1970	1980	1990	2000	2010	2012
Calcasieu	145,415	167,223	168,134	183,577	192,768	194,493
Cameron	8,194	9,336	9,260	9,991	6,839	6,702
Vermilion	43,071	28,458	50,055	54,014	57,999	58,723
Total	196,680	205,017	227,449	247,582	257,606	259,918

Sources: U. S. Census, 2010 and U.S. Census Abstract, 2013)

The trend in household formation, shown in Table 1-4, parallels the growth in population. Most households are located in the metropolitan areas which include: Lake Charles in Calcasieu Parish; Cameron (which serves as the seat of government in Cameron Parish; and Abbeville located in Vermilion Parish.

Table 1-4 Households (in thousands)

PARISH	1970	1980	1990	2000	2010	2012
Calcasieu	42.1	56.8	60.4	68.6	70.6	72.2
Cameron	2.3	3.0	3.1	3.6	2.5	2.4
Vermilion	12.8	16.3	17.7	19.9	21.1	21.6
Total	57.2	76.1	81.3	92.1	94.2	96.2

Sources: U. S. Census, 2010 and U.S. Census Abstract, 2013)

According to the Federal Emergency Management Agency, flood claims from all sources for the three-parish area between 1978 and 2012 totaled $420,900,000. See Table 1-5.

Table 1-5 Summary of Flood Claims Data for the Period 1978 to 2012

PARISH	CLAIMS	TOTAL NOMINAL DOLLAR AMOUNT (IN MILLIONS)	AVERAGE AMOUNT PER CLAIM
Calcasieu	4,008	$132.0	$32,930
Cameron	3,061	173.5	56,679
Vermilion	3,218	115.4	35,860
Total	7,712	420.9	54,574

Source: FEMA 2013

1.2.2 Employment, Business, and Industrial Activity

Table 1-6 shows the growth of non-farm employment in the three-parish area. The leading employment sectors are education, healthcare, petroleum production, and petrochemical refining. Other significant employment sectors include education, manufacturing, accommodations and social services, and retail trade. Employment growth was steady from 1970 to 2012 for Calcasieu and Vermilion parishes, although employment in Cameron parish declined since 2000, and is reflected in the population estimates previously described.

Table 1-6 Non-Farm Employment (in thousands)

PARISH	1970	1980	1990	2000	2010	2012

Calcasieu	41.1	67.0	69.0	84.6	87.9	93.3
Cameron	2.8	4.4	4.1	3.9	2.6	2.7
Vermilion	9.4	16.6	13.3	14.7	15.5	16.9
Total	53.3	88.0	86.4	103.2	106.0	112.8

Source: Moody's, 2013

Table 1-7 displays the percentage breakdown of non-farm employment by industry for each parish in the study area.

Table 1-7
Non-Farm Employment by Industry (2010)

Industry	Calcasieu	Cameron	Vermilion
Forestry, fishing, and related activities	0%	6%	3%
Mining	1%	6%	7%
Utilities	0%	X	0%
Construction	9%	7%	8%
Manufacturing	8%	10%	6%
Wholesale trade	2%	8%	3%
Retail trade	11%	X	13%
Transportation and warehousing	3%	11%	3%
Information	1%	X	1%
Finance and insurance	3%	X	4%
Real estate and rental and leasing	3%	X	4%
Professional, scientific, and technical services	5%	X	3%
Management of companies and enterprises	1%	X	0%
Administrative and waste management services	5%	3%	3%
Educational services	1%	1%	X
Health care and social assistance	12%	3%	X
Arts, entertainment, and recreation	2%	X	1%
Accommodation and food services	10%	X	5%
Other services, except public administration	6%	4%	9%
Federal, civilian	1%	1%	1%
Military	1%	1%	1%
State government	3%	2%	1%
Local government	10%	19%	14%

Source: Bureau of Economic Analysis (BEA)
An "X" denotes that data is not available for an entry.

Approximately 32% of the land area is used for agriculture. The major crops grown in the area are rice, soybeans, sugarcane, and sorghum. Pecans are also a major crop in Cameron Parish. According to the 2007 Census of Agriculture, the total stock of crops in the area is valued at over $62 million, with Vermillion Parish accounting for 80% of the total crop value.

1.2.3 Public Facilities and Services

Public facilities and services have historically grown to meet population demands. The area includes a mixture of community centers, schools, hospitals, airports, colleges, and fire protection. The Port of Lake Charles is a key center for international trade, and is among the top 15 busiest port in the nation. A total of 603 public and quasi-public buildings were specifically inventoried in the three-parish area in 2012

1.2.4 Transportation

The transportation infrastructure includes major roads, highways, railroads, and navigable waterways that have developed historically to meet the needs of the public. Interstate 10 (I-10), an east-west bi-coastal thoroughfare that connects Houston and Baton Rouge, crosses the northern part of the area and is a primary route for hurricane evacuation and post-storm emergency response. US-165, another evacuation and emergency response route , is located north of I-10. Most of I-10 is either at or just below the 100-year floodplain. Other major highways include US-13 and US-26, which runs north-south and intersects I-10 in the northeastern portion of the parishes.

Other modes of transportation include water transport along the GIWW and the Sabine and Calcasieu Rivers, all of which accommodate ocean-going vessel and barge traffic. Rail and aviation facilities are spread throughout.

During Hurricanes Rita and Ike, portions of I-10 were inundated by a combination of storm surge and rainfall. This interfered with emergency service access and prevented local and regional residents from returning to their primary residences and businesses. This delay in repopulation results in additional emergency costs, due to the longer time periods required for sheltering residents until the area was made safe to return.

1.2.5 Navigation Projects

Navigational channels in the Chenier Plain influence hydrology, primarily by increasing marine influences (saltwater intrusion, wave energies) into freshwater and other interior marshes (LCA, 2004).The following navigation waterways are in the vicinity of the Southwest Coastal Louisiana feasibility study area:

- Gulf Intracoastal Waterway (GIWW)
- Sabine-Neches Waterway
- Calcasieu River and Pass, LA
- Mermentau River, LA
- Freshwater Bayou, LA
- Bayou Teche and Vermilion River, LA

1.2.5.1 Gulf Intracoastal Waterway

The Gulf Intracoastal Waterway (GIWW) traces the U.S. coast along the Gulf of Mexico from Apalachee Bay near St. Marks, FL to Brownsville, TX, near the Mexico border. It intersects the Mississippi River and extends eastward for approximately 376 miles and west-southwestward for approximately 690 miles. In the study area, the approximate distances between major crossings are as follows:

- o Atchafalaya River to Vermilion River, 64 miles;

- Vermilion River to Mermentau River, 43 miles;
- Mermentau River to Calcasieu River, 37 miles;
- Calcasieu River to Sabine River, 27 miles.

In addition to its main stem, the GIWW includes a major alternative route (64 miles) which connects Morgan City, LA to Port Allen, LA. Project dimensions for the main stem channel and the alternative route are 12 ft deep and 125 ft wide, except for the reach between the Mississippi River and Mobile Bay, which is 150 ft wide. Today, parts of the GIWW are deeper and wider than the original construction dimensions.

The GIWW was first authorized and construction began in the 1920s. The project was authorized by the River and Harbor Act of July 24, 1946, Senate Document 242, 79th Congress, 2nd Session, and prior River and Harbor Acts. The primary purpose of the inland navigation channel is transportation of goods by barge. Numerous side channels and tributaries intersect both the eastern and western main stem channel, providing access to inland areas, coastal harbors, and the Gulf of Mexico. The USACE operates the Leland Bowman Lock located on the GIWW. The lock helps to regulate the flow of water in the Mermentau Basin and keeps salt water out of the fresh water supply that serves the farming communities further north, while allowing barge transportation.

1.2.5.2 Sabine-Neches Waterway and Sabine Pass Ship Channel

The Sabine-Neches Waterway is an approximately 64-mile federally authorized and maintained waterway located in Jefferson and Orange Counties in southeast Texas and Cameron Parish, Louisiana. The Sabine Pass, Sabine Lake, and Sabine River together form part of the boundary between the states of Texas and Louisiana. The Sabine-Neches main channel dimensions are currently 40 feet deep and 400 feet wide. The existing waterway consists of a jettied entrance channel, 42 feet deep and 500 to 800 feet wide, from the Gulf of Mexico; a channel 40 feet deep and 400 feet wide to Beaumont via the Neches River; and a channel 30 feet deep and 200 feet wide to Orange via the Sabine River.

The Sabine-Neches Project was authorized by the River and Harbor Act of 1962, House Document No. 553, 87th Congress, 2nd Session. The Sabine-Neches Waterway and the Sabine Pass Ship Channel serve the ports of Port Arthur, Beaumont, and Orange, Texas in the movement of commodities, particularly crude petroleum.

The USACE Galveston District is currently investigating navigation improvements on the Sabine-Neches Waterway. A draft report has been circulated for public review which tentatively recommends a channel modification to a depth of 48 feet. The project modification process is described in more detail in the chapter on Existing and Future Without Project Conditions.

1.2.5.3 Calcasieu River and Pass

The Calcasieu River is a 68-mile, deep-draft navigation channel. The northern boundary of the ship channel is located at Mile 36.0, just south of Interstate 10 in Lake Charles, LA. The southern boundary extends to Mile (-32.0) in the Gulf of Mexico.

The project was authorized under the River & Harbor Act of July 14, 1960 House Document 436, 86th Congress, 2nd Session (USACE). The purpose of this project is to provide deep-draft access to the Port of Lake Charles, the 12th largest port in the U.S. based on tonnage. The project also provides for a Saltwater Barrier Structure located north of Lake Charles, approximately 3 miles north of the northern boundary of the deep-draft ship channel.

1.2.5.4 Mermentau River

The Mermentau River navigation channel is a 4.6-mile channel beginning at the point of entry of the Mermentau River into Lower Mud Lake and extends in a southerly direction to the Gulf of Mexico.

The project includes two salinity control structures: the Catfish Point Control Structure located at Mile 24 of the Mermentau River, and the Schooner Bayou Control Structure located in the enlarged White Bay to Vermilion Bay channel, approximately 5 miles southwest of Intracoastal City. The Catfish Point and Schooner Bayou Control Structures reduce saltwater intrusion into the Mermentau Basin, which consists of hundreds of thousands of acres of rice and crawfish farms that are dependent on freshwater.

The project is authorized by the Flood Control Act of August 18, 1941, as modified by the River and Harbor Act of July 24, 1946. The Act provides for enlargement of the lower Mermentau River below Grand Lake to a minimum cross-sectional area of 3,000 sq ft below Mean Low Gulf (MLG) for discharge of flows. It also provides for channel enlargement and realignment of the Inland Waterway from Vermilion Bay to Grand Lake to provide a minimum cross-sectional area of 3,000 sq ft below MLG for discharge of flood flows and interflow between lakes.

This project also provides for the enlargement of the North Prong of Schooner Bayou and Schooner Bayou Cutoff to a channel -6 ft MLG by 60 ft. It also provides for a sector gated control structure at Catfish Point, Mile 24 of the Mermentau River, and Schooner Bayou Lock on Schooner Bayou. The Act further provides for incorporation of the existing projects: "Waterway from White Lake to Pecan Island, LA" and the portion of "Inland Waterway from Franklin, LA to the Mermentau River" west of Vermilion Bay. The waterway from "Inland Waterway from White Lake to Pecan Island, LA" consists of a channel -5 ft MLG by 40 ft.

1.2.5.5 Freshwater Bayou and Freshwater Bayou Lock

Freshwater Bayou is a 23.1-mile navigation channel that serves as the hydrologic boundary between the Mermentau Basin to the west and the Teche-Vermilion Basin to the east. The canal extends from the northern boundary at Mile 161.2 of the Gulf Intracoastal Waterway (GIWW), at Intracoastal City west of the Harvey Lock, to the 12-ft depth contour in the Gulf of Mexico.

A lock is located at the Gulf of Mexico to aid in reducing saltwater intrusion into interior wetlands along the canal. Between 1979 and 1986, approximately 300,000 tons of cargo was transported along Freshwater Bayou Canal, mostly in oil and gas service and supply vessels and commercial fishing boats (USACE, 1989).

The project was authorized under the River and Harbor Act of July 14, 1960 (USACE Project Fact Sheet) and constructed between 1965 and 1967. The purpose of this project is to provide deep-draft vessels access between the Gulf of Mexico and Intracoastal City, Abbeville Harbor and Terminal District, and the GIWW.

1.2.5.6 Bayou Teche and Vermilion River, LA

The Vermilion River is a 131.8-mile navigable channel that flows from the 8-foot (ft) contour in Vermilion Bay to the head of navigation at Mile 52 at Lafayette, LA. There is a flood control project from Lafayette to Port Barre, LA, as well as in Bayou Teche from 2 miles below Arnaudville to Port Barre (USACE Project Fact Sheet).

The project was authorized by the Flood Control Act of August 18, 1941 (USACE Project Fact Sheet). The purpose of this project is to provide a shallow-draft navigation channel to Lafayette and improve flood control from Port Barre to the Vermilion River via Bayou Teche, Bayou Fusilier, and the Vermilion River.

1.2.5.7 Operations and Maintenance Dredging of Navigation Channels

O&M dredging of navigation channels can provide a source of materials for ecosystem restoration projects. For example, the Calcasieu Dredge Material Management Plan estimates that over 6,000 acres could be created over the next 20 years from the Calcasieu River.

In general O&M Ops dredge material management plans must be “environmentally acceptable;” however, that does not necessarily mean that the material will be used beneficially. In the future, if the BUDMAT program is authorized and funded, it could provide a source of funding for beneficial use of dredged material. Funds for construction have been authorized, but until the Record of Decision (ROD) is signed, the USACE cannot proceed with construction. Of the nine authorized Federal navigation channels that represent the most significant opportunities for additional beneficial use of dredged material in coastal Louisiana, three are located in the Southwest Coastal area--Calcasieu River and Pass, Mermentau River, and Freshwater Bayou.

CHANNEL / REACH	AVG QUANTITY/ EVENT (cu. yd)	AVG. ANNUAL QUANTITY (cu. yd)	FREQUENCY OF DREDGING	FEDERAL STANDARD (% USED BENEFICIALLY)
Freshwater Bayou - Lock to Gulf	1,057,000	352,333	2 to 4 yrs	100
Freshwater Bayou - inland	2,000,000	133,333	every 15 yrs	n/a
Total	3,057,000	485,666		

Mermentau River - bar & inland	1,264,000	632,000	1 to 3 yrs	100
Total*	1,264,000	632,000		
Calcasieu - Mile 5 to 14	3,615,000	1,446,000	2 to 3 yrs	0
Calcasieu - Mile 14 to 24.5	5,250,000	2,100,000	2 to 3 yrs	0
Calcasieu - Mile 28 to 36	1,334,000	242,545	3 to 8 yrs	0
Calcasieu - bar	7,547,000	7,547,000	annually	10
Total	17,746,000	11,335,545		
Grand Total	22,067,000	12,453,211		

Note: Based on New Orleans District data from years 1996 through 2007. Extracted from BUDMAT Table 2-6. New Orleans District (CEMVN) Primary Navigation Channels

* The Mermentau River project includes dredging of the Mermentau River from Highway 82 out to the Gulf of Mexico (and also includes Schooner Bayou and Catfish Point Control Structures). The USACE typically dredges Mermentau from Hwy 82 to the Gulf (approx 6 mile reach) every 2 to 4 years. Most recent dredging took place after Gustav/Ike. However, in light of O&M funding being decreased and low use waterways being funded 50% of their average annual funding, USACE may not dredge the Mermentau again anytime soon. Mermentau falls under the classification of a "low use" waterway (communication with Tracy Falk, USACE Operations Manager for Mermentau).

1.2.6 Community and Regional Growth (Income)

Community and regional growth primarily track population and employment trends that were described in the preceding sections. Table 1-8 shows per capita growth in income since 2000.

Table 1-8 Per Capita Income

Parish	1990	2000	2010	2012
Calcasieu	$15,489	$22,528	$37,403	$40,892
Cameron	$13,011	$17,935	$31,136	$35,068
Vermilion	$29,729	$18,669	$28,274	$29,729

1.2.7 Tax Revenue and Property Values

Historically, damages from storm surge events have adversely impacted business and industrial activity, agricultural activity, and local employment and income, which then led to commensurate negative impacts to property values and the tax base upon which government revenues rely. As in other developed communities, the presence of high flood risk has reduced property values since the cost of repairing flood damages (whether directly by property owners or through claims made through the National Flood Insurance Program (NFIP) for which annual premiums are charged) increases the long-term cost of property ownership. Measurement of this loss is problematic since the market price of properties capture an extensive array of factors such that the contribution of flood risk cannot be directly ascertained.

Information for 46,860 residential and 4,997 non-residential structures was collected to assist in evaluating the impacts of flood risk under existing and future conditions. Currently, the median depreciated replacement value of housing units for the three-parish study area is $115,684 in 2012 price prices.

1.2.8 Community Cohesion

Community cohesion is based on the characteristics that keep the members of the group together long enough to establish meaningful interactions, common institutions, and agreed upon ways of behavior. These characteristics include race, education, income, ethnicity, religion, language, and mutual economic and social benefits. The area is comprised of communities with a long history and long-established public and social institutions including places of worship, schools, and community associations.

In 2005 with Hurricane Rita, and again in 2008 with Hurricane Ike, communities in Calcasieu, Cameron, and Vermilion Parishes were inundated by storm surge. In the absence of flood risk reduction measures, local populations were temporarily forced to evacuate and relocate for a significant period, thereby disrupting community cohesion.

1.2.9 Other Social Effects (OSE)

The Hazards and Vulnerability Research Institute at the University of South Carolina created an index that compares the social vulnerability of U.S. counties/parishes to environmental hazards. The variables included in the index are based on previous research which has found that certain characteristics (e.g., poverty, racial/ethnic composition, educational attainment, and proportion over the age of 65) contribute to a community's vulnerability when exposed to hazards. According to the IWR OSE handbook (USACE, 2008), the Social Vulnerability Index (SoVI®)[1] is a valuable tool that can be used in the planning process to identify areas that are socially vulnerable and whose residents may be less able to withstand adverse impacts from hazards.
The SoVI® was computed as a comparative measure of social vulnerability for all counties/parishes in the U.S., with higher scores indicating more social vulnerability than lower scores. Calcasieu Parish has a SoVI® 2006-10 score[2] of -1.21 (0.28 national percentile), Cameron Parish has a SoVI® 2006-10 score of -3.59 (.08 national percentile), and Vermilion Parish has a SoVI® 2006-10 score of -0.04 (0.49 national percentile). Calcasieu Parish is less socially vulnerable than roughly 28 percent of counties/parishes in the U.S., Cameron Parish is less socially vulnerable than about 8 percent of counties/parishes in the U.S., and Vermilion Parish is less socially vulnerable than roughly 49 percent of counties/parishes in the U.S. In comparison, Orleans Parish—notorious for its enduring levels of high poverty—has a SoVI® 2005-09 score of -0.92 with 67 percent of counties/parishes in the nation ranked more socially vulnerable.

Hence, Cameron Parish is the most socially vulnerable to coastal storm damage consequences, Calcasieu Parish is the next most socially vulnerable, and Vermilion Parish is the least socially vulnerable. In comparison, both Cameron and Calcasieu Parishes are more socially vulnerable to coastal storm damage consequences than Orleans Parish.

1.2.10 Environmental Justice

The EJ study area contains all Census Tracts and Census block groups located within Calcasieu, Cameron, and Vermilion parishes. .

[1] More information on the methodology and data used to calculate the SoVI® can be found here: http://webra.cas.sc.edu/hvri/products/sovi.aspx
[2] Data can be found here: http://webra.cas.sc.edu/hvri/products/sovi2010_data.aspx

High poverty rates negatively impact the social welfare of residents and undermine the community's ability to provide assistance to residents in times of need. Table 1-9 shows the racial characteristics of the three parishes according to the 2010 U.S. Census. The 2007-2011 American Community Survey (ACS) data indicate that 17 percent of households in Calcasieu Parish, 9 percent in Cameron Parish, and 18 percent in Vermilion Parish fell below the poverty line (figure 1-3). The 2007-2011 Census American Community Survey data indicate that there are:

- 34 poverty areas and 15 extreme poverty areas (block groups) in Calcasieu Parish (all areas are located in the urban center of Lake Charles)
- 0 poverty areas or extreme poverty areas (block groups) in Cameron Parish
- 18 poverty areas and 3 extreme poverty areas (block groups) in Vermilion Parish (all areas are located in Abbeville and Kaplan).

Table 1-9 Racial Characteristics							
Parish	**White***	**African American***	**American Indian/Alaska Native***	**Asian***	**Hawaiian/ Pacific Islander***	**Total**	**Percent Minority ****
Calcasieu	136,514	47,782	898	2,073	93	192,768	29%
Cameron	6,546	119	36	6	0	6,839	4%
Vermilion	46,922	8,286	209	1,160	5	57,999	20%
Source: Census 2010, Census ACS 2007-2011***							

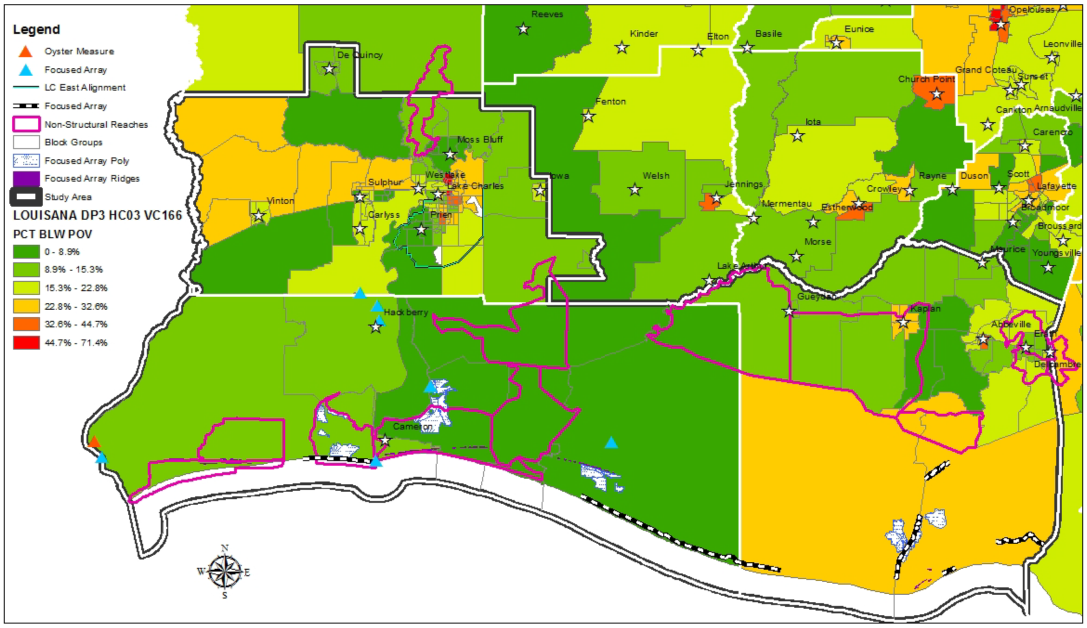

Figure 1-3. Percent Population Below Poverty Line, by Block Group

According to the 2010 U.S. Census data, there are 39 block groups in Calcasieu Parish and 9 block groups in Vermilion Parish where 50 percent or more of the population identify themselves as part of a minority group. There are no block groups in Cameron Parish where more than 1 percent identifies themselves as part of a minority group (Figure 1-4).

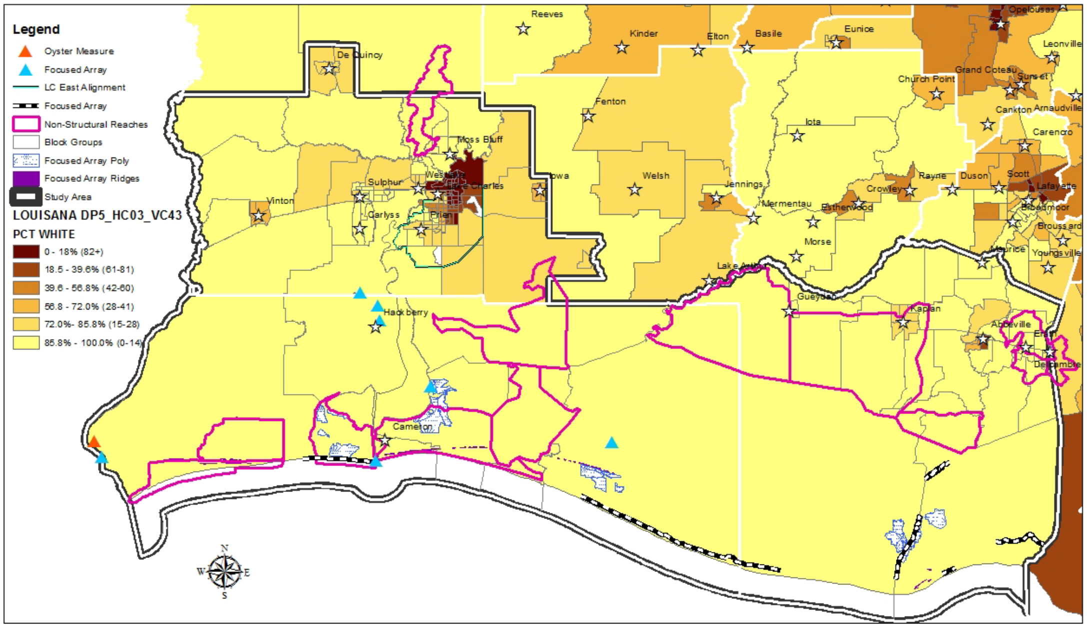

Figure 1-4. Racial Majority by Block Group

1.3.1 Water Environment

The two major hydrologic basins in the Chenier Plain are the Mermentau Basin and the Calcasieu-Sabine Basin (LCA, 2004). The Teche-Vermilion Basin is another significant hydrologic basin in the study area. The general location and major features/water bodies in each basin are described below. Figure 1-5 identifies major hydrologic features. For the most part areas below the GIWW are within the coastal zone.

Calcasieu-Sabine Basin - The Calcasieu-Sabine Basin lies in the western portion of the Chenier Plain in Cameron and Calcasieu Parishes. It is bounded to the east by LA Hwy 27, to the south by the Gulf of Mexico, and to the west by the Sabine River and Sabine Lake. The Basin is a shallow coastal wetland system with freshwater input at the north end, a north-south flow through Calcasieu and Sabine lakes, and some eastwest water movement through the GIWW and interior marsh canals (e.g., North Starks and South Starks canals on the Sabine National Wildlife Refuge). The dominant hydrologic features of the basin are the Calcasieu and Sabine Lakes, which are directly influenced by the Calcasieu, Sabine, and Neches Rivers. Navigation channels include the Sabine-Neches Waterway, Calcasieu River and Pass. Various water control structures in the area include the Calcasieu and Leland Bowman Locks. Managed wetlands are a significant feature of the Calcasieu-Sabine Basin (LADNR 2002).

The Calcasieu drainage basin drainage area north of the point where the river crosses the GIWW is 3,235 square miles. The Sabine drainage basin has a drainage area of 9,760 square miles. The headwaters start in northeastern Texas and the river runs about 150 miles before it meets the Louisiana-Texas state line, then runs to the Gulf. The Toledo Bend Reservoir and Sabine Lake are the major hydrologic features of the Sabine Basin.

The GIWW from the Sabine River to the Calcasieu River is a 125ft wide x 12ft deep. Construction of the GIWW significantly altered regional hydrology by connecting the two major ship channels. Prior to the construction of the GIWW, the Calcasieu and Sabine estuaries were mostly distinct and were more influenced by the Calcasieu and Sabine rivers, respectively. The Gum Cove Ridge once separated the Sabine Basin from the Calcasieu Basin, with little water exchange between the basins. Removing the mouth bars and deepening the CSC and the Sabine-Neches channels, as well as the GIWW and interior canals bisecting the Gum Cove Ridge, made the region hydrologically indistinct, which caused water flow and salinity patterns of one basin to profoundly affect those patterns of the other basin. In addition to effectively combining the two basins, the GIWW cut off all of the natural bayous and upland sheet flow that historically affected marshes, and channelized more freshwater inflow more directly to the Gulf of Mexico, partially bypassing the marshes.

<u>Mermentau Basin</u> - The Mermentau Basin lies in the eastern portion of the Chenier Plain in Cameron and Vermilion Parishes. The Mermentau River Basin, can be divided into three sub-basins: Upland, Lakes, and Chenier. The Upland Sub-basin covers an area of 3,683 square miles of predominantly agricultural land. The Lakes Sub-basin is delineated by the Freshwater Bayou Canal on the east, the limit of the coastal zone on the north, Louisiana Highway 27 on the west, and Louisiana Highway 82 on the south. Highway 82 runs atop and between the Grand Chenier-Pecan Island ridge complex. The Chenier Subbasin lies south of this ridge complex. The dominant hydrologic features of the Mermentau basin are the Grand and White Lakes and the Mermentau River. Navigation channels include the Mermentau Ship Channel. Various water control structures include the Freshwater Bayou Canal Lock, the Schooner Bayou Canal Structure, and the Catfish Point Control Structure.

Before human-induced hydrologic alterations from navigation channels in the early 1900s, the natural drainage in the Mermentau Basin was dominantly north-south through the Mermentau River, Freshwater Bayou, Bayou Lacassine, and Rollover Bayou. The eastern portion of the basin also drained in an easterly direction through Belle Isle and Schooner bayous . In addition, sheet flow over the marsh occurred between Grand Chenier and Pecan Island ridges, as well as to the west into the Calcasieu/Sabine Basin. Human activities related to wildlife management, navigation improvement, flood control, agriculture, and petrochemical exploitation have dramatically altered the hydrology of the Mermentau Basin. The net effect of these alterations is that drainage through the Lakes Sub-basin is now predominantly east-west and hydrologically isolated from the Chenier Sub-basin. The Lakes Sub-basin now functions more as a freshwater reservoir and less as a low-salinity estuary, its natural form (Gunter and Shell 1958; Morton 1973).

<u>Teche/Vermilion Basin</u> - The Teche/Vermilion Basin extends from Point Chevreuil to Freshwater Bayou Canal and includes East and West Cote Blanche Bays, Vermilion Bay, and the surrounding marshes. Navigation channels include the Freshwater Bayou Canal Navigational Channel. The Basin has a drainage area of 3,040 square miles LCA 2004)

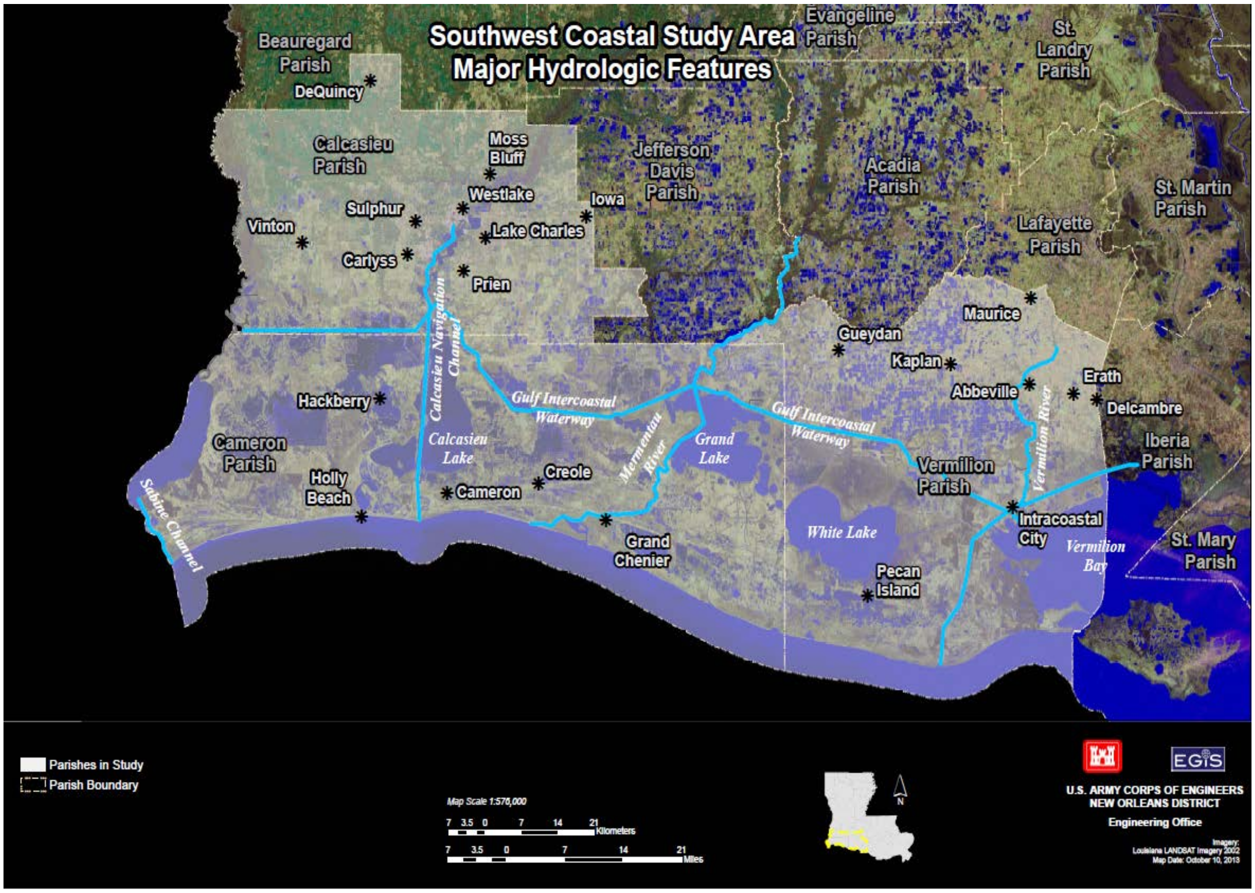

Figure 1-5. Major Hydrologic Features.

1.3.1.1 Water Stage Duration and Frequency

Normal astronomical tides in Louisiana are diurnal (one high tide and one low tide per day) and can have a spring range of as much as 2 feet. The mean tidal range is approximately 1.28 feet at Calcasieu Pass and 1.48 feet at Freshwater Canal. Amplitudes are influenced by tides, but are generally controlled by meteorological events. South winds drive water into the marshes.

1.3.1.2 Relative Sea Level Rise

In coastal Louisiana, *relative sea level rise* (RSLR) is the term applied to the difference between the change in eustatic (global) sea level and the change in land elevation. According to IPCC (2007), the global mean sea level rose at an average rate of about 1.7 mm/yr during the 20th Century. Recent climate research has documented global warming during the 20th Century, and has predicted either continued or accelerated global warming for the 21st Century and possibly beyond (IPCC, 2007).

Land elevation change can be positive (accreting) or negative (subsiding). Land elevations decrease due to natural causes, such as compaction and consolidation of Holocene deposits and faulting, and human influences such as sub-surface fluid extraction and drainage for agriculture, flood protection, and development. Forced drainage of wetlands results in lowering of the water table resulting in accelerated compaction and oxidation of organic material. Areas under forced drainage can be found throughout coastal Louisiana and the study area. Land elevations increase as a result of sediment accretion (riverine and littoral sources) and organic deposition from vegetation. Vertical accretion in most of the area, however, is insufficient to offset subsidence, causing an overall decrease in land elevations. The combination of subsidence and eustatic sea level rise is likely to cause the landward movement of marine conditions into estuaries, coastal wetlands, and fringing uplands (Day and Templet, 1989; Reid and Trexler, 1992).

Subsidence Rates - Subsidence rates vary considerably across coastal Louisiana. A coastwide system for quantifying and predicting subsidence on a regional scale has not yet been established. Therefore, subsidence rates are estimated using a combination of benchmark leveling, tide gauge measurements, and radiometric dating of buried marsh horizons.

The subsidence rate for most of the area is considered low, at zero to 1 ft/century; however, the subsidence rates in the Mermentau Basin for Hackberry Ridge, Big Lake, Cameron-Creole, Brown Lake, Hog Island Gully, and Mud Lake watersheds are considered intermediate, at 1.1 – 2 ft per century. Perry Ridge in the Calcasieu/Sabine Basin and Locust Island and Little Prairie in the Mermentau Basin are considered stable (Coast 2050, 2009).

Accretion Rates - Net accretion varies significantly on a local level and over time. Average measurements of accretion across the Louisiana coastal region indicate that current accretion rates are 0.7 to 0.8 cm per year (ERDC/EL TN-10-5). Since there is currently a lack of evidence to support applying a habitat specific accretion rate, a long-term accretion estimate of 0.7 cm per year captures the central tendency of all herbaceous marsh data that have been reviewed for the SW Coastal LA analysis.

1.3.1.3 Hydrology and Hydraulics

Calcasieu-Sabine Basin - The Calcasieu, Sabine, and Neches rivers are the principal sources of freshwater inflow into this region. The Sabine and Calcasieu rivers follow a north-south gradient, whereas the Neches River flows into Sabine Lake from the northwest. Additionally, an eastwest flow occurs between the basins via the GIWW and existing canals on the Sabine National Wildlife Refuge. The hydrology of this area is affected by a complex combination of riverine freshwater inflow, Gulf of Mexico tides, precipitation, and wind effects on water level and directional flow.

The lower Calcasieu River and the Calcasieu Ship Channel (CSC) have been maintained for navigation since 1874, when the U.S. Army Corps of Engineers (USACE) first constructed a navigation channel through the outer bar of Calcasieu Pass, between Calcasieu Lake and the Gulf of Mexico. Prior to the initial dredging, there was a 3.5-ft-deep shoal at the mouth of the Calcasieu River (War Department 1897). This natural bar acted as a constriction, minimizing saltwater and tidal inflow into the basin. Removal of the channel mouth bar, coupled with subsequent widening and deepening of the CSC, allowed increased saltwater and tidal intrusion into the estuary, resulting in catastrophic marsh loss, tidal export of vast quantities of organic marsh substrate, and an overall shift to more saline habitats in the region (USDA 1994). In addition, the CSC permits the upriver flow of denser, more saline water as a saltwater wedge. In 1968, the USACE completed construction of the Calcasieu River Saltwater Barrier on the Calcasieu River north of the city of Lake Charles. This barrier minimized the flow of the saltwater wedge into the upper reaches of the Calcasieu River to protect agricultural water supplies. The structure consists of a lock and a flood control barrier with five adjustable gates.

Only portions of the CSC are dredged annually. Approximately 75% of the dredged material is placed in upland and offshore disposal sites, but the remaining 25% is used for beneficial means, to create marsh.

The GIWW from the Sabine River to the Calcasieu River is a 125 ft wide x 12 ft deep. Construction of the GIWW significantly altered regional hydrology by connecting the two major ship channels. Prior to the construction of the GIWW, the Calcasieu and Sabine estuaries were mostly distinct and were more influenced by the Calcasieu and Sabine rivers, respectively. The Gum Cove Ridge once separated the Sabine Basin from the Calcasieu Basin, with little water exchange between the basins. Removing the mouth bars and deepening the CSC and the Sabine-Neches channels, as well as the GIWW and interior canals bisecting the Gum Cove Ridge, made the region hydrologically indistinct, which caused water flow and salinity patterns of one basin to profoundly affect those patterns of the other basin. In addition to effectively combining the two basins, the GIWW cut off all of the natural bayous and upland sheet flow that historically affected marshes, and channelized more freshwater inflow more directly to the Gulf of Mexico, partially bypassing the marshes.

Mermentau Basin - Before human-induced hydrologic alterations from navigation channels in the early 1900s, the natural drainage in the Mermentau Basin was dominantly north-south through the Mermentau River, Freshwater Bayou, Bayou Lacassine, and Rollover Bayou. The eastern portion of the basin also drained in an easterly direction through Belle Isle and Schooner bayous . In addition, sheet flow over the marsh occurred between Grand Chenier and Pecan Island ridges, as well as to the west into the Calcasieu/Sabine Basin. Human activities related to wildlife management, navigation improvement, flood control, agriculture, and petrochemical exploitation have dramatically altered the hydrology of the Mermentau Basin. The net effect of these alterations is that drainage through the Lakes Sub-basin is now predominantly east-west and hydrologically isolated from the Chenier Sub-basin. The Lakes Sub-basin now functions more as a freshwater reservoir and less as a low-salinity estuary, its natural form (Gunter and Shell 1958; Morton 1973).

1.3.1.3.1 Storm Surge

While the study area has periodically experienced localized flooding from excessive rainfall events, the primary cause of the flooding events has been the tidal surges from hurricanes and tropical storms. During the past eight years, the area has been greatly impacted by storm surges associated with three Category 2 or higher hurricanes—Lili, Rita, and Ike, which inundated structures and resulted in billions of dollars in damages to southwest coastal Louisiana. Hurricane surge also causes significant damage to wetlands. Hurricane surge has formed ponds in stable, contiguous marsh areas and expanded existing, small ponds, as well as removed material in degrading marshes (Barras, 2009). Fresh and intermediate marshes appear to be more susceptible to surge impacts, as observed in Barras (2006).

Storms of Record - There have been several floods caused by runoff from heavy rainfall. Some of the major events that occurred over the last thirty years, including Hurricanes Audrey, Lili, Rita and Ike are discussed below with more detail on other storms of record provided in Appendix A.

October 2002. Hurricane Lili (23 September - 3 October) was originally a Category 4 hurricane and first made landfall as a downgraded Category 2 hurricane near Intracoastal City, LA to the west. Wind gusts up to 61 mph were reported near the study area. Rainfall estimates were rather low at 5 inches, due to the rapid forward movement of the storm. Tide levels were 4 to 7 feet above normal, with many areas outside of the study area being flooded. The stage at Harvey Canal at Lapalco reached 9.84 feet NGVD on the 5th.

September 2005. Hurricane Rita (September 24-26) Hurricane Rita first made landfall just west of Johnson's Bayou, LA as a Category 3 hurricane after downgrading from a 180 mph Category 5 hurricane. The coastal communities of southwest Louisiana were all heavily damaged or totally destroyed by the 20-foot surge. The storm surge also completely overtopped the Calcasieu Lock structure. Many low lying areas in Lake Charles also flooded.

September 2008. Hurricane Ike (September 1-14) first made landfall near Galveston, Texas as a Category 2 hurricane with 110 mph winds on September 13, 2008. Although landfall was to the west in Texas, this storm caused extensive flooding due to storm surge created by the large wind field along the south central and southwest coastal parishes of Louisiana. The storm surge also completely overtopped the Calcasieu Lock structure.

1.3.1.4 Flow and Water Levels

The marsh area of southwest Louisiana extends northward and slightly beyond the GIWW. Rainfall runoff drains from the higher elevations in the north and is trapped in the marsh area to the south due to Chenier ridges that parallel the coast. The natural drainage pattern prior to the construction of the GIWW was for rainfall in the basin to drain through the Mermentau River and empty into the Gulf of Mexico. However, some of that flow is now redistributed to the east and west along the GIWW. The Calcasieu Lock, Catfish Point Control Structure, Leland Bowman Lock, and Schooner Bayou Lock were created to allow for navigation and salinity control.

Land stewardship through hydrologic management and shoreline protection are the mainstays of coastal restoration in the Calcasieu-Sabine basin. Water control structures are operated both passively and actively. Virtually all hydrologic management focuses on controlling salinity and minimizing tidal fluctuations by constructing and operating levees, weirs, and a variety of gated structures. A 1990 inventory of such water control structures identified 174 individual structures in the interior and along the perimeter of the basin (LADNR 2002; Marcantel 1996).

The Cameron-Creole Watershed Project covers approximately 176 square miles in Cameron Parish. The area is bounded by the GIWW on the north; Calcasieu Lake and Calcasieu Pass on the west; LA Highway 27, Little Chenier Ridge, and Creole Canal on the east; and the Gulf of Mexico and Mermentau River on the south. To counter this conversion of marsh to open water, the Cameron-Creole Watershed Project was initiated cooperatively by the Soil Conservation Service (now NRCS), Gulf Coast Soil and Water Conservation District, Cameron Parish Police Jury, Cameron Parish Gravity Drainage Districts 3 and 4, the Miami Corporation, and the USFWS, Sabine National Wildlife Refuge. The water control structures began operation in 1989 (LADNR 2002).

1.3.1.5 Water Quality and Salinity

Water quality is influenced by Chenier Plain elevations and geomorphologic processes, surface water budget, land cover and use, and regional weather. The study area consists of low relief topography to the north and estuary to the south, with increasing estuary salinity gradients to the south. The Calcasieu River is connected to the Gulf of Mexico via the Calcasieu ship channel (CSC) and the Mermentau River basin is maintained as a freshwater environment via several water control structures (Rosen and Xu 2011). Hydromodification has occurred as a result of the construction of water control structures, canals, and embankments (Demcheck et al. 2004).

The Sabine River is the dominant influence across most of the basin in moderating gulf salinity and tidal fluctuations. Observations by USFWS personnel reveal that strong and prolonged south and southeast winds result in large volumes of Gulf of Mexico water being pushed into Calcasieu and Sabine lakes, which causes the water level in the marshes to rise (Paille 1996). A similar effect on marsh water level has been observed during periods of low barometric pressure in the region (LADNR 2002; Paille 1996).

The primary saltwater barrier in the Calcasieu Basin is the Calcasieu Lock, located approximately two miles east of the CSC. This sector-gated lock, which opened in 1950, was designed to prevent saltwater intrusion into the Mermentau Basin, and is operated primarily for navigation. During flooding events, the structure is often operated for drainage of the Mermentau Basin to the east.

In general, water quality concerns are related to urbanization to the north, oil and gas activities and saltwater intrusion in the Calcasieu River basin, and agriculture in the Mermentau River basin. Reference the following literature for water quality and salinity studies in the area: Demcheck et al. (2004), Garrison (1997), Waldon (1996), Skrobialowski et al. (2004), Demcheck and Skrobialowski (2003), Macdonald et al. (2011), Rosen and Xu (2011), and Steyer et al. (2008).

Historically (1998-2012) Clean Water Act Section 305(b) assessments of subsegments in the area were evaluated. Long-term average support values reveal that impairments are most common in the uppermost subsegments in the Calcasieu and Teche-Vermillion watersheds. The most commonly suspected causes of impairments were low dissolved oxygen, elevated total suspended solids, mercury, elevated turbidity, nitrate/nitrite, carbofuran, and total phosphorus, while the most commonly suspected sources were unknown, agriculture, natural, atmospheric deposition, flow alteration, urban runoff, and on-site treatment systems. In a recent 305(b) assessment (2012), the most frequently cited suspected causes of impairment included fecal coliform, low dissolved oxygen, turbidity, mercury, total suspended solids, and carbofuran, while most frequently cited suspected sources of impairment include unknown, agriculture, natural, on-site treatment systems, atmospheric deposition, and drought-related effects(LDEQ 2013). Information and analysis for water quality monitoring will be developed for the TSP following sampling, analysis, and evaluation of water quality and sediment for the project conducted in later project phases.

1.4 Natural Environment

1.4.1 Sedimentation and Erosion

The study area is divided by the Sabine, Calcasieu, Mermentau, and Vermilion rivers which flow in a north-south direction. These rivers have been highly altered by the placement of locks and dams, dredged channels, manmade outlets to the Gulf, and bisected by the GIWW. These alterations influence the movement of sediment throughout the area. The rivers and interior lakes which they enter (Sabine, Calcasieu, and Grand) act as sediment sinks. Overbank deposition into adjacent marshes is minimal in these low flow rivers. Sediments in the interior lakes can be resuspended and deposited in adjacent marshes during storm events and cold front passages. Extensive hydrologic alterations within the area (levees, channels, roads, locks, control structures, etc.) influence sediment movement throughout. Sediments in the rivers that make it to the coast are deposited at the mouths and generally move westward nourishing the beaches and marshes.

A significant source of sediment is the Atchafalaya River. Sediment travels westward from Atchafalaya Bay and the GIWW and enters the area through tidal exchange at the Gulf and from flooding during storm events. A large percentage of Atchafalaya River sediments are deposited along the Gulf shoreline in the vicinity of Freshwater Bayou as mudflats while coarser sediments continue westward along the shoreline.

Erosion of material by wave and current action is found throughout. The shorelines of most channels, lakes, and the Gulf are experiencing erosion. Erosion rates are generally highest where the shorelines protrude into the lakes, focusing wave and current action. The Louisiana coast has approximately 350 miles of sandy shoreline along its barrier islands and gulf beaches; however, there are about 30,000 miles of land-water interface along bays, lakes, canals, and streams. Most of these consist of muddy shorelines and bank lines, and virtually all are eroding. In many instances, rims of firmer soil around lakes and bays, and natural levees along streams have eroded away leaving highly organic marsh soils directly exposed to open water wave attack. Examples include Redfish Point, Grassy Point, Umbrella Point, Short Point, and Commissary Point. High rates of Gulf shoreline erosion occur from the vicinity of Rollover Bayou, west to Mermentau River. Accelerated shoreline loss occurs where erosion has caused Gulf, lake, and channel shorelines to intersect interior water bodies.

1.4.2 Soils, Water Bottoms and Prime and Unique Farmlands

Both hydric and non-hydric soils are found through. The area consists generally of forested terrace uplands and Gulf Coast Prairies in the northern portions and Gulf Coast Marsh habitats in the southernmost portions. Predominate soils are described in appendix A. The major water bottoms throughout include: Lake Charles, Prien Lake, Sabine Lake, Calcasieu Lake, Grand Lake, White Lake and Vermilion Bay. There are numerous smaller lakes such as Sweet Lake, Mud Lake, Black Lake, Big Constance Lake, and Lake Misere. Rivers include the Calcasieu, Sabine, Mermentau and Vermillion Rivers. A listing of the water bottoms is described in appendix A

Prime and Unique Farmlands: Prime farmlands are present and make up approximately 941,196 acres, or 34.3 percent of the soils; breakdown by parish is as follows: Calcasieu Parish is 479,426 acres, or 68.5 percent; Cameron Parish is 106,008 acres, or 10 percent; Vermilion Parish is 355,761 acres, or 36 percent. The majority of the Gulf Coast Marshes consists of wetland type soils and shorelines that are prone to frequent flooding and not suitable for agricultural use. Prime farmland is more predominant inland, and outside, of the Gulf Coast Marsh physiographic area. Prime farmland can also be found on natural ridge tops and cheniers (Hackberry loamy fine sand).

Prime farmland soils are best suited for producing food, feed, forage, fiber, and oilseed crops, and posses qualities that are favorable for crop production using only acceptable farming methods (NRCS Soil Survey of Calcasieu Parish, dated June 1988). Several soil types exist that meet those qualities and are identified as prime farmlands. These are listed in appendix A. Urban areas, like Lake Charles and Abbeville, as well as industrial areas have excluded some prime farmlands from agricultural use. There is no Unique farmland. Coordination with the Natural Resources Conservation Service (NRCS) is on-going.

1.4.3 Gulf Coastal Shorelines

Gulf coastal shorelines, located along the northern rim of the Gulf of Mexico, provide essential and critical shelter, nesting, feeding, roosting, cover, nursery, and other habits and life requirements for fish and wildlife. They also function as the boundary between marine and estuarine ecosystems and provide protection to the estuarine wetlands, bays, and other inland habitats. Coastal shorelines limit storm surge heights, retard saltwater intrusion and limit mechanical erosion by reducing wave energy at the margins of coastal wetlands (Williams et al. 1992).

Coastal shorelines, as well as other coastal landscape features such as shoals, coastal marshes, and forested wetlands, can provide a significant and potentially sustainable buffer from wind wave action and storm surge generated by tropical storms and hurricanes. Rapid deterioration of the barrier coast in costal Louisiana is resulting in a transformation of low-energy, semi-protected bays into high-energy, open marine environments (Stone et al. 2005). Numerical modeling by Stone et al. (2005) demonstrated that physical loss of the barrier system and marsh results in a considerable increase in modeled storm surge levels and wave heights. Geomorphic features such as coastal shorelines and barrier islands, as well as coastal marsh and other wetland land masses can block or channelize flows (Working Group for Post-Hurricane Planning for the Louisiana Coast 2006). The area's coastal shorelines are experiencing some of the highest land loss rates in the Nation, due to both natural and man-made factors (USACE 2004).

Barrier beach and surf, dune, supratidal and intertidal wetlands and swale habitats have undergone substantial loss due to oil and gas activities (e.g., pipeline construction), construction of navigation channels and jetties, subsidence, sea-level rise, and marine and wind-induced erosion. Recent estimates find Gulf shoreline recession rates vary from 8 feet per year near Cheniere Au Tigre to 52.9 feet per year near the center of the 76,000-acre Rockefeller Wildlife Refuge, located in eastern Cameron and western Vermilion Parishes which borders the Gulf of Mexico for 26.5 miles.

1.4.4 Vegetation Resources

The area consists of open water ponds and lakes, cheniers, Gulf shorelines, and freshwater, intermediate, brackish, and saline marsh. Table 1-11 compares habitat types pre- and post-Hurricane Rita.

Gulf Coast Prairie and Forested Terraced Uplands vegetation includes:

- Swamp, found in low-lying areas typically adjacent to waterways, is dominated by cypress and tupelo-gum.
- Riverine habitats along stream and river bottoms and bottomland forests are comprised of water tupelo, willow, sycamore, cottonwoods, green ash, pecan, elm, cherrybark oak, white oak; these are often interspersed with Chinese tallow. Depending upon the locations, riverine habitats grade into higher elevated and better drained areas comprised of oak-pine forests.
- Oak-pine forest types dominate the better drained areas especially surrounding Lake Charles and Sulfur and include longleaf pine, loblolly pine, slash pine, sweetgum, blackgum, elm, southern red oak, water oak, black gum and Chinese tallow.
- Pasture and rangelands with mixtures of perennial grasses and legumes (e.g.,

bermundagrass, Pensacola bahiagras, tall fescue, and white clover) comprise the majority of the outlying areas surrounding Abbeville, Erath and Delcombre.

The Gulf Coast Marsh consists of gulf shorelines with barrier shorelines, dunes and back barrier vegetated areas; cheniers; freshwater, intermediate, brackish, and saline marsh; interspersed with bayous, lakes, ponds and other waters of which some may include subaquatic vegetation (SAVs). Vegetation typically follows the salinity gradient (O'Neil 1949; Chabreck et al. 1972; Gosselink et al. 1979; Visser et al. (2000):

- Gulf shorelines vegetation includes sea-beach orach, sea rocket, pigweed, beach tea, salt grass, seaside heliotrope, common and sea purslane, marsh-hay cordgrass, and coastal dropsead (LCA 2004, Gosselink et al. 1979).
- Cheniers are live oak-hackberry forests with live oak and hackberry the dominant tree canopy species with other typical species including swamp red maple, toothache tree, green ash, American elm. Although this forest type is the typical habitat, some areas may be scrub thicket or grasslands (source: http://dnr.louisiana.gov/assets/docs/coastal/227-009-001NG-Chenier-Rpt-DNR.pdf; accessed September 16, 2013; LADNR 2009).
- Marsh types: Visser et al (2000), expanding on previous studies by Penfound and Hathaway (1938) and Chabreck (1970), classified freshwater marsh in the Chenier Plain as a combination of maidencane and bulltongue arrowhead; intermediate marsh as sawgrass, saltmeadow cordgrass, and California bulrush; brackish marsh as saltmeadow cordgrass, chairmaker's bulrush, and sturdy bulrush; and saline marsh as smooth cordgrass, needlegrass rush, and saltgrass.
- SAVs: wild celery, duckweed, pickerelweed, sago pondweed, southern naiad.

Invasive plants include water hyacinth, alligatorweed, hydrilla, common salvinia, giant salvinia, Chinese tallow, Chinese privet, Cogon grass, Johnsongrass, Japanese privet, Japanese honeysuckle, common ragweed, rescuegrass, sticky Chickweek, purple nutsedge, mimosa tree (personal communication Cindy Steyer, NRCS on September 20, 2013). These invasive species compete with native flora for resources such as nutrients and light, community structure and composition, and ecosystem processes. Water hyacinth, common salvinia, giant salvinia, and hydrilla all limit the amount of light penetrating the water column which effects 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.

TABLE 1-11 Habitat types by basin in acres with square kilometers (km²) listed in parentheses.

Habitat Type	Calcasieu/Sabine Basin		Mermentau Basin		Teche/Vermilion Basin	
	2004	2005	2004	2005	2004	2005
Forested Wetlands	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	46,080 (186.5)	46,080 (186.5)
Other Land	46,080 (186.5)	45,4400 (183.9)	51,840 (209.8)	38,400 (155.4)	21,760 (88.1)	20,480 (82.9)
Freshwater Marsh	96,000 (388.5)	89,600 (362.6)	281,601 (1,139.6)	230,401 (932.4)	33,280 (134.68)	32,640 (132.1)

Intermediate Marsh	177,520 (694.1)	163,200 (660.5)	119,680 (484.3)	103,040 (417.0)	122,880 (497.3)	122,600 (492.1)
Brackish Marsh	81,280 (328.9)	78,720 (318.6)	60,800 (246.1)	55,680 (225.3)	82,560 (334.1)	80,640 (326.3)
Saline Marsh	8,960 (36.3)	8,960 (36.3)	26,240 (106.3)	25,600 (103.6)	5,120 (20.7)	5,120 (20.7)
Water	184,961 (748.5)	202,881 (821.0)	202,241 (818.4)	289,281 (1,170.7)	348,162 (1,408.9)	353,281 (1,429.7)
Totals	588,803 (2,382.8)	588,803 (2,382.8)	742,403 (3,004.4)	742,403 (3,004.4)	659,843 (2,670.3)	659,843 (2,670.3)

***Land Loss* –** The process for wetland loss can start with the result of gradual decline of marsh vegetation due to inundation and saltwater intrusion eventually leading to complete loss of marsh vegetation or the result of storm surge events. As marsh vegetation is lost, underlying soils are more susceptible to erosion and are typically lost as well, leading to deeper water and precluding marsh regeneration. Significant accretion of sediments is then required in order for marsh habitat to reestablish. Perhaps the most serious and complex problem in the study area is the rate of land and habitat loss. The Louisiana coastal plain contains one of the largest expanses of coastal wetlands in the contiguous United States and accounts for 90 percent of the total coastal marsh loss in the nation (USACE 2004).

The effects of recent hurricanes have accelerated marsh loss. Table 1-12 includes estimates of wetland loss attributed to the major hurricanes of 2004 to 2008 in the Chenier Plain and throughout coastal Louisiana.

Table 1-12. Wetland loss estimates (km^2) following hurricanes Katrina and Rita (2005) and Gustav and Ike (2008) by geographic province (Barras 2009).

Period	Storms	Chenier Plain	Marginal Delta Plain	Delta Plain	Coastal Louisiana
2004-2006	Katrina + Rita	-292	-2.6	-230	-525
2006-2008	Gustav + Ike	-139	-59	-124	-323
2004-2008	All storms	-432	-62	-354	-848

1.4.5 Rare, Unique, and Imperiled Vegetative Communities

The following rare, unique, and imperiled communities, documented by the Louisiana Natural Heritage Program, are important in that they contribute to the diversity and stability of the coastal ecosystem. In the future without action, these rare, unique, and imperiled vegetative communities are expected to continue disappearing. For example, without action, saltwater intrusion and drainage problems would continue, resulting in the conversion of freshwater marsh to intermediate and brackish marsh. Table 1-13 displays information from the LNHP database identifying rare, unique or imperiled vegetative communities (LDWF 2013).

Coastal Live Oak-Hackberry Forest (chenier maritime forest): Also known as chenier maritime forest, this natural community formed on abandoned beach ridges primarily in southwest Louisiana. Composed primarily of fine sandy loams interbedded with sand and shell debris, these ridges range in height from 4 to 5 ft above sea level. Live oak and hackberry are the dominant canopy species. Other common species include red maple, sweet gum, water oak, green ash, and American elm.

Chenier forests have historically been subject to human disturbance. It is the only high ground in the landscape and therefore is used for development, highways, access roads, infrastructures, oil and gas production, and agriculture. In a study conducted by Providence Engineering and funded by the LDNR on the cheniers and natural ridges, approximately 11 percent of the cheniers studied were undeveloped (Cheniers and Natural Ridges Report, 2009). Of the original 100,000 to 500,000 acres in Louisiana, only 2,000 to 10,000 acres remain.

Coastal Dune Grassland: Coastal dune grasslands occur on beach dunes and elevated backshore areas above intertidal beaches. Louisiana's coastal dunes are poorly developed because of the high frequency of overwash associated with hurricanes and storms, and a limited amount of eolian-transported sand. Vegetative cover ranges from sparse to fairly dense and is dominated by salt spray tolerant grasses. Coastal dune grasslands are estimated to have occupied less than 2,000 acres in pre-settlement times, and 50 to 75 percent was thought to remain prior to the 2005 hurricanes. Some of the most extensive examples of coastal dune grasslands in Louisiana occur in the Chenier Plain.

Coastal Prairie: The Coastal Prairie can be divided into two main types, upland dry to mesic prairies at the northern end of its range, and marsh fringing prairies on "islands" or "ridges" in the marsh at the southern end of its range. The soil conditions and frequent burning from lightning strikes prevented invasion by woody trees and shrubs and maintained the prairie vegetation. Coastal prairie vegetation is extremely diverse and dominated by grasses. Remnant Louisiana coastal prairies, once covering an estimated 2.5 million acres, have been reduced to less than 1 percent of the original extent. Some of the larger prairie remnants are marsh fringing, wet prairies found in Vermilion and Cameron Parishes.

Freshwater Marsh: Freshwater marsh is generally located adjacent to intermediate marsh along the northern extent of the coastal marshes. Salinities are usually less than 2 parts per thousand (ppt) and normally average about 0.5-1 ppt. Freshwater marsh has the greatest plant diversity of any of the marsh types. Although the freshwater marshes, as previously described, compose a large amount of the entire coastal marsh acreage, the Louisiana Natural Heritage Program ranks this community as imperiled because it has undergone the largest reduction in acreage of any of the marsh types over the past 20 years due to saltwater intrusion. Some of the largest contiguous tracts of freshwater marsh in Louisiana occur in Vermilion and Cameron Parishes.

Table 1-13 Louisiana Natural Heritage Program rare, unique or imperiled vegetative communities in the area.

Vegetative Communities	Basins or Parish
Submergent Vascular Vegetation (Marine & Estuarine)	Waters of northern Gulf of Mexico, Vermilion-Teche, Mermentau, Calcasieu and Sabine.
Salt Marsh	Vermilion-Teche, Mermentau, Calcasieu and Sabine
Brackish Marsh	Vermilion-Teche, Mermentau, Calcasieu and Sabine
Intermediate Marsh	Vermilion-Teche, Mermentau, Calcasieu and Sabine
Coastal Prairie	Vermilion-Teche, Mermentau, Calcasieu and Sabine

Table 1-13 Louisiana Natural Heritage Program rare, unique or imperiled vegetative communities in the area.

Vegetative Communities	Basins or Parish
Flatwoods Ponds	Calcasieu Parish
Western Hillside Seepage Bogs	Calcasieu and Sabine
Scrub/Shrub Swamp	Vermilion-Teche, Mermentau, Calcasieu and Sabine
Cypress Swamp	Vermilion-Teche, Mermentau, Calcasieu and Sabine
Bottomland Hardwood Forest	Vermilion-Teche, Mermentau, Calcasieu and Sabine
Bature	Vermilion-Teche
Live Oak Natural Levee Forest	Vermilion-Teche
Bayhead Swamp/Forested Seep	Calcasieu Parish
Pine Flatwoods	Calcasieu Parish
Western Longleaf Pine Savannah	Calcasieu Parish
Small Stream Forest	Calcasieu Parish
Coastal Dune Grassland	Mermentau, Cacasieu, Sabine
Coastal Dune Shrub Thicket	Mermentau, Cacasieu, Sabine
Coastal Live Oak-Hackberry Forest	Vermilion-Teche, Mermentau, Calcasieu and Sabine
Western Upland Longleaf Pine Forest	Calcasieu Parish
Western Xeric Sandhill Woodland	Calcasieu Parish
source: http://www.wlf.louisiana.gov/wildlife/louisiana-natural-heritage-program	

1.4.6 Wildlife Resources

Coastal and especially estuarine wildlife is taxonomically diverse with distributions shaped by landforms, climate, salinity, tides, vegetation, other animals and human activities (Day et al. 1989). shows the status, functions of interest, trends, and projections from 1985 through 2050 for avifauna, furbearers, game mammals, and reptiles as adapted from the Coast 2050 report by LCWCRTF & WCRA (1999).

Birds

Area estuarine wetlands, cheniers and barrier habitats have historically provided many different species of birds and other wildlife with shelter, nesting, feeding, roosting, cover, nursery, and other life requirements. These habitats provide neotropical migrants with essential staging and stopover habitat (after Stoffer and Zoller 2004, Zoller 2004). Cheniers attract thousands of trans-Gulf migrant birds during their peak migratory months of April to May and August through October. The majority of these birds fly to and from parts of Mexico, and the cheniers offer the birds an important stop-over on their migration. Millions of ducks and geese also use the area from September through February. Over 300 species of birds have been recorded in the area, making this region a popular destination for visiting birders, wildlife photographers, and hunters. However, climate and seasonal availability of resources affect the ways estuaries are used by birds and other wildlife (Day et al. 1989). Vegetated habitats within urban and suburban areas, such as BLH and swamp habitats along streams, lakes and other waterways, provide critical breeding bird habitats (Wakeley and Roberts 1996).

Among the several sources documenting Louisiana birds, Lowery (1974) and the US Forest Service (source: http://www.fs.fed.us/land/pubs/ecoregions/ch21.html accessed September 20, 2013) indicate the area supports shorebirds (e.g., piping plover, sandpipers, gulls, stilts, skimmers and oystercatchers), ducks and geese (e.g., mottled duck, mallard, fulvous tree-duck, pintail, teal, wood duck, scaup, mergansers and Canada goose); herons, egrets, ibis and commorants; hawks and owls (e.g., bald eagle, osprey and barred owl); belted kingfisher;

woodpeckers and sapsuckers; marsh birds (e.g., rails and gallinules); and various songbirds (e.g., wrens, flycatchers, swallows, warblers, and vireos). Waterfowl, seabirds, coots, and rails populations are stable within the Calcasieu-Sabine and Mermentau basins (LCWCRTF & WCRA 1999)).

The bald eagle and brown pelican have increased populations resulting in de-listing as endangered species. Colonial nesting waterbird rookeries (e.g., herons, egrets, ibis, night-herons, and roseate spoonbills) are found throughout and generally show stable or increasing populations (LCWCRTF & WCRA 1999)).

Habitat loss and fragmentation is among the most pervasive threats to the conservation of biological diversity (Rosenberg et al. 1997). Area BLH, swamp and other riverine habitats provide travel corridors for birds and other wildlife connecting populations which have been effected by habitat loss and fragmentation. The greatest threat to birds throughout not only the area, but the entire North American continent, is habitat loss (American Bird Conservancy 2009).

Mammals
Most estuarine mammals show distributions or behaviors that are related to salinity patterns (Day et al. 1989). Large herbivores and carnivores include manatee, coyote, red wolf, ringtail, and river otter; smaller herbivores include swamp rabbit, fulvous harvest mouse, eastern wood rat, and nutria (source: http://www.fs.fed.us/land/pubs/ecoregions/ch21.html accessed September 20, 2013). Populations of furbearers (nutria, muskrat, mink, otter, and raccoon) and game mammals (rabbits, squirrels, and white-tailed deer) have been stable or increasing (LCWCRTF & WCRA 1999)).

Prior to the introduction of nutria to Louisiana in 1930s (USGS 2000, Baroch et al. 2002), no invasive wildlife species were known to be present. A substantial population increase of nutria is attributed to the decline in the price of pelts in 1989 (USGS 2000, Baroch et al. 2002). Areas of extensive nutria damage, or “eat outs,” alter the composition and habitat type of wetland communities (USGS, 2000). Aerial surveys estimated 80,000 acres of marsh in the State of Louisiana were damaged by nutria (Keddy et al. 2007).

Amphibians and Reptiles
Common species of amphibians and reptiles include the Gulf coast salt marsh snake, Gulf coast toad, pig frog, American alligator, diamondback terrapin, Mediterranean gecko, and Texas horned lizard (source: http://www.fs.fed.us/land/pubs/ecoregions/ch21.html accessed September 20, 2013). The LADNR (2009) observed the following reptiles within the cheniers: the American alligator; turtles (e.g., musk turtle, pond slider, and red-eared slider); snakes (e.g., plain-bellied water snake, banded water snake). Various lizards, and skinks (LADNR 2009). Little is known about amphibian or reptile populations with the exception of the American alligator whose population continues to remain stable (source: accessed on September 19, 2013; http://www.wlf.louisiana.gov/general-alligator-information)

1.4.7 Aquatic and Fisheries Resources
Plankton communities serve several important roles in the coastal waters of Louisiana. Bacterioplankton are primarily decomposers; phytoplankton are the primary producers of the water column, and form the base of the estuarine food web; 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; Thompson and Forman 1987). Biological factors such as predation by nekton and ctenophores, duration of the larval stages of meroplankton, and changes in the aquatic environment brought by the zooplankton populations themselves are important biological factors in the regulation of zooplankton densities (Bouchard and Turner 1976; Conner and Day 1987). Bouchard and Turner (1976) found that salinity largely influenced the distribution of zooplankton. Gillespie (1978) found spring zooplankton peaks were related to temperature. Conner and Day (1987) identified the following factors affecting zooplankton populations: tidal flushing, inflow of freshwater carrying organic detritus, river discharge, water depth, tidal changes, turbidity, and dissolved oxygen.

Benthic Resources—Gosselink et al. (1979) provide an extensive overview of benthic resources in the area. The bottom estuarine substrate or benthic zone regulates or modifies most physical, chemical, geological, and biological processes throughout the entire estuarine system via what is called a benthic effect (Day et al. 1989). Benthic communities do not have a static structure; rather, they provide a residence for many sessile, burrowing, crawling, and even swimming organisms. Benthic animals are directly or indirectly involved in most physical and chemical processes that occur in estuaries and trophic relationships that occur in aquatic ecosystems (Day et al. 1989). Oysters and mussels from the epibenthic community provide commercial and recreational fisheries and create oyster reef habitats used by many marine and estuarine organisms. Estuarine benthic organisms include: macrobenthic (e.g., molluscs, worms, large crustaceans); microbenthic (e.g., protozoa); and meiobenthic (e.g., microscopic worms and crustaceans) groups (Day et al. 1989). Primary consumer groups of the benthic habitat include: bacteria and fungi, microalgae, meiofauna, and microfauna (Mitsch and Gosselink 2000). A major link in the aquatic food web between plants and predators is formed by the conversion of plant material (formed in primary production) by benthic detritivores and herbivores to animal tissue (Cole 1975). The salt marsh is a major producer of detritus for both the salt marsh system and the adjacent estuary (Mitsch and Gosselink 2000). In some cases, exported marsh detritus is more important than the phytoplankton based production to the estuary. Detritus export and the shelter found along marsh edges make salt marshes important nursery areas for many commercially important fish and shellfish.

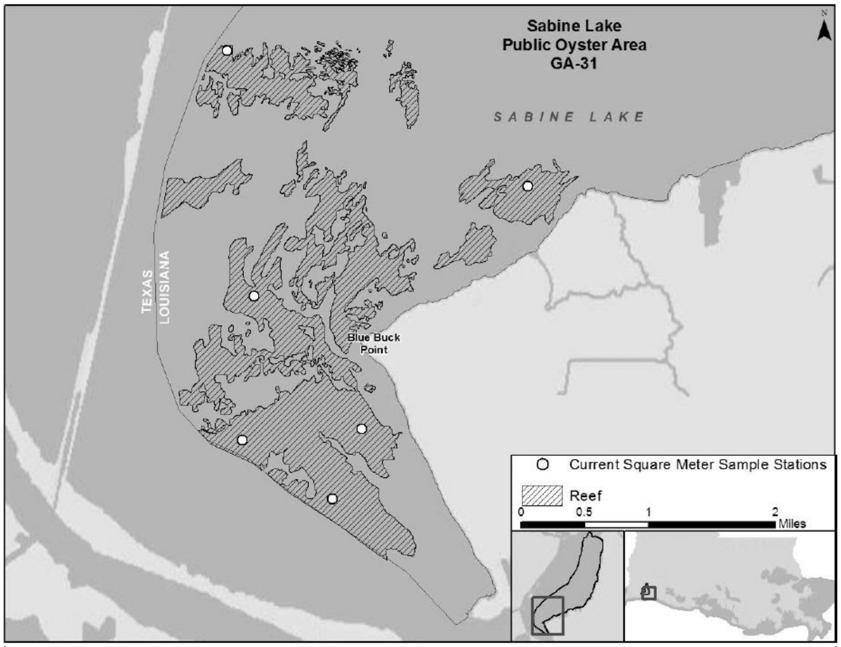

Figure 1-6. Oyster reefs in Sabine Lake.

The American oyster is a keystone estuarine species and has been identified as an ecosystem engineer (Dame 1996). Oyster reefs provide major structural components of estuaries and support more animal life than any other portion of the sea bottom (Bahr and Lanier 1981; Meyer and Townsend 2000; Nelson et al. 2004;

Tolley and Volety 2005; Tolley et al. 2005; Boudreaux et al. 2006). The total number and densities of fish, invertebrate and algal species greatly increase in areas containing oyster reefs (Bahr & Lanier 1981). More than 300 marine invertebrate species may occupy an oyster reef at one time (Wells 1961). In addition to increasing species richness, the three-dimensional structure of the reef provides other services such as stabilizing and buffering shorelines from high wave energy (Smithsonian 2001). Because oysters are sessile and pump water through their bodies, they are recognized as good ecosystem monitors. Changes in ecosystem health can be noted over time scales varying from hours to years. Because oysters are continually submersed in environmental conditions, they actively contribute to water quality assessments (Smithsonian 2001). In addition, the chemistry of their shell can provide information on global changes in the environment (Surge et al. 2003). Accordingly, oysters have been used as monitors and indicators of stress in marine ecosystems. Figure 1-6 shows the location of the oyster reefs Sabine Lake. Calcasieu Lake has been designated by the LDWF as a Public Oyster Tonging Area. More information on oysters including locations of oyster reefs in other areas can be found at the Louisiana Department of Wildlife and fisheries website (http://www.wlf.louisiana.gov/fishing/oyster-program). The Louisiana portion of Sabine Lake has approximately 34,067 water bottom acres. This area was cleared by LDHH in March of 2011 for harvesting, but LDWF has not opened a season on this area at this time.

Fisheries Resources—The area contains a variety of aquatic habitats, including rivers, bayous, canals, lakes, ponds, shallow open water areas, the Gulf of Mexico, and estuarine marsh and embayments. Salinity and submerged vegetation affect the distribution of fish and macrocrustaceans throughout the area with three general types: freshwater, resident, and transient marine species. Freshwater species, some of which may tolerate low salinities, generally live in the freshwater portions of the more interior and northern-most regions of the area. Resident species are generally smaller and do not commonly migrate very far. Marine transient species spend a portion of their life cycle in the estuary, generally spawning offshore or in high-salinity bays, and use coastal marshes as nursery areas (Herke 1971, 1995). Speices typically found in freshwater areas include: spotted gar, bowfin, largemouth bass, channel catfish, crappie, and gizzard shad. Estuarine-dependent species typically include red and black drum, spotted seatrout, Gulf menhaden, and southern flounder. Typical marine species include king and Spanish mackerel, and cobia.

1.4.8 Essential Fish Habitat (EFH)

Figures 1-7, 1-8, 1-9 and 1-10 displays EFH for coastal migratory pelagics (king mackerel, Spanish mackerel and cobia); shrimp (brown, white and pink shrimp); red drum; and stone crab, respectively within the area (source: http://www.habitat.noaa.gov/protection/efh/newInv/index.html). Table 1-14 list the EFH for life stages of species

Figure 1-7. Coastal Migratory Pelagic EFH
(source: http://www.habitat.noaa.gov/protection/efh/newInv/index.html)

Figure 1-8. Shrimp EFH (source: http://www.habitat.noaa.gov/protection/efh/newInv/index.html)

Figure 1-9. Red Drum EFH (source: http://www.habitat.noaa.gov/protection/efh/newInv/index.html)

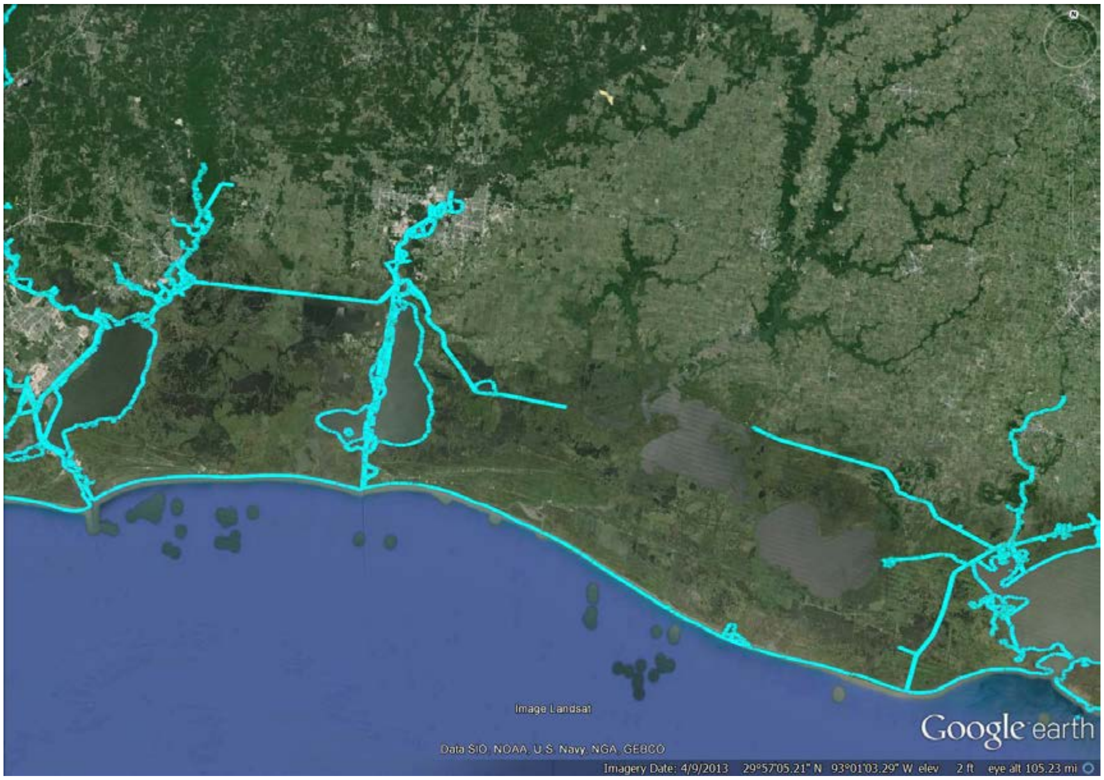

Figure 1-10. Stone Crab EFH (source: http://www.habitat.noaa.gov/protection/efh/newInv/index.html)

Table 1-14. EFH for life stages of species in the area (source: http://www.habitat.noaa.gov/protection/efh/newInv/index.html)

Species	Life Stage	EFH
Brown shrimp	eggs	Gulf of Mexico < 110 m, demersal
	larvae	Gulf of Mexico < 110 m, planktonic
	postlarvae/ juvenile	marsh edge, SAV, tidal creeks, inner marsh
	subadult	estuarine mud bottoms, marsh edge
	adult	Gulf of Mexico <110m, silt sand, muddy sand
White shrimp	eggs	Gulf of Mexico < 40 m, demersal
	larvae	Gulf of Mexico < 40 m, planktonic
	postlarvae/ juvenile,	marsh edge, SAV, marsh ponds, inner marsh, oyster reefs
	subadult	marsh edge, SAV, marsh ponds, inner marsh, oyster reefs
	adult	Gulf of Mexico < 33 m, silt, soft mud
Red drum	eggs, larvae	Gulf of Mexico planktonic
	postlarvae/juvenile	SAV, estuarine mud bottoms, marsh/water interface
	subadult	estuarine mud bottoms, oyster reefs
	adult	(Marine and Estuarine systems) Gulf of Mexico & estuarine mud bottoms, oyster reefs
Spanish mackerel	larvae	offshore <50 m
	juvenile	offshore, beach, estuarine
	adult	marine pelagic
King Mackerel	juvenile/adults	marine pelagic
Cobia	eggs	marine pelagic
	larvae	estuarine & shelf
	postlarvae/juvenile	coastal & shelf
	adults	coastal & shelf

1.4.9 Threatened and Endangered Species

There are eleven threatened or endangered species, one candidate species known or believed to occur in the area (table 1-15) as well as critical wintering habitat for the piping plover. There are no threatened or endangered plants in the area (informal coordination based on personal communication with Brigette Firmin, USFWS, September 20, 2013).

Table 1-15. Listed and Candidate Species within the area.

Species	Acadia Parish	Calcasieu Parish	Cameron Parish	Vermilion Parish
*Sprague's Pipit (*Anthus spragueii*)	Candidate	Candidate	Candidate	Candidate
Red-cockaded woodpecker (*Picoides borealis*)		Endangered		
Piping plover (*Charadrius*			Threatened	Threatened

Table 1-15. Listed and Candidate Species within the area.

Species	Acadia Parish	Calcasieu Parish	Cameron Parish	Vermilion Parish
melodus)			Critical habitat	Critical habitat
*Red knot (*Calidris canutus*)			Candidate	Candidate
**Whooping crane (*Grus americana*)				Threatened
West Indian manatee (*Trichechus manatus*)			Endangered	Endangered
Gulf sturgeon (*Acipenser oxyrinchus desotoi*)			Threatened	Threatened
Green sea turtle (*Chelonia mydas*)			Threatened	Threatened
Kemp's (Atlantic) ridley sea turtle (*Lepidochelys kempi*)			Endangered	Endangered
Leatherback sea turtle (*Dermochelys coriacea*)			Endangered	Endangered
Loggerhead sea turtle (*Caretta caretta*)			Endangered	Endangered
* Candidate species are those taxa for which the Service has on file sufficient information regarding biological vulnerability and threat(s) to support issuance of a proposal to list. **This is a nonessential population which is considered “threatened.” However, Section 7 of the Endangered Species Act consultation regulations do not apply.				

Piping plovers winter in Louisiana but do not nest on Louisiana’s coast. Critical wintering habitat encompasses 24,950 acres along 342.5 miles of shoreline, which is most of the coast of Louisiana. Critical habitat is presented in figure 1-11. Piping plovers arrive from their northern breeding grounds as early as late July and may be present on designated critical wintering habitat for 8 to 10 months of the year.

Figure 1-11. Designated critical habitat for wintering piping plover
(source: http://www.fws.gov/plover/finalchmaps/Plover_LA_1.jpg
accessed September 20, 2013).

1.4.10 Historic and Cultural Resources

The cultural history of coastal southwest Louisiana is a very rich one, going back some 10,000 years or more. The general chronological sequence of Louisiana's past can be summarized as follows: Paleoindian (11,500 - 8,000 B.C.), Archaic (8,000 - 800 B.C.), Woodland (800 B.C. - A.D. 1200), and Mississippian (A.D.1200 - 1700). The historic period begins at approximately A.D. 1700, and historic perspectives include the Attakapa Indians, first European settlement in Attakapa country, the Acadian migration, the Louisiana Purchase with the western boundary of the United States in dispute until 1819, the Civil War, postbellum period, and the early 20th century.

The NED alternative is located within both the Marginal Plain and the Pleistocene Prairie Terrace, while the NER alternatives are limited to the Marginal Plain. Archaeological sites in the southernmost portion of the area postdate the formation of the Marginal Plain (or Chenier Plain) at the end of the Pleistocene Epoch.

Numerous archaeological sites have been previously recorded within a one-mile buffer of the NED alternative. Thousands of standing structures that have been identified as potential candidates for nonstructural measures have a minimum age of 50 years and have not been assessed for eligibility. Fourteen historic properties have been identified in Calcasieu Parish, including ten that are listed in the National Register of Historic Places (NRHP). An additional two historic properties listed in the NRHP have been identified in Vermilion and Iberia parishes.

Thirty-one archaeological sites have been identified within a one-mile buffer of the NER alternatives. The recorded sites include two prehistoric sites that have been determined potentially eligible for listing in the NRHP and nine archaeological sites that have been determined not eligible for listing in the NRHP. The remaining thirty have not been assessed. No previously recorded sites have been identified within the proposed borrow areas. Hundreds of standing structures that have a minimum age of 50 years have not been assessed for eligibility.

The information provided above is based upon a review of cultural resources literature and records maintained by the Louisiana Division of Archaeology and Division of Historic Preservation, and CEMVN has determined that additional investigations would be required to locate and define the boundaries of cultural resources within the area of potential effects (APE) for the NED and NER TSP. Additional archaeological sites and standing structures may be identified during the cultural resource investigations of the APE. The cultural resources investigations would also include eligibility determinations for archaeological sites and historic standing structures located within the APE. CEMVN has initiated Section 106 consultation, and the APE, research design and survey methodology will be determined through consultation with the Louisiana State Historic Preservation Officer, federally recognized Indian Tribes, and additional consulting parties. The results of the identification and evaluation of historic properties will be coordinated with the Louisiana SHPO, Tribes, and additional consulting parties, and the CEMVN will seek to identify ways to avoid, minimize, and/or mitigate impacts to historic properties and resources of religious and cultural significance to Tribes that may be impacted by the proposed action.

1.4.11 Aesthetics and Visual Resources

Based on available aerial photography, the visual conditions of the study area have changed significantly over the past twenty years. The landscape and view sheds have changed due to the growth of urban development and the loss or change of swamps into marsh, or small open water areas. Comparisons between the 1992 and 2010 photography show that the same public thoroughfares that are in place today were in place then; however, the scenery has changed from natural to a more developed state with residential, commercial and industrial development dominating U.S. Highway 90, Interstate 10, and the state and parish roads in the areas surrounding Lafayette and Lake Charles. The areas to the south in Cameron and Vermillion Parish are still relatively rural, giving the viewer near unobstructed views of a native landscape that has remained aesthetically pleasing during this twenty year time frame. Primary view sheds then, as they are today, were best taken from the local road system.

The Louisiana Scenic Rivers Act of 1988 was established to preserve, protect, and enhance the wilderness qualities, scenic beauties, and ecological regimes of rivers and streams in the state. There is one identified Scenic Stream located near the study area. Calcasieu River is located in the northeastern corner of Calcasieu Parish. The portion of Calcasieu River that qualifies as scenic stretches from the northeastern corner of Calcasieu Parish northeast into Allen Parish south some 34 miles. The Calcasieu River flows through a relatively uniform type of mixed pine-hardwood forest of uneven ages on low, rolling, well drained hills. Much of the timberland is grazed by cattle which tend to lower its value for wildlife. The best habitat can be found immediately adjacent to the stream where the area exhibits high habitat diversity.

Access to the study area is in abundance with highways and byways crisscrossing the region along with local streets and neighborhoods in the more developed portions. Scenic Byways in the area include the Creole Nature Trail; which traverses State and Parish Highways 82, 27, 384, 385, and 397. This Scenic Byway is both state and federally designated and also has an “All American Road” status, making it significant in culture, history, recreation, archeology, aesthetics and tourism. Other Scenic Byways include the Zydeco Cajun Priairie Scenic Byway, located just north of Lafayette and the Jean Lafitte Scenic Byway, located just south of Lafayette. Both of these byways carry a state designation only, but are no less significant in their importance to the region in terms of tourism, scenic vistas, recreation and the local economy.

The Calcasieu River flows through a relatively uniform type of mixed pine-hardwood forest of uneven ages on low, rolling, well drained hills. Much of the timberland is grazed by cattle which tend to lower its value for wildlife. The best habitat can be found immediately adjacent to the stream where the area exhibits high habitat diversity. Recreation opportunities are abundant and include canoeing and fishing but access is relatively limited.

Other major water resources include the Gulf of Mexico, Sabine Lake, Calcasieu Lake, Grand Lake, White Lake and Vermillion Bay as large bodies of water. Within the coastal parishes there is an abundance of varying water bodies both salt and fresh water mixed with marsh, swamp and wetland. Numerous canals, streams and creeks crisscross the native habitat south of I-10 and the more developed areas along that corridor.

There are a variety of eco-regions within the area. Cameron Parish is primarily made up of Texas – Louisiana Coastal Marshes. Vermilion Parish is made up of Northern Humid Gulf Coastal Prairies in the northwest, Lafayette Loess Plains in the northeast, and Texas – Louisiana Coastal Marshes in the south. Calcasieu Parish is made up of Northern Humid Gulf Coastal Prairies in the southern parish of the parish, Flatwoods in the northern portion of the parish, and small pockets of Texas – Louisiana Coastal Marshes along the Calcasieu River corridor (according to the State of Louisiana Eco-Region Map, ref. “Louisiana Speaks.

The Northern Humid Gulf Coast Prairies originally contained tallgrass grasslands with gallery forests along streams paired with gently sloping coastal plain. In modern times, almost all of the coastal prairies have been converted to croplands, pasture, aquaculture or urban land uses. Texas – Louisiana Coastal Marshes is an area characterized by extensive freshwater and saltwater coastal marshes, few bays, and lack of barrier islands. There are many rivers, lakes, bayous, tidal channels, and canals. Chenier plains occupy about three percent of the region and are typically treeless. Lafayette Loess plains originally were home to a variety of plant species that included trees and grasses. In modern times native species have been replaced with crops of rice, soybeans, cotton, sugarcane, sweet potatoes, wheat, and aquaculture. Urban expansion into this eco-region has been substantial. Flatwoods generally occurs on mostly flat to gently sloping sediments. This eco-region was once dominated by longleaf pine flatwoods and savannas, pimple mounds, and small hillocks. While reduction of these characteristics has taken place, these features still dominate the area, especially in the case of the longleaf pine.

Access to the area is in abundance with highways and byways crisscrossing the region along with local streets and neighborhoods in the more developed portions. Scenic Byways in the area include the Creole Nature Trail; which traverses State and Parish Highways 82, 27, 384, 385, and 397. This Scenic Byway is both state and federally designated and also has an "All American Road" status, making it significant in culture, history, recreation, archeology, aesthetics and tourism. Other Scenic Byways include the Zydeco Cajun Priairie Scenic Byway, located just north of Lafayette and the Jean Lafitte Scenic Byway, located just south of Lafayette. Both of these byways carry a state designation only, but are no less significant in their importance to the region in terms of tourism, recreation and the local economy.

Other entities with institutional and public significance include the Sabine National Wildlife Refuge, Cameron Prairie National Wildlife Refuge, and Locassine National Wildlife Refuge, all of which are located in Cameron Parish, and, finally, Sam Houston Jones State Park, which is located in Calcasieu Parish. These state and federally protected areas offer a refuge for the landscape and wildlife of southeast Louisiana and important recreational opportunities.

1.4.12 Recreation Resources – see Recreation Annex

1.4.13 Noise

Noise, or unwanted sound, may be objectionable in terms of the nuisance, health, or well-being effects it may have upon humans and the human environment, as well as upon animals and ecological systems (Kryter 1994). Generally, noise is a localized phenomenon. Regulations for Occupational Noise Exposure (29 CFR §1910.95) under the Occupational Safety and Health Act of 1970, as amended, establishes a means for effective coordination of Federal activities in noise control and to provide information to the public regarding noise emissions. There are many different noise sources throughout the area including commercial and recreational boats, and other recreational vehicles; automobiles and trucks, and all terrain vehicles; aircraft; machinery and motors; and industry-related noise.

1.5 Future Without Project Conditions (No Action Alternative)

This section presents the future without project conditions for the human and natural environment for not implementing a Federal project or taking No Action. For all resources discussed below there would be no direct effects from taking 'no action'.

1.5.1 Human Environment

1.5.1.1 Population and Housing

<u>Future Without-Project Conditions (No Action Alternative)</u>

Changes in population, households, and housing are expected to follow the growth in employment within the area. Recent trend analysis (Moody's Analytics 2008) indicates an increase of 15,000 residents and approximately 5,600 residential structures projected for the area which will impact estimates of employment, as described in the next section. Generally, the overall population is projected to increase. However, the Cameron Parish population is projected continue its trend of decreasing since 2000 (table 1-16).

A single catastrophic storm surge event or multiple events could result in significant damage to economic assets including primarily residential, commercial, and industrial structures. Additionally, property owners could potentially incur higher insurance premiums offered by the National Flood Insurance Program (NFIP) should flood rate insurance maps (FIRM) be updated to reflect an increase in risk over time due to relative sea level rise.

Parish	Population		
	2020	2030	2080
Calcasieu	195.0	200	236.7
Cameron	6.6	6.6	3.9
Vermillion	59.9	63	76.8
Total	261.4	269.6	317.4

Table-1-16 Projected Parish Population (in Thousands)

Indirect impacts include an increased potential for flood damage to economic assets due to relative sea level rise. As a consequence of this increased flood risk, property owners and the NFIP (if insured) over time would together incur increased costs to repair flood-damaged property. Additional costs to implement appropriate mitigation measures to address potential increased flood risk would also be incurred. Such mitigation could include the migration (or displacement) of affected populations from areas exposed to high flood risk to area with relatively lower flood risk. Migration out of the area could also aisle from the temporary or permanent relocation of businesses and employment opportunities.

1.5.1.2 Employment, Business, and Industrial Activity (including Agriculture)

Future Without-Project Conditions (No Action Alternative)

Indirect impacts would include a higher potential for temporary interruption or permanent displacement of employment, business, and industrial activity as businesses temporarily or permanently relocate to areas with less storm damage risk. Growth in employment, business and industrial activity is expected to follow national economic trends to the extent that economic growth is dependent upon macroeconomic variables such as inflation, interest rates, and the business cycle. However, employment in this region is also partially dependent on the petroleum exploration, production, and refining industries, which do not necessarily correlate with national economic trends. Employment trends (Moody's Analytics 2008) suggests growth from 2012 to 2038 with an additional 6,880 jobs projected by the year 2038 (table 1-17). Cameron Parish, employment is expected to stabilize at 2012 levels (Moody's Analytics 2008).

One or more series of catastrophic storm surge events in the future could result in significant disruption to business and industrial activity that could adversely affect employment and population. Such catastrophic events causing significant damage to non-residential, commercial, and industrial structures would likely increase over time as a result of multiple factors such as relative sea level rise and global warming (source: http://www.climatehotmap.org/global-warming-effects/economy.html accessed October 30, 2013). Additionally, business owners in these communities could potentially incur higher flood insurance premiums should the FIRMs be updated to reflect an increase in flood risk over time.

Table 1-17 Projected Non-Farm Employment (in 1,000s)

PARISH	2012	2020	2030	2038
Calcasieu	91.89	96.5	95.5	95.4
Cameron	2.69	2.8	2.7	2.7
Vermilion	16.54	17.7	18.4	19.9
Total	111.12	116.9	116.5	118.0

Source: Moody'sAnalytics

1.5.1.3 Public Facilities and Services

Future Without-Project Conditions (No Action Alternative)

Indirect impacts would include a greater potential for permanent displacement of public facilities and services due to storm surge events. Public facilities and services are expected to grow with the needs of the population and would follow population growth trends. In addition to the existing 603 public and quasi-public buildings, an additional 193 such facilities are projected by 2080. These projected facilities are expected to be placed at elevations above the 100-year floodplain. Over time, all facilities would be more susceptible to damages resulting from future hurricane and storm surge events as relative sea level rise occurs. The increased risk of damage to public facilities and the resulting temporary or potentially permanent relocation of these facilities would have a negative impact on services which would no longer be available either temporarily or permanently.

1.5.1.4 Transportation

Future Without-Project Conditions (No Action Alternative)

There would be no direct impacts. Transportation infrastructure would be more susceptible to damages resulting from storm surge events due to expected relative sea level rise. There would also be reduced access to infrastructure due to storm surge.

1.5.1.5 Community and Regional Growth

Future Without-Project Conditions (No Action Alternative)

There would be no direct impacts. Income growth and associated community and regional growth are expected to follow trends in national income, local employment, household formation, and the demand for public facilities and services. There would also be a higher potential for unstable or disrupted community and regional growth due to increasing risk of damage from storm surge events.

1.5.1.6 Tax Revenues and Property Values

Future Without-Project Conditions (No Action Alternative)

Indirect impacts would include lower tax revenues as property values decline due to higher risk of damage from storm surge events over time. The real estate market cycle is the primary factor in establishing existing and future property values at any point in time. However, over the period of analysis (50 years) changes in property values would be primarily reflective of the growth in income. As flood risk grows over time due to higher surge events as a feature of relative sea level rise, the effects of higher flood risk would continue to suppress real estate market values for residential and non-residential properties. As in other coastal regions, higher flood risk would manifest itself in higher premiums for flood insurance under the NFIP: higher premiums are expected to increase the cost of property ownership and result in correspondingly lower market values. In extreme cases, such premiums are expected to rise to such high levels that the cost of flood insurance would become prohibitively expensive to some property owners. As a result, some properties would not be marketable and their values be reduced to an extremely low level. To the extent that government assessments of these properties accurately reflect the diminished market values, the tax base would be reduced and property tax revenues decline.

Some property owners would choose to reduce higher expected future flood risk through mitigation activities. These activities would primarily include, but are not limited to, structure elevation, flood-proofing of commercial structures, and relocation to less risky portions of the study area. Each of these mitigation efforts require substantial financial resources to implement, whether these costs are borne by the property owner or are supplemented, in whole or in part, by public assistance.

1.5.1.7 Community Cohesion

Future Without-Project Conditions (No Action Alternative)

The area would become more susceptible to damage caused by storm surge events that is projected to increase over the period of analysis. The increased risk of damage to residential and non-residential structures and the resulting temporary and/or permanent relocation of populations would negatively affect the community cohesion in many communities. Additional indirect effects would include a greater potential reducing community cohesion if the civic infrastructure continues to be damaged as a result of storm surge events. Community cohesion may also be reduced if residents and businesses relocate to lower-risk areas.

1.5.1.8 Other Social Effects (OSE)

Future Without-Project Conditions (No Action Alternative)

The area's social vulnerability is expected to increase over time if subsidence and sea level rise continue to increase, and the population in the study area increases as it is projected to do. The absolute number of socially vulnerable people (e.g., low-income, minority, less-educated, and over the age of 65) at risk for flood events will increase. This, in turn, may lead to an increased burden placed on local, state, and federal agencies to ensure that the most socially vulnerable populations have access to resources before, during, and after flood events.

1.5.1.9 Environmental Justice

Future Without-Project Conditions (No Action Alternative)

Indirect impacts would include a higher potential for temporary displacement of minority and/or low-income populations because residents within the project area would remain vulnerable to flooding and may be forced to relocate to areas with risk reduction features in place. Storm surge increase due to subsidence and sea level rise will exacerbate their vulnerability to flooding. Low-income populations may also find it more difficult to bear the cost of evacuation. This alternative would not contribute to any additional EJ issues when combined with other Federal, state, local, and private risk reduction efforts.

1.5.2 Water Environment

1.5.2.1 Relative Sea Level Rise

Future Without-Project Conditions (No Action Alternative)

Sea level rise (SLR) conditions were simulated by incorporating the predicted subsidence levels into the initial water elevation parameter to capture the combined effects of subsidence and local SLR into a single RSLR value. For the 2025 and 2075 hydrologic simulations, RSLR values specific to each gage were added to the 2013 initial water surface elevations (WSE) to calculate the initial WSE appropriate for each year and SLR rate. SLR and RSLR data is listed in table 1-18 and shown in figure 1-12. Four gages were used for the entire RSLR analysis, however only the gage closest to the main area with potential benefits is shown.

Table 1-18: RSLR rise for the gage on the GIWW west of Calcasieu Lock.

Year and SLR Scenario	Calcasieu West RSLR increment (in feet)	Calcasieu West gage elevations (NAVD88 feet)
2025 Low SLR	0.16	0.78
2025 Intermediate SLR	0.22	0.84
2025 High SLR	0.40	1.02
2075 Low SLR	0.85	1.47
2075 Intermediate SLR	1.42	2.04
2075 High SLR	3.24	3.86

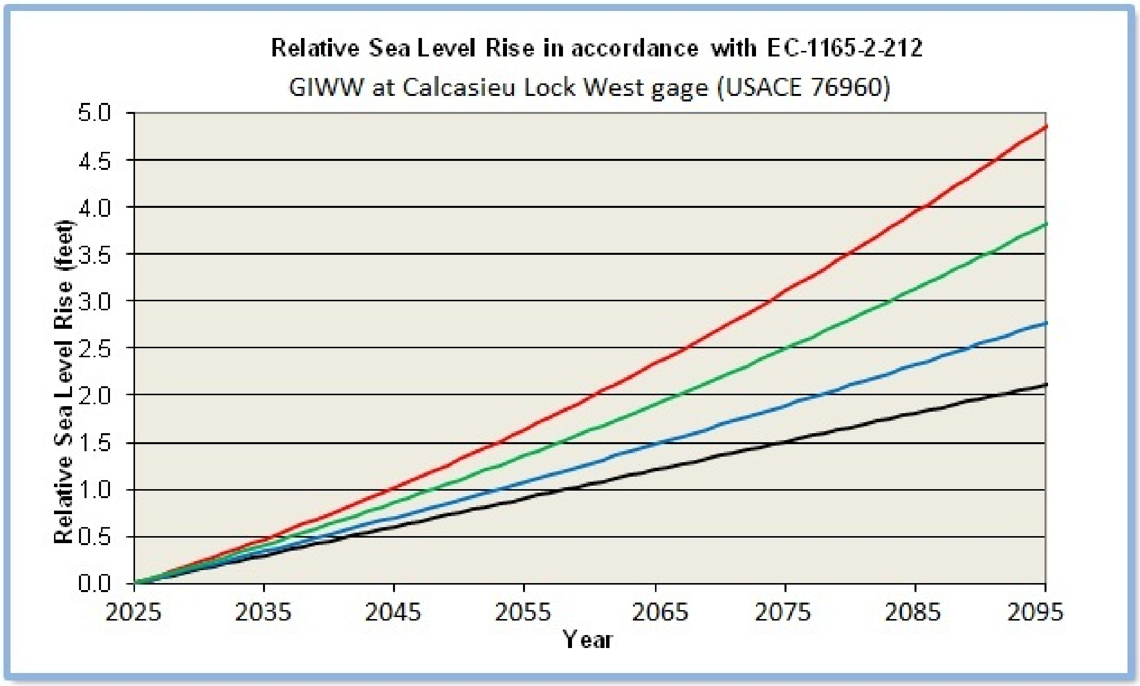

Figure 1-12. Relative sea level rise in the project area.
Black = extrapolation of historic rate Blue = low RSLR. Green = intermediate RSLR. Red = high RSLR.

1.5.2.2 Hydrology and Hydraulics

Future Without-Project Conditions (No Action Alternative)

In the immediate area of Lake Charles, 100-year frequency event water levels are estimated to rise between 0.47 feet and 1.19 feet between 2013 and 2075. In the surrounding marsh areas for all parishes, water levels are estimated to rise between 1.30 feet and 7.40 feet. For the areas along I-10 such as Welsh, Jennings, and Crowley that are far away from any water source connected to the Gulf of Mexico, there is no estimated rise in water surface elevations. This data is shown in tables in the Engineering appendix - Southwest Coastal Louisiana Explanation of FWOP Results. This analysis is based upon the intermediate rate of relative sea level rise. Adding marsh accretion raises water levels slightly in the marsh areas, while not impacting any NED areas.

1.5.2.3 Flow and Water Levels

Future Without-Project Conditions (No Action Alternative)

Indirect impacts would be continuation of the existing water flow and water level trends. As existing marsh fragments and is eventually converted to open water, the rainfall runoff from the north and the increasing sea level rise would result in the area converting to greater expanses of fragmented marsh and open water. As sea levels rise, existing locks and control structures used for salinity control would be closed on a more frequent basis over time until they would be closed all the time to prevent saltwater intrusion. Natural drainage pattern flow paths would remain unchanged; however, as sea levels rise, drainage times would increase.

1.5.2.4 Water Quality and Salinity

Future Without-Project Conditions (No Action Alternative)

Existing water quality trends would be expected to continue. Without the proposed project there would be an increased risk of flooding of the urban areas, and drainage of floodwaters containing elevated nutrients, metals, and organics into waterbodies connected to the Calcasieu, Mermentau, and Tech-Vermillion river basins is a possibility. Without the proposed project, study area would still be affected by existing and proposed restoration efforts, chenier geomorphologic processes, development (in particular, oil and gas development in the Calcasieu River basin and agriculture in the Mermentau River basin), and climate patterns (Mousavi et. al 2011).

1.5.3 Natural Environment

1.5.3.1 Sedimentation and Erosion

Future Without-Project Conditions (No Action Alternative)

Indirect effects would include persistence of current sedimentation and erosion patterns. Relative sea level rise would expose additional shoreline areas to erosive forces into the foreseeable future. Existing hydrologic alterations would continue to impact water levels and salinities and continue influencing land loss at similar or increased rates.

North White Lake in the Mermentau Basin is expected to lose approximately 3,500 acres of freshwater marsh by 2050 (Coast 2050) resulting from shoreline erosion. South White Lake is expected to lose approximately 4,200 acres of freshwater marsh by 2050. The Vermilion Bay Marshes are expected to lose 13,560 acres of marsh by 2050 (Coast 2050). Rainey Marsh is expected to lose approximately 7,900 acres by 2050 (Coast 2050).

1.5.3.2 Soils, Water Bottoms and Prime and Unique Farmlands

Future Without-Project Conditions (No Action Alternative)

There would be no direct effects. Indirect effects would be the continuation of existing conditions with coastal shoreline recession, subsidence and land loss continuing at similar or increasing rates of change. As RSLR increases and areas become inundated by salt water, prime farmlands could be lost.

Some unknown extent of existing oak-pine forest habitats would likely be converted to pasture, agriculture, rural, suburban and urban human habitats. As human populations and development increase, prime farmlands could be converted to suburban, urban, and industrial uses and areas available for agricultural use would decrease.

Gulf shoreline recession rates, varying between 8 feet to 52.9 feet per year, would result in Gulf shoreline rollover onto back barrier marsh and cheniers would continue to be lost throughout the southwest coastal area due to subsidence and change in land use patterns from forested areas to agriculture and grazing pasture. Soils identified as prime farmlands on chenier ridge tops would be susceptible to flooding events and subsidence and could be lost as RSLR increases.

1.5.3.3 Gulf Coastal Shorelines

Future Without-Project Conditions (No Action Alternative)

There would be no direct effects. Indirect effects would be the continuation of existing conditions with coastal shoreline recession, subsidence and land loss continuing at similar or increasing rates of change. The loss of these coastal shorelines would also adversely impact the extraordinary scenic, scientific, recreational, natural, historical, archeological, cultural, and economic importance of the coastal shorelines. The continued loss of coastal shorelines would result in the reduction and eventual loss of the natural protective storm buffering. Without the protective buffer provided by the coastal shorelines, interior estuarine wetlands would be at an increased risk to severe damage from tropical storm events. Continued shoreline recession, subsidence and land loss resulting in the movement of unstable sediments would undermine man-made structures, especially the extensive oil and gas pipelines and related structures in this “working coastline.”

1.5.3.4 Vegetation Resources

Future Without-Project Conditions (No Action Alternative)

Indirect effects would be the continuation of existing conditions and factors driving trajectories of ecological change to area vegetation zones. Without an extensive ecosystem restoration plan, marsh habitat would continue to be restored through other restoration projects and programs such as those authorized for construction through CWPPRA, CIAP, and LCA, but not on a large and broad enough scale to completely restore natural processes and features vital to the long-term sustainability of the watershed. Without action, the coastal vegetated resources would continue to decline, including bankline erosion and sloughing of the shoreline, and continued fragmentation and conversion of existing brackish and saline marsh to shallow open water habitats. Both human-induced impacts and natural processes would contribute to the continued loss of vegetated habitats, including continued shoreline erosion and subsidence, increased saltwater intrusion, increased water velocities, and increased herbivory.

Gulf Coast Prairie and Forested Terraced Uplands:

- Some unknown extent of existing oak-pine forest habitats would likely be converted to pasture, agriculture, rural, suburban and urban habitats, generally in this order of conversion, as human populations and development increase.
- Some unknown extent of existing riverine BLH and associated swamp habitats would be converted to more efficient water conveyance channels as human populations and development increase.
- Some unknown extent of existing pasture and rangelands would be converted to rural, suburban and urban human habitats, generally in the order presented, as human populations and development increase.

Gulf Coast Marshes

- Habitat switching would occur due to increasing sea level rise, subsidence, shoreline erosion and other land loss drivers.
- Gulf shoreline recession rates, varying between 8 feet to 52.9 feet per year, would result

in Gulf shoreline rollover onto back barrier marsh thereby converting these existing habitats.

- Chenier ridge habitat is being lost throughout the southwest coastal area due to subsidence and change in land use patterns from forested areas to agriculture and grazing pasture. However, no loss of chenier habitat is anticipated within the proposed restoration areas because these areas are at least +4 foot NAVD88.
- Inland ponds and lakes shoreline loss rates, varying between 3.6 feet and 9.3 feet, would result in conversion of existing salt, brackish, and intermediate/fresh marsh to shallow open water habitats.
- Habitat switching of interior marsh could from saline intolerant dominant species to species that can tolerate higher salinities.
- SAVs could become lost due to erosive forces and increased sedimentation due to land loss.

Reference Table 1-19 for the NER restoration feature habitat type, acres and quality by hydrologic basin for comparison between the future without and with project condition (reference chapter 2 and 4 for plan formulation details and description of the NER TSP).

Table 1-19: NER Features by Basin

Basin	Category	Feature	Habitat Type	FWOP Acres	FWP Acres	NET AAHUs[1]
Mermentau/Teche-Vermilion	**Hydraulic/ Salinity Control**	**13**	**Unknown**		**~2,791[2]**	**11[2]**
	Marsh Restoration	**47a1**	**Brackish**	**0**	**895**	**378**
		47a2	**Brackish**	**0**	**1,218**	**517**
		47c1	**Brackish**	**0**	**1,135**	**497**
		127c3	**Brackish**	**0**	**735**	**320**
		306a1	**Brackish**	**1,945**	**2,688**	**362**
	Shore Protection	**6b1**	**Saline**	**0**	**2,140**	**678**
		6b2	**Saline**	**0**	**1,583**	**499**
		6b3	**Saline**	**0**	**1,098**	**326**
		16b	**Brackish**	**1,456**	**2,744**	**212**
	Chenier Restoration	**CR**	**BLH**	**252**	**242 planted**	**85[3]**
Calcasieu/Sabine	**Hydraulic/ Salinity Control**	**74a**	**Unknown**		**~ 1,395[2]**	**-83[2]**
	Marsh Restoration	**3a1**	**Brackish**	**0**	**454**	**252**
		3c1	**Brackish**	**0**	**1,451**	**705**
		124c	**Saline**	**248**	**2,163**	**1,059**
		124d	**Saline**	**307**	**475**	**104**
	Shore Protection	**5a**	**Barrier Headland**	**0**	**26**	**56[3]**
	Chenier Restoration	**CR**	**BLH**	**459**	**426 plante**	**173[3]**

					d	
	Oyster Reef Protection	**ORP**	**Oyster Reefs**		**~1,480** [4]	**N/A**[4]

The numbers used to feed the WVAs were pulled from State of Louisiana Master Plan Modeling effort.
[1]A non certified version of the WVA model was used for all Marsh Restoration features. A sensitivity analysis needs to be done to see if using the certified model would change the outcome of the plan selection.
[2] Separate WVAs were not run for the Hydraulic/Salinity Control features. The numbers presented here are based on WVAs run for multiple features and are mathematical subtractions from plans with and without the feature.
[3] The BLH and Barrier Headland WVA models used are certified models with no restrictions on use.
4 No habitat model was used to determine the value of this feature. A certified model needs to be run to determine the value.

1.5.3.5 Rare, Unique, and Imperiled Vegetative Communities

Future Without-Project Conditions (No Action Alternative)

Existing conditions and trends of land loss are expected to continue resulting over time in the loss of these valuable vegetative communities. For example, without action, saltwater intrusion and drainage problems would continue, resulting in the conversion of freshwater marsh to intermediate and brackish marsh and eventual open water.

1.5.3.6 Wildlife Resources

Future Without-Project Conditions (No Action Alternative)

Existing conditions and changes caused by ecosystem drivers would persist. RSLR, human encroachment and development and other factors would result in loss of existing wildlife estuarine, chenier, riverine and oak-pine forest habitats. Increases in RSLR would increase saltwater intrusion and exacerbate ongoing conversion of estuarine wetlands to shallow open water. As habitat loss continues, migratory neotropic avian species would have less habitat for resting forcing them to fly further to suitable habitat. Flying longer distances to find suitable stopover habitat could result in an increase in mortality resulting in a corresponding reduction in overall species diversity and abundance. Most mammalian, amphibian and reptilian species would migrate to more suitable habitats. Wildlife would benefit from restoration activities implementated by other programs such as CIAP, CWPPRA, beneficial use of dredged material; However these activities are not enough to keep up with the current trends in habitat loss and RSLR.

1.5.3.7 Aquatic and Fisheries Resources

Future Without-Project Conditions (No Action Alternative)

Existing conditions and associated changes due to ecosystem drivers would likely persist into the future. Increases in RSLR would increase saltwater intrusion and exacerbate ongoing conversion of estuarine wetlands to shallow open water and loss of existing estuarine fish habitats. Increases in RSLR could exacerbate ongoing conversion of existing aquatic organism distributions from an estuarine-dependent to more marine-dependent distribution. As habitat loss continues, there would be a corresponding reduction in overall species diversity and abundance as well as loss of estuarine nursery, foraging, refugia and other estuarine aquatic habitats. Aquatic and fisheries would benefit from restoration activities implementated by other programs such as CIAP, CWPPRA, beneficial use of dredged material; However these activities are not enough to keep up with the current trends in habitat loss and RSLR.

1.5.3.8 Essential Fish Habitat (EFH)

Future Without-Project Conditions (No Action Alternative)

Existing trends and continued shoreline erosion, subsidence and land loss would continue to convert existing estuarine EFH to marine and open water EFH types resulting in the loss of existing estuarine EFH but an increase in the other types.

1.5.3.9 Threatened and Endangered Species

Future Without-Project Conditions (No Action Alternative)

Land loss would directly reduce the availability of habitat for T&E species. Piping plover would lose access to some forage and roosting habitat as it shifts to shallow open water. As interior marshes are lost, shoreline retreat rates increase. The coastal habitat utilized by sea turtles would continue to be impacted from this accelerated shoreline retreat rate. The continued erosion of the Gulf coast shoreline would result in additional salt water intrusion into the interior wetlands area resulting in additional marsh loss. Conversely, the recently delisted brown pelicans would gain access to more shallow water foraging areas, resulting from the shoreline retreat. Indirect effects would be the continued reduction of piping plover critical wintering habitat due to coastal erosion. The primary consequence of not implementing the NER plan would be the continued degradation and loss of emergent wetland habitats used by many different fish and wildlife species for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements. The loss and deterioration of transitional wetland habitats over time could continue to indirectly affect, to an undetermined degree, all listed species that may potentially utilize the area including: Gulf sturgeon, piping plovers, green sea turtles, Kemp's Ridley sea turtles, loggerhead sea turtles, hawksbill sea turtle, leatherback sea turtle, and the West Indian manatee. The recovery of some sensitive/delisted species such as brown pelican, bald eagle, and colonial nesting birds could be indirectly impacted if habitat loss goes unabated.

1.5.3.10 Cultural and Historic Resources

Future Without-Project Conditions (No Action Alternative)

Impacts to historic and cultural resources in southwest Louisiana have resulted from both natural processes, such as redeposition, and human activities. Coastal environments are dynamic, and impacts to cultural and historic resources in the area would continue as a result of both natural processes and cultural modifications of the coastal environment of southwest Louisiana.

1.5.3.11 Aesthetics and Visual Resources

Future Without-Project Conditions (No Action Alternative)

There would be no direct, indirect or cumulative effects.

1.5.3.12 Recreation Resources – See Recreation Annex

1.5.3.13 Noise

Future Without-Project Conditions (No Action Alternative)

There would be no direct, indirect or cumulative effects.

1.6 Cumulative Impacts for Future Without Project Conditions

Cumulative impacts would be the incremental direct and indirect effects of not implementing proposed NED and NER efforts. These incremental effects would be in addition to the direct and indirect effects attributable to the lost opportunity of not implementing other HSDRR or ecosystem restoration efforts which have been considered, but for whatever reasons are not or would not be implemented.

There is little published data with which to provide a quantitative comparison regarding HSDRR or ecosystem restoration projects which have been considered but have not been authorized for implementation or have not been constructed throughout Louisiana. Some information regarding such efforts:

- The 1990 Coastal Wetlands Coastal Wetlands Planning, Protection and Restoration Act, (CWPPRA; Public Law 101-646, Title III CWPPRA).
- The 1998 *Coast 2050: Toward a Sustainable Coastal Louisiana* plan to address Louisiana's costal land loss and provide for a sustainable costal ecosystem. This collective effort among Federal, State, and local governments was affirmed by the adoption of the plan by the Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority as their official restoration plan; transmission of this plan to the U.S. Department of Commerce by the State of Louisiana to incorporate it into the Louisiana Coastal Resources Program Guidelines; and resolutions of support from 20 coastal parish councils and police juries.
- The Louisiana Coastal Area (LCA), Louisiana Ecosystem Restoration Study (hereinafter "LCA Plan," USACE 2004).
- Louisiana's Comprehensive Master Plan for a Sustainable Coast (hereinafter "2012 State Master Plan; CPRA 2012).

Since its inception, the CWPPRA program has authorized for construction 151 coastal restoration or protection projects, benefiting over 110,000 acres in Louisiana (source: http://lacoast.gov/new/About/#projects accessed October 22, 2013). However, hundreds of ecosystem restoration projects have been considered as candidate or demonstration projects. Of these, approximately 253 projects were not selected for detailed consideration (personal communication Ms Susan Hennignton, USACE Representative CWPPRA, on October 24, 2013).

The LCA Plan identified 15 projects. Six LCA feasibility studies were approved in 2010 and a PED agreement executed in 2011. In 2012 the state changed direction and withdrew their support for four of the six projects and indicated their intent to pursue those efforts independently or through other partnerships. In October 2012 the state requested suspension of the "LCA 4" ongoing feasibility studies. As of November 2013, only one LCA feasibility study is underway-- the development of river modeling tools to be used in assessing management of the Mississippi River delta. This study is scheduled to be completed in fiscal year 2016. In the LCA Program the State is expected to continue to partner with the USACE on the advancement of the Small Diversion at Convent/Blind River projects (currently in design), and to construct the Caminada Headland component of the Barataria Basin Barrier Shoreline project (currently in design by the State) and Demonstration Projects (currently developing program implementation plans). The State has declined to participate in the LCA BUDMAT program; however, agreements with another non-federal cost share sponsor are presently being negotiated.

The 2012 State Master Plan (CPRA 2012) states that more than 23 large-scale studies and planning efforts have been conducted for coastal Louisiana since the 1920's. The State developed and screened over 1,500 project ideas to develop a more manageable number of candidate projects. From this, the State evaluated 248 restoration projects, 33 structural and 116 conceptual non-structural flood risk reduction projects. The State acknowledges that each project has its own timeline and budget. The 2012 State Master Plan indicates how the State of Louisiana would spend dollars they now have in hand as well as how they would use new dollars that are allocated for Louisiana's coast. It is reasonably foreseeable that some of the identified projects would likely not be constructed.

In response to the 2012 Gulf of Mexico Deepwater Horizon oil spill to help ensure the long-term restoration and recovery of the Gulf Coast region, the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act of 2012, or the RESTORE Act (herein referred to as Act), was passed by Congress on June 29, 2012, and signed into law by President Obama on July 6, 2012 ((http://www.restorethegulf.gov/sites/default/files/The%20Path%20Forward%20to%20Restoring%20the%20Gulf%20Coast%20-%20Gulf%20Restoration%20Council%20FINAL.pdf accessed November 22, 2013). The Act provides for planning and resources for a regional approach to the long term health of the natural ecosystems and economy of the Gulf Coast region. The Act sets forth the following framework for allocation of the Trust Fund (http://www.restorethegulf.gov/release/2012/11/30/gulf-coast-ecosystem-restoration-council-help-rebuild-gulf-coasts%E2%80%99-ecosystems-and accessed November 22, 2013):

- 35 percent equally divided among the five States for ecological restoration, economic development, and tourism promotion;
- 30 percent plus interest managed by the Council for ecosystem restoration under the Comprehensive Plan;
- 30 percent divided among the States according to a formula to implement State expenditure plans, which require approval of the Council;
- 2.5 percent plus interest for the Gulf Coast Ecosystem Restoration Science, Observation, Monitoring and Technology Program within the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA); and
- 2.5 percent plus interest allocated to the States for Centers of Excellence Research grants, which will each focus on science, technology, and monitoring related to Gulf restoration.

The Act requires the Initial Comprehensive Plan (Plan) to include "a list of projects and programs authorized prior to the date of enactment of [the Act] but not yet commenced, the completion of which would further the purposes and goals of [the Act]." The Department of Agriculture identifies 8 projects; U.S. Forest Service identifies 3 projects; Department of Commerce identifies 6; Department of Interior identifies 3 projects; Louisiana identifies 6 projects; USACE identifies 42 projects; EPA identifies 6 projects specific to Louisiana and 1 project Gulf-wide (http://www.restorethegulf.gov/sites/default/files/Authorized%20But%20Not%20Yet%20Commenced%20List_8-6-13_FINAL.pdf?utm_medium=email&utm_source=govdelivery accessed November 22, 2013):

In 2013, the Coastal Protection and Restoration Authority (CPRA) submitted a request for a Department of Army permit pursuant to Section 404 Clean Water Act and Section 10 of the Rivers and Harbors Act and permissions under the 33 U.S.C. Section 408 for a proposed action on the Mid-Barataria Sediment Diversion. The project involves structural crossings of the Federal Mississippi River and Tributaries Levee and the future NEW Orleans to Venice Hurricane Protection Levee and could impact the Mississippi River Navigation Channel, Davis Pond Freshwater Diversion as well as other Federal projects. The CEMVN intends to prepare an EIS. The notice of intent was published in the Federal Register/Vol. 78, No. 193/Friday, October 4, 2013.

The cumulative effects of not implementing the proposed action would include the incremental effects of not providing HSDRR and/or ecosystem restoration on the following:

Human Environment

- an estimated population of 225,000 and 15,000 residential structures in the study area in the year 2075;
- employment of 106,000 workers in the three-parish area in the year 2010; 1580 non-residential structures in the study area by 2075; 808,414 acres of agricultural land within the three-parish area in 2009 projected 603 public and quasi-public buildings, and an additional 193 such facilities projected by 2080;
- transportation infrastructure would be more susceptible to damages resulting from storm surge events due to expected RSLR
- reduced access to infrastructure due to storm surges;
- community and regional growth;
- tax revenues and property values;
- higher flood insurance premiums would be expected to increase the cost of property ownership and result in correspondingly lower market values;
- continued or increased risk of damage to residential and non-residential structures resulting in temporary and/or permanent relocation of populations would negatively affect the community cohesion in many communities;
- continued temporary displacement of minority and/or low-income populations because residents within the area would remain vulnerable to flooding and may be forced to relocate to areas with risk reduction features in place;
- continued higher flood risks would manifest itself in higher premiums for flood insurance under the NFIP
- continued shoreline recession, subsidence and land loss resulting in the movement of unstable sediments would undermine man-made structures, especially the extensive oil and gas pipelines and related structures in this “working coastline;”

Water Environment

- existing hydrologic alterations would continue to impact water levels and salinities and continue influencing land loss at similar or increased rates;
- as sea levels rise, natural drainage pattern flow paths would remain unchanged but drainage times would increase;
- continued salt water intrusion and inundation during hurricane and storm surge events;
- continued erosion by wave and current action resulting in continued shoreline erosion of most channels, lakes, and the Gulf;

Natural Environment

- continued loss of soil resources. The LCA Study (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 is almost 10 percent of Louisiana’s remaining coastal wetlands. However, these wetland soil losses would be offset to some extent by restoration projects implemented through other programs.
- continued increases in RSLR which could increase saltwater intrusion and exacerbate ongoing conversion of existing estuarine wetlands to shallow open water; impacts to cultural and historic resources in the area would continue as a result of both natural processes and cultural modifications of the coastal environment of southwest Louisiana;
- recreational infrastructure would remain vulnerable to hurricanes and storm surges.

- continued conversion of existing vegetated wetlands used as foraging, nesting, and over-wintering habitat to open water habitats;
- reduction in overall species diversity and abundance as well as loss of estuarine nursery, foraging, refugia and other estuarine aquatic habitats;
- continued bankline erosion and sloughing of the shoreline;
- continued encroachment of salinity in areas with brackish and freshwaters;
- continued habitat switching due to increasing RSLR, subsidence, shoreline erosion and other land loss drivers;
- loss of habitat would further stress species that are dependent on these habitats for all or a part of their life cycle.

2 ENVIRONMENTAL CONSEQUENCES (*NEPA REQUIRED)

This chapter describes the environmental consequences associated with the alternatives for the non structural Hurricane and Storm Damage Risk Reduction (HSDRR) NED plans and the ecosystem restoration NER plans. The impacts described here are programmatic in nature. Subsequent NEPA documents will analyze in detail site specific project(s) impacts prior to implementation.

2.1 The Human Environment (Socioeconomics)

2.1.1 Population and Housing

HSDRR (NED) Plans

Alternative - Nonstructural Justified Reaches (TSP)

Direct impacts include the inconvenience of residents having to move their personal possessions and relocate to a temporary residence while their residences are being raised or new residence in the case of buy outs.

Indirect Impacts of the TSP NED plan include reduced flood risk from the surges associated with tropical events for population and housing deemed eligible. This reduction in flood risk would lead to greater stability and sustainability of population and housing resources. Furthermore, if a residence is elevated, then access to the elevated residences could be more difficult, especially for the elderly and physically handicapped, even if retrofitted. For population and housing not included in the nonstructural plan either due to ineligibility or location outside of the justified reaches, indirect impacts include increased risk for flood damage and corresponding increased insurance costs and decreased property values as discussed in more detail in Sections 1.8.1.1 and 1.8.1.6, the No Action Alternative.

Alternative – Nonstructural 100-year Floodplain

The impacts from this alternative are similar but for the most part greater than the impacts from the Nonstructural Justified Reaches (TSP) alternative because of the larger numbers of structures that would be included in the program. This is true for all resources hence a discussion of impacts will not be added to each of the following resource unless there is a significant reason for it to be addressed separately in that resource. The scale of the differences would vary by resource.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

Restoration features of this alternative would have no direct impacts on population and housing. Indirect impacts would include decreasing the rate of shoreline erosion, thereby, preserving the temporary population of the Holly Beach camp community located along the shoreline of the Gulf of Mexico.

Alternative – Mermentau Small Integrated Restoration Plan

Impacts are the same as the Mermentau Basin (MB) component of the TSP.

2.1.2 Employment, Business, and Industrial Activity (Including Agriculture)

HSDRR (NED) Plans

Alternative - Nonstructural Justified Reaches (TSP)

Direct impacts associated with the flood proofing of businesses include business disruption, shutdown and temporary relocation while the measure is being applied.

Indirect Impacts would include reduced flood risk from the surges associated with tropical events which could promote increased stability for employment and business, and industrial activity in the study area. Indirect impacts to industrial and agricultural structures, which are not included in the nonstructural plan, include a risk of flood damage which is discussed in Section 1.8.1.2, the No Action Alternative. No loss of employment is expected.

Ecosystem Restoration (NER) Plans
Alternative - Comprehensive Small Integrated Restoration Plan (TSP)
No direct or indirect impacts

Alternative - Mermentau Small Integrated Restoration Plan
Impacts are the same as the MB component of the TSP.

2.1.3 Public Facilities and Services

HSDRR (NED) Plans
Alternative - Nonstructural Justified Reaches (TSP)
Direct impacts associated with the TSP include interruption or unavailability of public facilities and services during temporary closure or relocation during flood proofing.

Indirect impacts include reduced flood risk from the surges associated with tropical events for public facilities and services in the area thereby reducing the number of days a structure is unavailable for use and minimizing the inconvenience to the general public. Indirect impacts to public facilities and services not included in the plan would be the same as the no-action alternative.

Ecosystem Restoration (NER) Plans
Alternative - Comprehensive Small Integrated Restoration Plan (TSP)
Restoration features would have no direct, indirect or cumulative impacts on public facilities or services.

Alternative - Mermentau Small Integrated Restoration Plan
Impacts same as MB component of the TSP.

2.1.4 Transportation

HSDRR (NED) Plans
Alternative - Nonstructural Justified Reaches (TSP)
There could be minor indirect short term impact to transportation due to construction related activities from both elevations and buyouts. These impacts will vary depending on the number of structures in each category and the timing of the activities. There would be no long term impact.

Ecosystem Restoration (NER) Plans
Alternative - Comprehensive Small Integrated Restoration Plan (TSP)
No direct impacts on transportation. Indirect impacts would include mitigating the wave action that Highway 27 is routinely subject to, thereby reducing the frequency and intensity of the damages it sustains.

Alternative - Mermentau Small Integrated Restoration Plan
Impacts are the same as the MB component of the TSP

2.1.5 Community and Regional Growth

HSDRR (NED) Plans

Alternative - Nonstructural Justified Reaches (TSP)

No direct impacts. Indirect impacts would include reduced risk of damage for communities from the storm surges associated with tropical events, thus preserving growth opportunities for communities in the region.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

No direct or indirect impacts.

Alternative - Mermentau Small Integrated Restoration Plan

Impacts are the same as MB component of the TSP

2.1.6 Tax Revenues and Property Values

HSDRR (NED) Plans

Alternative - Nonstructural Justified Reaches (TSP)

Parish sales tax revenue would likely increase during implementation of nonstructural measures as a result of an expected influx of workers and construction expenditures from outside of the area. Construction activities associated would provide jobs and could increase the level of spending, labor, and capital expenditures in the area. Indirect impacts may include an increase in tax revenue and property values due to the increased risk reduction from flooding for residential properties and businesses. The tax revenues and property values for properties no included in the program would be the same as the without project values.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

No direct effects to tax revenues and property values. Indirect effects would include the prevention of land loss, which could result in localized positive effects of maintaining tax revenues and property values.

Alternative - Mermentau Small Integrated Restoration Plan

Impacts are the same as the MB component of the TSP.

2.1.7 Other Social Effects (OSE)

HSDRR (NED) Plans

Alternative - Nonstructural Justified Reaches (TSP)

A summary of OSE's is presented in the table 3-1. These include reduction in risks associated with damages from tropical/hurricane storm surge events to housing units, public facilities, and commercial structures located within reaches where the TSP is implemented, as well as improvement in the health and safety of those residents living within these and surrounding areas. The social vulnerability of all three parishes would be reduced, and thus, the potential for long-term growth and sustainability would be enhanced. These areas would be at a reduced risk of incurring costs associated with clean-up, debris removal, and building and infrastructure repair as a result of flood events.

Table 3-1: Summary of Other Social Effects.

OSE Alternative Evaluation				
Social Factors and Metrics	*Nonstructural Measures*	*CB and MB Salinity Control*	*MB*	*No Action*
	DL / FE	DL / FE	DL / FE	DL / FE
Physical Health/Safety	1/2	1/1	0/0	-1/-2
Regional Healthcare	1/2	1/1	0/0	0/-2
Employment Opportunities	1/3	0/0	0/0	-1/-3
Community Cohesion	1/2	0/0	0/0	-1/-1
Vulnerable Groups	1/1	1/1	0/0	-1/-2
Residents of Study Area	1/1	1/1	0/0	-1/-2
Recreational Activities	1/2	1/2	0/1	-1/-2
Impacts are in comparison to the Without Project Condition DL = impacts to daily life when there is no storm/flooding FE = impacts during a storm/flood event Scores can range from -3 (significant negative impact) to +3 (significant positive impact)				

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

This alternative would reduce the risks associated with habitat damage via saltwater intrusion, shoreline retreat, and loss of geomorphologic infrastructure. The area's social vulnerability would be reduced under this alternative via improved leisure and recreation opportunities, access to health and safety facilities, economic vitality, and reduced stress. Thus, the potential for long-term growth and sustainability would be enhanced.

Alternative - Mermentau Small Integrated Restoration Plans

Impact are the same as the MB component of the TSP.

2.1.8 Community Cohesion

HSDRR (NED) Plans

Alternative - Nonstructural Justified Reaches (TSP)

Direct Impacts would include the temporary displacement of residents residing in those reaches benefiting by non-structural measures. If residential structures were elevated then the residents would be temporarily relocated, disrupting community cohesion during the elevation process. Furthermore, non-residential structures that serve as meeting places for the community could become temporarily unavailable during the flood proofing process.

Indirect impacts for the nonstructural plan would include reduced risk for select communities from the damages associated with tropical/hurricane storm surge events, thus preserving the cohesion of these communities in the region. Depending on the method used on any individual property there may be a cumulative change in the communities.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

No direct or indirect.

Alternative - Mermentau Small Integrated Restoration Plan

Impacts are the same as the MB component of the TSP.

2.1.9 Environmental Justice

HSDRR (NED) Plans

Alternative - Nonstructural Justified Reaches (TSP)

Population groups residing or working near the construction site itself may experience direct impacts due to the construction traffic, noise, and dust. Indirect impacts include a decrease in risk of damage from 1 percent (and more frequent) exceedance storm events for minority and/or low-income populations residing in those reaches where the nonstructural plan is implemented.

It is assumed that all structures within the 100-year flood zone in the economically justified 11 reaches are flood-proofed, elevated, or acquired; therefore all residents within the 11 reaches, irrespective of race, ethnicity, or income, would be expected to be similarly impacted. Further evaluation will determine if the federal action causes a disproportionate impact to low-income or minority communities.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

Many of the areas are sparsely populated or devoid of permanent structures and/or population. Construction of control structures to reduce saltwater intrusion and tidal influx would temporarily impact leisure and recreation at any nearby camps or designated fishing and hunting spots. Access to some areas due to marsh restoration and nourishment activities may be temporarily interrupted. Impacts due to shoreline protection construction would also be temporary. The long-term benefits of salinity control, marsh restoration, shoreline protection, bank stabilization, chenier reforestation, and oyster reef restoration would improve wetland habitat which would subsequently improve leisure and recreation opportunities. If this alternative encourages regional economic growth, any additional jobs created may benefit minority and/or low-income groups living within the project area. Temporary impacts from construction activities due to increased turbidity, noise, and access interruption are compensated for by the opportunity for long-term positive cumulative impacts as other restoration programs improve the habitat and sustainability of coastal Louisiana.

Alternative - Mermentau Small Integrated Restoration Plan

Impacts are the same as the MB component of the TSP.

2.2 Water Environment (Hydrology and Hydraulics)

2.2.1 Flow and Water Levels

Alternative - Nonstructural Justified Reaches (TSP)

Potential direct and indirect impacts to flow and water depending on the method used.

1. Raising of structures with the use of pilings or buyout could increase storage capacity and lower the surge elevations for those structures not elevated.
2. Raising of structures with the use of earthen mounds, flood proofing or individual ring levees could decrease storage capacity and raise the surge elevations for those structures that not elevated.

3. Raising of structures with the use of cinderblock chain wall would have similar impacts as existing conditions on storage capacity and surge elevations since it would mimic existing conditions of the home.

The total level of impact would be dependent on the combination of methods and number of structures in each of those methods but at the same time would be minor.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

Hydro/Salinity: General flow patterns would not change.

- *Marsh Restoration*: Existing water levels in fragmented marsh and shallow open water areas would be converted to marsh habitat. Water levels in adjacent lakes would not change. Flows would generally overflow restored and nourished marsh areas.
- *Shoreline Protection*: Segmented breakwaters along the Gulf would dissipate the high energy Gulf waves without changing water levels or flows. Rather, these structures would provide conditions conducive to land building behind them. Interior shoreline protection measures will not alter flows or water levels. Rather, these structures will reduce erosion caused by waves.
- *Cheniers and Oyster Reef*: No direct or indirect impacts.

Alternative - Mermentau Small Integrated Restoration Plan

Impacts same as MB component of TSP.

2.2.2 Water Quality and Salinity

HSDRR (NED) Plans

Alternative - Nonstructural Justified Reaches (TSP)

Direct impacts of nonstructural component would be associated with construction for raising of structures. Indirect impacts of raising structures would be the prevention of flooding during storm surge which would reduce water quality impacts in comparison to FWOP conditions.

Construction impacts to runoff would be minimized through implementation of a Stormwater Pollution Prevention Plan (SWPPP) (USEPA 2012). Any structure demolition and removal would be required to adhere to applicable regulations pertaining to surface water quality, such as Louisiana Permitted Discharge Elimination System (LPDES) permitting. Structures not either raised or demolished/removed face the risk of flooding and are capable of releasing constituents associated with structure and housed materials; for a local example of water quality impacts of flooded structures please see Skrobialowski et al. (2007)

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

Direct impacts of ecosystem restoration features would convert existing open water, wetland, and low-quality chenier habitat to oyster reef, marsh, and improved chenier habitat, hydrologic structure, and shoreline protection features. Because rock, fill, and construction materials for proposed hydrologic/salinity control and shoreline protection features are anticipated to be free of contaminants, discharge of these materials into existing adjacent waters is not expected to result in adverse effects to aquatic organisms. Material proposed for construction of marsh and chenier restoration features would be evaluated to determine suitability for placement in the aquatic environment in accordance with Clean Water Act Section 404(b)(1).

Indirect impacts regarding ecosystem restoration features could lead to water quality improvements through the restoration and protection of wetland and chenier habitat. Hydrologic/salinity control structures are expected to aid in reducing salinities in some regions of the study area, the benefits of which are largely unknown, as area wetlands have likely adapted to existing salinity patterns. These structures may also impede water exchange and contribute to localized hypoxia, similar to the MRGO closure (Swarzenski et al. 2013, in preparation).

Alternative - Mermentau Small Integrated Restoration Plan
Impacts are the same as the MB component of the TSP.

2.3 Natural Environment

2.3.1 Sedimentation and Erosion

HSDRR (NED) Plans

Alternative - Nonstructural Justified Reaches (TSP)
There would be no direct or indirect.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

- *Hydro/Salinity*: Sediment transport at salinity control structures sites would likely be altered. Sediment delivery to coast may be reduced. Water control structures may lead to minimal local increased water levels landward (drainage from rainfall) and seaward (tidal and storm surge) when closed which may increase erosion rates.
- *Marsh Restoration*: Increased marsh surface area would increase sediment entrapment when marshes are flooded (e. g. tidal and storm surge). Restored marsh would reduce fetch over open water areas thereby reducing wind generated waves and subsequent erosion.
- *Shoreline Protection*: Sedimentation patterns in the vicinity of the features would be altered. Sediment deposition and/or erosion would occur depending on the hydrodynamics at the site. For example, the location and orientation of individual features could cause erosion and/or sediment accretion. Shoreline erosion adjacent to the features would likely be reduced.
- *Cheniers*: Tree roots would likely reduce erosion of cheniers if they are overtopped due to storms or relative sea level rise by binding sediments together. Trees would likely reduce storm surge and subsequent erosion of adjacent marshes.
- *Oyster Reefs*: Reefs would likely trap sediments and reduce erosion of the water bottom and adjacent shorelines.

Alternative - Mermentau Small Integrated Restoration
Impacts are the same as the MB component of the TSP

2.3.2 Soils, Water Bottoms, and Prime and Unique Farmlands

HSDRR (NED) Plans

Alternative - Nonstructural Justified Reaches (TSP)
Nonstructural component would have no direct impacts on soils, prime and unique farmlands, or water bottoms. However, a beneficial indirect impact through the acquisition of property in the event of a buyout of the structure could result in soils being returned to "green space" and soils that are prime and unique farmlands could become available for agriculture and use as pastureland (i.e., structures, including slab foundations, would be removed from the area).

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

- *Hydro/Salinity*: Hydro/salinity measure MB #13 would reduce saltwater intrusion and tidal flux from the lower Mermentau River into the wetlands adjacent to Little Pecan Bayou. Construction of the retention structure would directly impact less than one acre of water bottoms on Little Pecan Bayou. Soft surface water bottoms would be replaced with rock resulting in indirect impacts to aquatic habitat. Hydric soils located in the marsh areas along Little Pecan Bayou consist primarily of Aquents (AN) frequently flooded soils; Bancker muck (BA); and Clovelly muck (CO). A major cause of wetland loss can be attributed to saltwater intrusion and erosion of hydric soils from storm surges and sea level rise. The reduction of saltwater intrusion and tidal fluctuations into Little Pecan Bayou would contribute to soil stabilization in the adjacent wetlands and provide a beneficial impact to hydric soils. No prime or unique farmlands were identified along Little Pecan Bayou. Hydro/salinity measure Calcasieu/Sabine Basin (CB) #74a is currently a spillway structure located on East Calcasieu Lake. The proposed action would evacuate storm surge waters from wetlands located behind the Cameron-Creole levee. The measure would not be used to manage daily tidal exchange from Calcasieu Lake. The structure dimensions are 204 feet wide by 1509 feet in length, and would directly impact approximately 7 acres of water bottoms in Calcasieu Lake. Bancker and Clovelly muck hydric soils are most common in the wetlands located behind the Cameron-Creole levee, as well as along the East Calcasieu Lake shore. The use of the proposed spillway channel to control or remove storm surge flood waters from the wetlands could slow or prevent further erosion and provide a beneficial impact to hydric soils and wetlands adjacent to East Calcasieu Lake. The closest identified soils to East Calcasieu Lake and the proposed H/S #74a measure that are classified as prime farmlands consist primarily of Hackberry loamy fine sand (Hb) and Judice silty clay loam (Ju) on chenier ridge tops. Prime farmlands would not be directly impacted by the construction or use of the spillway channel, but could benefit indirectly by the prevention of future soil and land losses attributed to storm surges.
- *Marsh Restoration*: These marsh restoration features would include the beneficial use of dredged material from the Calcasieu Ship Channel and the Gulf of Mexico (Gulf) for the restoration and nourishment of marsh. Hydric soils in the marsh restoration areas consist primarily of Bancker muck, Creole mucky clay, Scatlake mucky clay, Larose mucky clay; and less frequently Allemands mucky peat, Clovelly muck, and Mermentau clay (table 3-2).

Table 3-2: Hydric soils in marsh restoration areas.

Soil Association	Acres
Allemands mucky peat (AE)	40
Bancker muck (BA)	4747
Clovelly muck (CO)	142
Creole mucky clay (CR)	3481
Larose mucky clay (LR)	503
Mermentau clay (MM and ME)	24
Scatlake mucky clay (SC)	1327

Impacts to hydric soils from the restoration and nourishment of marsh would be beneficial. As marsh is restored, hydric soils would increase and become more stable.

Soils associated with prime and unique farmlands are most common on chenier ridges, and none of these soils were identified in the marsh restoration areas. There would be no direct impacts to prime and unique farmlands as a result of the restoration and nourishment of marsh areas. The restoration and nourishment of marsh could result in an indirect impact that could be beneficial to soils identified as prime and unique farmlands. The restoration of marsh would contribute to flood attenuation from small storm events and could prevent future loss of prime and unique farmland soils that may be present on nearby chenier ridges.

- *Shoreline Protection*: The Holley Beach shoreline stabilization measure would include placement of rock breakwaters, resulting in direct impacts to approximately 46,000 linear feet of water bottoms in the Gulf of Mexico. The Gulf shoreline restoration would be constructed in three segments, resulting in direct impacts to approximately 139,400 linear feet of water bottoms in the Gulf of Mexico. The fortification of spoilbanks along Freshwater Bayou would consist of bankline protection with rock dikes along three separate reaches, resulting in direct impacts to approximately 81,500 linear feet of water bottoms in Freshwater Bayou. In all shoreline protection measures, soft surface water bottoms would be replaced with rock resulting in indirect impacts to aquatic habitat along the shorelines. Hydric soils could be directly impacted during the placement of stone breakwaters and rock dikes, but long term indirect impacts would include the prevention of further erosion and loss of these soils, and potentially an increase in hydric soils along the Gulf shoreline. Soils associated with prime and unique farmlands are most common on chenier ridges, and none of these soils were identified in the vicinity of the Gulf shoreline restoration or Freshwater Bayou features. Approximately 549 acres of Hackberry loamy fine sand, classified as a prime farmland soil, is located along the shoreline adjacent to the Holley Beach shoreline stabilization feature. The 549 acres of prime farmland soils along the shoreline at Holley Beach would not be directly impacted by the placement of the rock breakwaters, nor would any other prime and unique farmlands be directly impacted or removed from agriculture use by the shoreline protection feature of the TSP. Indirect impacts to the 549 acres of Hackberry loamy fine sand resulting from the shoreline stabilization feature at Holley Beach would include a reduction in erosion and loss of the prime farmlands.
- *Cheniers*: A total of 578 acres of hydric soils (Table 3-2) were identified along the cheniers. Reforestation of the cheniers would stabilize soils and could prevent future erosion and loss of hydric soils. Therefore, the direct and indirect impacts to hydric soils on the cheniers would be beneficial. No water bottoms were identified on the cheniers, so there would be no direct or indirect impacts to water bottoms as a result of chenier reforestation. Soils that are suitable for agriculture and pastureland in the Chenier Plains are most commonly located on the chenier ridges. Approximately 514 acres of soils classified as prime farmlands, consisting entirely of Hackberry loamy fine sand, are present along the chenier ridges that are proposed for reforestation under this alternative. The reforestation of the chenier ridges would remove these areas and identified prime farmlands from future agricultural use. In compliance with the Farmland Protection Policy Act (FPPA), the USACE would consult with the Department of Agriculture – Natural Resources Conservation Service (NRCS) to determine the precise acreage that would be impacted.
- *Oyster Reefs*: Preservation of the existing historic oyster reef in Sabine Lake would have no direct impacts to soils, water bottoms, or prime and unique farmlands. The preservation of the oyster reef is an effective technique for controlling salinity and limiting saltwater intrusion into wetlands. A beneficial indirect impact would be the preservation of hydric soils and wetlands adjacent to Sabine Lake.

<u>Alternative - Mermentau Small Integrated Restoration Plan</u>

Impacts are the same as the MB component of the TSP; there are no oyster reef restoration measures in the MB.

2.3.3 Coastal Shorelines

HSDRR (NED) Plans

Alternative - Nonstructural Justified Reaches

No impacts as the NED areas are located far removed from the Gulf coastal shoreline.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

- *Hydro/Salinity*: No impacts.
- *Marsh Restoration*: Only the marsh restoration feature at Mud Lake (124c) would occur in proximity to the Gulf shoreline. Construction of this measure would require dredged material to be pumped across the shoreline from the Gulfborrow site to the marsh restoration sites resulting in only temporary and minor disturbance to the shoreline resources expected from this construction activity.
- *Shoreline Protection*: Proposed segmented breakwaters are expected to eliminate or substantially reduce erosion of the gulf shoreline, but would not directly affect hydrology or salinity levels since the openings between the breakwater segments would allow free passage of water. Indirectly, the breakwaters would maintain existing salinity and hydrology in the marshes and water bodies behind the shoreline, which could otherwise be altered by continued erosion. In the MB there are numerous canals and natural bayous and ponds that lie behind the gulf shoreline. Gulf shoreline restoration measures (6b1, 6b2, and 6b3) would prevent new openings from forming between the Gulf and these water bodies.
- *Cheniers*: Several of the chenier restoration projects would occur in close proximity to the Gulf shoreline. It is possible that some construction equipment may be delivered by barge from the Gulf to access the chenier ridges to perform restoration activities. In such cases, there would be minor, localized, temporary adverse impacts, including loss of vegetation cover and displacement of shoreline sediments.
- *Oyster Reefs*: No impacts.

Alternative - Mermentau Small Integrated Restoration

Direct and Indirect Impacts: Impacts same as MB impacts of TSP.

2.3.4 Vegetation Resources

HSDRR (NED) Plans

Alternative - Nonstructural Justified Reaches (TSP)

The eleven reaches within the area identified as the nonstructural component of the TSP would not significantly impact existing vegetation resources as any construction would be to previously disturbed areas. There is a risk that certain methods at certain locations could impact wetlands on that site but these methods and locations combinations would be avoided where practicable.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

The TSP would restore/nourish/protect a total of about 7,315 acres in the CB; and 16,868 acres in the MB.

- *Hydro/Salinity*: Measure #74a in the CB would provide benefit to approximately 1,395 acres of existing wetlands through the evacuation of wetland-damaging storm surge-deposited water from behind the Cameron-Creole levee during storm events. However, this measure is not anticipated to affect daily tidal exchange from Calcasieu Lake. There is a potential that it could do more harm than good. Measure #13 in the MB would provide benefit to approximately 2,791 acres of existing wetlands by reducing saltwater intrusion and tidal flux from the lower Mermentau River into the wetlands adjacent to Little Pecan Bayou south of Grand Lake in the MB through freshwater introduction and construction of a retention structure or sill on Little Pecan Bayou. Together these measures would indirectly benefit aquatic organisms by reducing the existing rapid changes in salinities and moderate the hydrologic flux of these systems thereby providing for a more stable system.

- *Marsh Restoration*: These measures would restore and/or nourish a net total of approximately 2,083 acres of saline marsh and 1,905 acres of brackish marsh in the CB and 4,726 acres of brackish marsh in the MB. Of these totals approximately 9 acres of saline marsh and 10 acres of brackish marsh would be impacted in the CB, and approximately 67 acres of brackish marsh would be impacted in the MB from access required for borrow deposition. More detail on the benefits derived from the marsh restoration features can be found in table 1-13. Restored/nourished marsh would contribute to reducing the overall habitat fragmentation in the area as well as provide many different species of fish and wildlife with shelter, nesting, feeding, roosting, cover, nursery, and other life requirements habitat. These marsh habitats will also provide neotropical migrants with essential staging and stopover habitat (after Stoffer and Zoller 2004, Zoller 2004).
- *Shoreline Protection*: These measures would protect a net total of approximately 26 acres of barrier island habitat in the CB, and 4,821 acres of saline marsh and 1,288 acres of brackish marsh in the MB. These shoreline protection measures would restore an important geomorphic framework for preventing further fragmentation and loss of interior wetlands used as habitat by many different species of fish and wildlife.
- *Cheniers*: Measures would provide reforestation of Chenier forests and improve a net total of 426 acres of habitat in the CB and 242 acres of habitat in the MB. The proposed reforestation would provide critical stopover habitat for migratory neotropic birds.
- *Oyster Reefs*: This measure would preserve the historic Sabine Lake oyster reef located in the southern end of Sabine Lake near Sabine Pass in the CB. Preservation of this oyster reef would provide a major structural component of the Sabine Lake estuary and support more animal life than any other portion of the sea bottom (Bahr and Lanier 1981; Meyer and Townsend 2000; Nelson et al. 2004; Tolley and Volety 2005; Tolley et al. 2005; Boudreaux et al. 2006). In addition to increasing species richness, the preservation of this three-dimensional structure will help stabilize and buffer adjacent shorelines from high wave energy (after Smithsonian 2001).

<u>Alternative - Mermentau Small Integrated Restoration</u>
Impacts are the same as the MB component of the TSP.

2.3.5 Wildlife Resources

HSDRR (NED) Plans

<u>Alternative - Nonstructural Plan (TSP)</u>
No significant impacts on most wildlife resources except for human commensal wildlife (e.g., rats, mice, pigeons, etc.) which thrive in association with human habitations which typically disrupt the natural habitats. There could be possible benefits to wildlife if enough structures on land contiguous with each other were bought out and allowed to return to a natural state and if that area was contiguous with an adjacent wildlife corridor.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

- *Hydro/Salinity*: The loss of fresh marsh attributed to salinity intrusion from daily tidal movement as projected within areas controlled by these proposed structures would be largely eliminated helping to preserve the existing marsh in the area and the wildlife populations dependant on this habitat type. No wildlife impacts are anticipated from installation of these structures.
- *Marsh Restoration*: Approximately 2,542 acres of open water would be converted to brackish marsh, and 3,025 acres to saline marsh in the CB, and approximately 4,362 acres of open water would be converted to brackish marsh in the MB. Additional nourishment could occur adjacent to the marsh restoration sites. The proposed restoration/nourishment in these basins would result in improved habitat conditions for several species of wildlife including migratory and resident waterfowl, shorebirds, wading birds, and furbearers. Migratory waterfowl utilizing the area would benefit from a greater food supply resulting from the increased abundance and diversity of emergent and submerged species. Habitat for the resident mottled duck would also improve considerably as the marsh platform would provide more desirable nesting habitat. Intertidal marsh and marsh edge would also provide increased foraging opportunities for shorebirds and wading birds. Small fishes and crustaceans are often found in greater densities along vegetated marsh edge (Castellanos and Rozas 2001, Rozas and Minello 2001), and many of those species are important prey items for wading birds such as the great blue heron, little blue heron, great egret, black-crowned night-heron, and snowy egret. Mudflats and shallow water habitat restored by the deposition of dredged material would provide increased foraging opportunities for shorebirds such as least sandpipers, killdeer, and the American avocet. Those species feed on tiny invertebrates and crustaceans found on mudflats which are exposed at low tide and in shallow-water areas of the appropriate depth. Furbearers (such as nutria and muskrat) which feed on vegetation would benefit from the increased marsh acreage in the project area. Representative furbearers such as the mink, river otter, and raccoon have a diverse diet and feed on many different species of fishes and crustaceans. Those species often feed along vegetated shorelines which provide cover for many of their prey species. The loss of open water habitat with construction of these features would not be expected to adversely affect species that currently utilize these habitats as there is ample open water habitat in the basins. Wildlife species currently utilizing the shallow open water and vegetated shorelines in the project area are highly mobile and/or suited to semi-aquatic life and should not be affected during construction.
- *Shoreline Protection*: The installation of approximately 186,000 ft of segmented offshore breakwaters and 81,500 ft rock revetment would work to protect the marshes behind these structures from wave induced erosion and help maintain wildlife populations dependent on this habitat type. Some habitat would be lost during installation of the rock revetment reducing the available habitat for wildlife species and resulting in the demise of more immobile wildlife species. However, these impacts would result in a minimal overall impact to wildlife populations in the area and would work to protect the adjacent habitat these species depend on for survival that could be lost in the future if the revetment not installed.
- *Cheniers*: Approximately 426 acres of existing Chenier habitat in the CB and 242 acres of existing Chenier habitat in the MB would undergo invasive species control and reforestation with construction of the proposed action. Implementation of these measures wouldincrease the diversity of the existing habitat and the quality of the available foraging, resting and nesting habitat necessary for numerous terrestrial and avian wildlife species and essential for neotropical migrants. Construction would be minimally invasive (no earthwork is required)

and some species may temporarily avoid these project features during construction, but would quickly return once construction is complete.

- *Oyster Reefs*: Oyster reefs provide major structural components of estuaries and support more animal life than any other portion of the sea bottom (Bahr and Lanier 1981; Meyer and Townsend 2000; Nelson et al. 2004; Tolley and Volety 2005; Tolley et al. 2005; Boudreaux et al. 2006). The total number and densities of fish, invertebrate and algal species greatly increase in areas containing oyster reefs (Bahr & Lanier 1981). More than 300 marine invertebrate species may occupy an oyster reef at one time (Wells 1961). Many of the marine organisms attracted to oyster reefs are also used by seabirds, shorebirds, piping plovers, pelicans, marine mammals, and sea turtles as source of food. In addition, the three-dimensional structure of the reef provides other services such as stabilizing and buffering shorelines from high wave energy (Smithsonian 2001) which provide beach, dune, and back barrier marsh habitats to a wide variety of wildlife species.

<u>Alternative - Mermentau Small Integrated Restoration</u>
Impacts to wildlife resources would be similar to those discussed for the NER TSP except to a lesser extent.

2.3.6 Fisheries and Aquatic Resources

HSDRR (NED) Plans

<u>Alternative - Nonstructural Justified Reaches (TSP)</u>
The nonstructural features should have no impact to these resources depending on the methods used. Direct and indirect impacts to these resources will be refined when the actual method of nonstructural and number of structures are examined in future NEPA documents.

Ecosystem Restoration (NER) Plans

<u>Alternative - Comprehensive Small Integrated Restoration Plan (TSP)</u>

- *Hydro/Salinity*: The CB component (#74a) as presently described would convert approximately 7 acres open water benthic habitat and 0.25 acres of marsh into a rock structure, part of this structure would be out of the water and would be completely unavailable for fisheries use. The majority of the open water area is now listed a public oyster seed ground. The MB component (#13) would directly impact approximately 0.40 acres of benthic habitat and neck down the bayou and limit organism access to marsh and open-water areas behind the structure. This measure may also change the species profile behind structure by both the physical limitation of access and the freshening of the area. Direct effects on benthic habitat from both measures include covering and smothering of benthic organisms including oysters by the placement of rock. During construction of project features, there would be short-term indirect adverse impacts to plankton, benthic populations and fisheries species due to increases in turbidity, low dissolved oxygen, and introduction of sediments into shallow open water areas. Filter feeding species would be impacted due to clogging of the gills which could either cause death or reduce growth and reproduction. Visual predators would have a reduced success rate due to turbidity. Mobil species would attempt to move from the area of influence.
- *Marsh Restoration*: Impacts in the construction footprint (CB over 6,000 acres and MB over almost 6,550 acres restored or nourished), and construction activities using earthen materials to create wetland could include the elimination of benthic, oyster, and fishery habitat or the conversion of shallow open water habitats to less valuable deep water borrow areas, and direct mortality or injury of fisheries and benthic species due to burial or increased turbidity. Approximately 9,100 acres are identified for borrow (3,300 acres from

Calcasieu Ship Channel, 5800 acres Gulf) Depending on the depth of the borrow canal this deeper water habitat could provide a refuge for during extreme water temperature spike. Improved marsh habitats and increased SAV could have positive indirect impacts on juvenile fishes, shrimp, crabs, and other species by increasing food and cover if they are able to access the area. The conversion of open water to marsh is generally considered a benefit to aquatic species.

- *Shoreline Protection*: Impacts in the construction footprint (CB/ 24.4 and MB/72.96 acres of segmented offshore break water) would include the elimination of benthic, oyster, and fishery habitat and would cause the conversion of sandy shallow open water habitats to rock habitat which will only partially be submerged. Additionally 63.63 acres of shallow mud bottom would be converted to rock with the MB components in the GIWW and Freshwater Bayou. During construction of project features, there would be short-term indirect adverse impacts to plankton, benthic populations and fisheries species due to increases in turbidity, and low dissolved oxygen. Filter feeding species would be impacted due to clogging of the gills which could either cause death or reduce growth and reproduction. Visual predators would have a reduced success rate due to turbidity. Mobil species would attempt to move from the area of influence. Rock substrate is known to provide benefits to some aquatic species by providing them a refuge from predation. They also provide a hard substrate for oyster spat to settle on.
- *Cheniers*: Reforestation of the Chenier ridges would have no direct, indirect or cumulative impacts on these resources.
- *Oyster Reefs*: The active preservation of oyster reefs will overtime provide a net indirect and cumulative positive impact to these resources by limiting the loss of limited habitat type. There would be no direct impacts to aquatic and fisheries species.

<u>Alternative - Mermentau Small Integrated Restoration Plan</u>
Impacts are the same as the MB component of the TSP.

2.3.7 Essential Fish Habitat

HSDRR (NED) Plans

<u>Alternative - Nonstructural Justified Reaches (TSP)</u>
No significant impact to these resources are expected. There is a risk that certain methods at certain locations could impact wetland EFH on that site but these methods and locations combinations would be avoided where practicable.

Ecosystem Restoration (NER) Plans

<u>Alternative - Comprehensive Small Integrated Restoration Plan (TSP)</u>

- *Hydro/Salinity*: Measure #74a in the CB would directly impact water bottom EFH by converting approximately 7 acres into rocky bottom and 0.25 acres of marsh EFH into a rock structure. Additionally measure MB #13 would impact 0.40 acres water bottom EFH in the same way, and would restrict the bayou and limit organism access to approximately 2,791 acres of marsh and open-water EFH. Rock is not considered EFH in coastal Louisiana.
- *Marsh Restoration*: Both the CB and MB components would convert over 4,400 acres and almost 4,150 acres of open water (combination of estuarine mud bottoms and oyster reefs EFH) respectively to marsh (marsh edge, SAV, marsh ponds, and inner marsh EFH). Construction activities using earthen materials to create marsh could bury EFH substrates or temporarily change environmental conditions, including turbidity and salinity, in the water column. The project would increase SAV and adjacent intertidal marsh vegetation (marsh

restoration areas) in some areas. The CB components and MB components will nourish over 1,600 acres and almost 2,400 acres, respectively, of existing marshes and terraces. This will be a long term indirect positive impact to marsh (marsh edge, SAV, marsh ponds, and inner marsh EFH). Approximately 9,100 acres are identified for borrow (3,300 acres from Calcasieu Ship Channel, 5800 acres Gulf for the CB) If the dredged material coming from the ship channel is coming during a maintenance event there would be no additional impacts to EFH. Borrow from the Gulf would convert Gulf water EFH to a deeper depth Gulf water EFH. Some of the offshore borrow areas could refill with material overtime.

- *Shoreline Protection*: Both the CB and MB components would convert almost 25 acres and 140 acres of open water (combination of estuarine mud bottoms, oyster reefs, Gulf waters, marsh edge, offshore, beach, coastal, and sand EFH) respectively to rock which is not considered EFH in coastal Louisiana.
- *Cheniers*: Reforestation of the Chenier ridges would have no direct, indirect or cumulative impacts on EFH.
- *Oyster Reefs*: The active preservation of oyster reefs will overtime provide a net indirect and cumulative positive impact to EFH by limiting the loss of oyster reef habitat. There would be no direct impacts to EFH.

<u>Alternative - Mermentau Small Integrated Restoration Plan</u>
Impacts same as the MB component of TSP.

2.3.8 Threatened and Endangered Species and Other Protected or Species of Concern

HSDRR (NED) Plans

<u>Alternative - Nonstructural Justified Reaches (TSP)</u>
This alternative would not adversely impact the success of the red-cockaded woodpecker (RCW) or any other listed species or the success of any species of concern within the project area. Direct impacts would be avoided in accordance with the Endangered Species Act (ESA), Marine Mammals Protection Act, Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act by the use of best management practices (BMPs) (see appendix A) and recommendations from USFWS and NMFS. Depending on final designs of the NED TSP, potential minimal indirect impacts could occur to the listed RCW and the candidate species, Sprague's pipit. These impacts could include the disturbance of any foraging or nesting birds due to construction activity and noise. This disturbance could force any RCWs and Sprague's pipit to seek foraging and/or nesting grounds in surrounding areas which offer suitable habitat. However, impacts to these listed species would be avoided, minimized and reduced to the maximum extent practicable and mitigated as necessary.

Species of Concern: Depending on final designs of the NED TSP, there could be a potential for minimal indirect impacts to colonial nesting water birds. These impacts could include the disturbance of roosting or foraging birds due to construction activity and noise. It is assumed the birds would relocate to adjacent foraging/roosting grounds. Nesting birds would not be impacted as no work would take place within a rookery. Additionally, during nesting season, work would be required to take place outside of the USFWS and LDWF-declared buffer zones (appendix A annex K). Work within the buffer zones may only take place during non-nesting season (September 1 to February 15). There would be no impacts to the bald eagle as no known nests are located near any project features. If an eagle's nest is sighted within the project area, a no-work zone would be implemented (appendix A annex K).

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

Direct impacts would be avoided in accordance with the ESA, BGEPA, MMPA and MBTA by the use of BMPs (appendix A annex K) and recommendations from USFWS and NMFS. All indirect impacts would be avoided, minimized and reduced to the maximum extent practicable and mitigated as necessary. Further consultation will occur as this project moves forward.

- *Hydro/Salinity*: No anticipated impacts to T&E.
- *Marsh Restoration*: Potential temporary minimal indirect impacts to the West Indian manatee, Gulf sturgeon and all sea turtles identified in Chapter 1. In addition critical habitat for piping plover will be impacted by the dredge pipeline coming in from the Gulf where it crosses the beach. Timing of placement and removal of the pipeline will be coordinated with USFWS. Temporary construction related impacts would result from noise, turbulence and the mere presence of workers in the marsh restoration sites, access routes and borrow sites and would likely result in the species avoiding the area temporarily. Beneficial impacts would be the increase in wetland habitat which is utilized by the Whooping crane.
- *Shoreline Protection*: Potential Indirect impacts to the West Indian manatee, Gulf sturgeon and all sea turtles listed in appendix A annex K would be temporary and minimal. Temporary construction related impacts would be due to noise, turbulence and mere presence of workers in the marsh restoration sites, access routes and borrow sites and would likely result in the species avoiding the area temporarily. Permanent impacts would be the hindrance of access by sea turtles, to thousands of linear feet of shoreline. Although, it is assumed that they could easily go around the breakwater as it would not be continuous. Indirect beneficial impacts would be the protection of thousands of linear feet of shoreline which is designated piping plover critical habitat and also used by the Red knot.
- *Cheniers*: There could be potential minimal indirect impacts to the Sprague's pipit if reforestation of grasslands would occur. It is assumed that the bird would relocate to an adjacent or nearby suitable foraging/roosting area.
- *Oyster Reefs*: Oyster reef preservation could benefit the Red Knot as they have been observed foraging on oyster reefs.

Species of Concern:

- Potential for minimal indirect impacts to colonial nesting water birds. Impacts could include disturbance of roosting or foraging birds due to construction activity and noise. It is anticipated nesting birds would not be impacted as no work would take place within a rookery. Additionally, during nesting season, work would be required to take place outside of the USFWS and LDWF declared buffer zones (appendix A). Work within buffer zones may only take place during non-nesting season (September 1 to February 15). In addition to these potential adverse impacts, marsh restoration would beneficially impact colonial nesting water birds by providing additional foraging grounds.
- No impacts to the bald eagle, as no known nests are located near any project features. If an eagle's nest is found within the project area, a no-work zone must be implemented.
- Bottlenose dolphins could be found in the vicinity of these project features, but with the utilization of the measures for reducing entrapment of this species found in appendix A, no indirect impacts are anticipated.

Alternative - Mermentau Small Integrated Restoration Plan

Impacts to T&E resources would be similar to those discussed for the NER TSP except to a lesser extent.

2.3.9 Cultural and Historic Resources

The following alternatives have the potential to impact cultural resources, and CEMVN has determined that additional investigations would be required to locate and define the boundaries of cultural resources within the area of potential effects (APE) for the TSP. Cultural resources investigations would also include eligibility determinations for archaeological sites and historic standing structures located within the APE. The information provided below is based upon a preliminary review of cultural resources literature and records maintained by the Louisiana Division of Archaeology and the Division of Historic Preservation. CEMVN has initiated Section 106 consultation, and the APE, research design and survey methodology will be determined through consultation with the Louisiana State Historic Preservation Officer, federally recognized Indian Tribes, and additional consulting parties. The results of the identification and evaluation of historic properties will be coordinated with the Louisiana SHPO, Tribes, and additional consulting parties, and the CEMVN will seek to identify ways to avoid, minimize, and/or mitigate impacts to historic properties and resources of religious and cultural significance to Tribes that have the potential to be impacted by the proposed action.

HSDRR (NED) Plan

Alternative - Nonstructural Justified Reaches (TSP)

There is the potential for direct and indirect impacts to previously recorded archaeological sites and standing structures with a minimum age of 50 years, as well as any unrecorded sites and/or standing structures that may be identified during the cultural resource investigation. Approximately 26,000 standing structures located within the 100-year flood plain have been identified as candidates for nonstructural measures. Although specific structures have not been selected for nonstructural measures, thousands of standing structures that have been identified as potential candidates have a minimum age of 50 years and have not been assessed for eligibility. Fourteen historic properties have been identified in Calcasieu Parish, including ten that are listed in the National Register of Historic Places (NRHP). An additional two historic properties listed in the NRHP have been identified in Vermilion and Iberia parishes.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

CB - There is the potential for direct and indirect impacts to eighteen previously recorded archaeological sites and forty-eight standing structures with a minimum age of 50 years that have not been assessed for eligibility, as well as any unrecorded sites and/or standing structures that may be identified during the cultural resource investigation. The previously recorded sites include one potentially eligible for listing in the NRHP and four that have been determined not eligible for listing in the NRHP. The remaining thirteen have not been assessed. Of the eighteen, thirteen have prehistoric components, and six have historic components.

- *Hydro/Salinity*: No previously recorded sites or standing structures have been identified within a one-mile buffer of the proposed measure (#74a).
- *Marsh Restoration*: One prehistoric site of unknown eligibility has been identified within a one-mile buffer of the proposed measures (3a1, 3c1, 124c, 124d). No previously recorded standing structures have been identified within a one-mile buffer of the proposed measures. No previously recorded sites have been identified within the proposed borrow areas.

- *Shoreline Protection*: One historic site that has been determined not eligible for listing in the NRHP has been identified within a one-mile buffer of the proposed measure (5a). Four previously recorded standing structures within the one-mile buffer have a minimum age of 50 years and have not been assessed for eligibility.
- *Cheniers*: Twelve prehistoric sites, one with a historic component, and four historic sites have been identified within a one-mile buffer of the proposed measures (416, 510a, 510b, 510d), one of which has been identified as potentially eligible for listing in the NRHP and three that have been determined not eligible for listing in the NRHP. The remaining twelve have not been assessed. Forty-four previously recorded standing structures within the one-mile buffer have a minimum age of 50 years and have not been assessed for eligibility.
- *Oyster Reefs*: No previously recorded sites or standing structures have been identified within a one-mile buffer of the proposed measure (604).

MB - There is the potential for direct and indirect impacts to twenty-six previously recorded archaeological sites and thirty-one standing structures with a minimum age of 50 years that have not been assessed for eligibility, as well as any unrecorded sites and/or standing structures that may be identified during the cultural resource investigation. The previously recorded sites include two potentially eligible for listing in the NRHP and seven that have been determined not eligible for listing in the NRHP. The remaining eighteen have not been assessed. Of the twenty-six sites, twenty-four have prehistoric components, and three have historic components.

- *Hydro/Salinity*: Four prehistoric sites have been identified within a one-mile buffer of the proposed measure (#13), one of which has been identified as potentially eligible for listing in the NRHP and three that have not been assessed. No previously recorded standing structures have been identified within a one-mile buffer of the proposed measure.
- *Marsh Restoration*: Nine prehistoric sites have been identified within a one-mile buffer of the proposed measures (47a1, 47a2, 47c1, 127c3, 306a1), one of which has been identified as potentially eligible for listing in the NRHP and two that have been determined not eligible for listing in the NRHP. The remaining six have not been assessed. Fifteen standing structures within the one-mile buffer have a minimum age of 50 years and have not been assessed for eligibility. No previously recorded sites have been identified within the proposed borrow areas.
- *Shoreline Protection*: Eight prehistoric sites have been identified within a one-mile buffer of the proposed measures (16b, 6b1, 6b2, 6b3), four of which have been determined not eligible for listing in the NRHP. The remaining four have not been assessed. No previously recorded standing structures have been identified within a one-mile buffer of the proposed measure.
- *Cheniers*: Twelve prehistoric sites, one with a historic component, and two historic sites have been identified within a one-mile buffer of the proposed measures (416, 509c, 509d, 510d), one of which has been identified as potentially eligible for listing in the NRHP and three that have been determined not eligible for listing in the NRHP. The remaining ten have not been assessed. Thirty-one standing structures within the one-mile buffer have a minimum age of 50 years and have not been assessed for eligibility.
- *Oyster Reefs*: No previously recorded sites or standing structures have been identified within a one-mile buffer of the proposed measure (604).

<u>Alternative - Mermentau Small Integrated Restoration</u>

Impacts would be the same as those described for the MB component of the TSP.

2.3.10 Aesthetics (Visual Resources)

HSDRR (NED) Plans

Alternative - Nonstructural Justified Reaches (TSP)

Minimal impacts to visual resources. The raising of homes would not impact view sheds into any surrounding areas. In cases where a home or land buyout may be taking place this could indirectly impact visual resources by removing the viewer from a given area. In areas where there is public access from a street or roadway, these non-structural elements would not change the view shed. Houses being raised are currently present, their elevation would change, but the site is still occupied either way. In the case of a home buyout, if a home is removed and open land is created, then this could be considered as a benefit to drivers looking for natural scenery or a loss to an established neighborhood.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (TSP)

- *Hydro/Salinity*: In terms of technical significance, reducing the flow of salinity excesses and increasing wetland productivity, visual resources would most certainly see a benefit. In those areas where these measures would take place, open water areas would grow into healthy marshes, bringing more texture, color and framing elements to the landscape. Greater habitat diversity would be achieved, bringing a greater variety of fauna to the given area to serve as focal points of life. In terms of public and institutional significance, the measures associated with hydro/ salinity will positively benefit areas in Cameron Parish along the Creole Nature Trail Scenic Byway and All American Road. Those areas project designated areas along State Highways 27 and 82 will be directly visible to those travelling the scenic byway.
- *Marsh Restoration*: This element would not be all that different from the definitions listed under Hydro/ Salinity. The areas of significance, in terms of what Hydro/ Salinity goals are meant to achieve, are almost exactly the same as they relate to Visual Resources. The primary difference is in how the marsh is restored. With the use of beneficial use dredge material from Calcasieu Ship Channel, where impacts will be minimal, visual resources will be greatly and positively impacted. Those areas along the Creole Nature Trail will positively impact the byway creating enhanced view sheds for travelers. Other areas, such as that located along the Intracoastal waterway and Freshwater Bayou Canal have less visual significance because those areas are remote with limited access.
- *Shoreline Protection*: These elements do have public visual significance and their protection and restoration would add an element of form, line and color to the shoreline of Louisiana. However; many of these areas are remote and public access is severely limited.
- *Cheniers*: Visually, these features are the most significant of any other in the study area. Cheniers aid in the form and function of developing the design elements of the landscape. As small hillocks or mounds, they offer the variation in terrain that makes the view shed interesting and memorable. They offer islands of oasis for different plant materials to develop and add texture and color to the land. In most cases, they allow taller trees to grow in a region which adds the necessary framing elements to the landscape to give it artistic quality and character. Most of the designated chenier restoration features are located directly adjacent to the Creole Nature Trail and would drastically and positively add to design elements already described under marsh restoration and hydro/ salinity.
- *Oyster Reefs*: These elements have little to no technical, public or institutional significance in terms of Visual Resources. However; it could be imagined that oyster reefs would create

areas of diverse habitat. Elements of design, seen by the naked eye of the viewer would be limited. These sites are remote and public access is limited..

Alternative - Mermentau Small Integrated Restoration
Impacts would be the same as those described for the MB component of the TSP.

2.3.11 Recreation – See Recreation Annex

2.4 Cumulative Impacts
2.4.1 HSDRR (NED) Plans
Alternative - Nonstructural Justified Reaches (TSP)
The direct and indirect incremental impacts of implementing the Nonstructural Plan on valued environmental components, or significant environmental resources, determines if cumulative effects need to be addressed (USACE 2007) utilizing CEQ's 11-step cumulative effects analysis process (CEQ 1997). Cumulative impacts are the incremental direct and indirect effects on each significant human and natural resource identified above, caused by elevating 3,665 residential structures, flood proofing 247 non-residential structures and acquiring 3 residential structures for acquisition. These incremental impacts would be in addition to the direct and indirect impacts attributable to other existing and authorized for construction levee systems throughout the Sabine, Calcasieu, Mermentau and Teche-Vermilon basins; the State and the Nation. The proposed action incremental effects would be in addition to the State's approximately 3,122 miles of levee (source: http://www.infrastructurereportcard.org/louisiana/louisiana-overview/); and the approximately 100,000 miles of levees which exist throughout the Nation (source: http://www.infrastructurereportcard.org/levees/).

- Consistent with Step 1 of the CEQ 11-step process, this report identifies in previous sections the potential significant direct and indirect effects and issues associated with implementing the proposed nonstructural risk reduction plan on significant human and natural resources. Generally, there would be no significant direct or indirect effects on the natural environment. Rather, most effects would be on the human environment as described in preceding sections.
- Consistent with CEQ step 2, this report identifies the geographic scope of the analysis as the area consisting of Calcasieu, Cameron and Vermilion Parishes; additionally, the report characterizes the affected resources.
- Consistent with CEQ step 3, this report identifies the time frame by describing in previous sections the historic, existing, future without project and future with project conditions for the identified significant natural and human environmental resources.
- Regarding CEQ step 4, other actions potentially affecting the significant natural and human resources in the area as well as Louisiana and the Nation include:
  a. The American Society of Civil Engineers (http://www.infrastructurereportcard.org/) rates America's public infrastructure as a report card with performance rated as D^+ and an estimated investment needed by 2020 of $3.6 trillion. Among this infrastructure approximately 3,122 miles of levees within Louisiana (source: http://www.infrastructurereportcard.org/louisiana/louisiana-overview/); and approximately 100,000 miles of levees which exist throughout the Nation (source: http://www.infrastructurereportcard.org/levees/). However, the reliability of these levees is unknown and the country has yet to establish a National Levee Safety Program. Public safety remains at risk from these ageing structures, and the cost to repair or

rehabilitate these levees is roughly estimated to be $100 billion by the National Committee on Levee Safety.

- Consistent with CEQ steps 5 and 6, response to change has been documented for each identified significant human and natural resource in previous sections. In addition, the stressors potentially affecting significant human and natural resources, and if appropriate, their relationship to regulatory thresholds have also been identified (e.g., air quality and water quality standards; factors for managing and identifying cultural resources; the age (50 years) and other requirement for eligibility to be considered for the national register of historic structures have also been identified. This latter example is of particular concern considering the 50-year period of analysis due to the potential numerous structures in the area which may qualify as a historic or national register structure over the period of analysis. With regard to their capacity to withstand stresses affecting the human environment, the recent Hurricane Rita (2005) and Ike (2008) caused significant damage to both the human and natural environmental resources. The human impacts of preparing for, mitigating, and recovering from these damages has placed a significant economic, physical, and emotional burden on both individuals and communities. According to the Louisiana Recovery Authority's 2006 "The Rita Report", the devastation Hurricane Rita left behind made it the third most expensive natural disaster in US history (source: http://lra.louisiana.gov/assets/docs/searchable/reports/RitaReportFinal091806.pdf). About 98 percent of oil and natural gas production in the gulf was halted as workers evacuated. The Rita Report estimated almost $600 million dollars of damage to agriculture, forestry and fishing.
- Consistent with CEQ step 7, the baseline condition has been documented for each significant human and natural resource including the historic, existing and future without project conditions (Chapter 1). Generally, current trends in the human environment such as employment, business and industrial activity, community and regional growth tend to mirror the increases demonstrated in populations and housing, Only Cameron Parish has had a population decline.
- Consistent with CEQ step 8, the most important cause and effect relationships between human activities and resources, ecosystems and human communities have been addressed in previous sections by identifying the direct and indirect impacts of the proposed action on significant human and natural resources. The Conceptual Ecological Model (CEM) provides a network diagram which identifies and illustrates connections and inter-relationships among the area's major drivers. The CEM was used throughout the plan formulation process.
- With regard to CEQ step 9, the magnitude and significance of cumulative effects associated with implementing the nonstructural measures are primarily related to providing the incremental risk reduction achieved by elevating 3,665 residential structures, flood proofing 247 non-residential structures and acquiring 3 residential structures. These impacts would be in addition to other infrastructure risk reduction measures such as those described in the American Society of Civil Engineers Report Card of America's public infrastructure (http://www.lasce.org/documents/LouisianaInfastructureReportCard2012.pdf). Louisiana's levee system is rated C^{-} and has more than 2,800 miles of levees that are critical to protecting the residents and economy of the state from flood events. Of these, approximately 2,500 miles are river levees, while about 365 miles are hurricane protection levees. More than 19,000 square miles of land area is protected by these structures. The levees are managed by 27 levee districts with members appointed by the governor and Louisiana Legislature. The districts are funded by local property tax assessments for operation and maintenance (O&M) of the systems. District personnel work closely with the US Army Corps of Engineers (USACE), the Louisiana Department of Transportation and

Development (LADOTD), the Coastal Protection and Restoration Authority (CPRA), and others. The state funded flood control program and capital outlay program provide approximately $18 million to $30 million dollars annually. Federal funds appropriated by Congress directly to the USACE for Corps operations and construction total about $220 million annually.

- Consistent with CEQ step 10, during plan formulation the alternatives were modified, removed and new alternatives added to avoid, minimize and reduce potential significant project-induced effects. For example several structural levees were considered but were later screened out due to a failure of benefits to exceed costs. When considered incrementally with other risk reduction efforts the state of Louisiana still owes the federal government about $1.3 billion for its share of the construction costs of the New Orleans HSDRRS system. The State has already paid about $300 million and has an agreement to pay the rest over the next 30 years. In addition, many levees outside of the New Orleans area are still below the 100-year level of risk reduction and do not meet current design standards (http://www.lasce.org/documents/LouisianaInfastructureReportCard2012.pdf).
- With regard to CEQ step 11—monitoring effects of the proposed action and adaptation of management: an Adaptive Management and Monitoring Plan is included in appendix A annex L. Generally, the NED components of implementing nonstructural risk reduction would be turned over to the structure owner and have no post construction monitoring or adaptive management other than suggested owner's monitoring of the structural soundness of the nonstructural risk reduction measure on a regular basis. However, the nonstructural requirements and implementation is still undergoing development.

Ecosystem Restoration (NER) Plans

<u>Alternative - Comprehensive Small Integrated Restoration Plan (TSP)</u>

The direct and indirect incremental impacts of implementing the TSP on valued environmental components, or significant human and natural environmental resources, determines if cumulative effects need to be addressed (USACE 2007) utilizing CEQ's 11-step cumulative effects analysis process (CEQ 1997). Cumulative impacts are the incremental direct and indirect effects on each significant human and natural resource identified above, caused by restoring over 6,000 acres of wetlands impacted by saltwater intrusion and inundation via hydrology/salinity control structures; over 8,700 acres of marsh restoration and nourishment; over 5,500 acres (almost over 266,900 linear feet) of shoreline protection; over 1,400 acres of chenier restoration; and preservation of the Sabine Lake oyster reef.

- Consistent with Step 1 of the CEQ 11-step process, this document has identified in previous sections the significant effects and issues associated with implementing the proposed action by documenting the direct and indirect effects of the proposed action on significant environmental resources.
- Consistent with CEQ step 2, this document has identified the geographic scope of the analysis as the area consisting of Calcasieu, Cameron and Vermilion Parishes.
- Consistent with CEQ step 3, the time frame of the analysis consisted of the historic, existing, future without project and future with project conditions for the identified significant natural and human environmental resources.
- Consistent with CEQ step 4, Other actions affecting the significant natural and human resources in the area include the following:

a. CWPPRA program — 151 restoration/protection projects benefiting over 110,000 acres.
b. LCA Program — the USACE and the State will continue to partner on the Mississippi River Hydro/Delta Management Feasibility Study. In addition, the State is expected to continue to partner with the USACE on the advancement of the Small Diversion at Convent/Blind River projects (currently in design), and to construct the Caminada Headland component of the Barataria Basin Barrier Shoreline project (currently in design by the State) and Demonstration Projects (currently developing program implementation plans). The State has declined to participate in the LCA BUDMAT program; however, other non-federal cost share sponsors are presently being negotiated.
c. There are other Gulf shoreline protection and restoration projects that have been constructed along the Gulf shoreline through other funding sources. Segmented breakwaters have been constructed under at least two separate projects to the west of the proposed Holly Beach Shoreline Stabilization (5a) measure. The proposed breakwater would provide shoreline protection from the eastern end of the existing breakwaters eastward to the Calcasieu Pass jetty and compliment that existing project. The shoreline where the proposed Holly Beach measure would be built has been nourished with material dredged from the bottom of the Gulf of Mexico to help ensure that shoreline erosion did not compromise Louisiana Highways 27/82. Rock and rip/rap has also been placed at critical locations where shoreline erosion has threatened the highway. The proposed Holly Beach measure is compatible with and would augment these prior efforts. There have been proposals to construct shoreline protection measures along the Gulf shoreline where the proposed Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou (6b1, 6b2, and 6b3) measures are proposed, but no projects have been constructed.
d. The 2012 State Master Plan (CPRA 2012) — the State evaluated 248 restoration projects, 33 structural and 116 conceptual non-structural flood risk reduction projects. The State acknowledges that each project has its own timeline and budget.
e. Recreation: Temporary negative impacts of marsh restoration activities due to increased turbidity and possible boating access issues are mediated by the presence of other productive and popular recreation areas throughout the coastal region of Louisiana. Long-term positive cumulative impacts are expected to occur as restoration measures help protect recreational resource lands from effects of coastal storm surge while improving recreational opportunities by enhancing the sustainability of valuable nursery habitats.
f. Visual resources: The continued relative sea level rise could potentially impact the entire area resulting in vast areas of shallow open water as vertical accretion rates fail to keep pace with rising sea levels. Impacts to visual resources would continue throughout the not only the project area but coastal Louisiana and the Nation due to the loss of wetlands and conversion of existing habitats to open water habitats. However, wetland restoration efforts such as the CWPPRA, CIAP, and LCA Programs could restore the land would convert existing view sheds of open water into marsh, wetland, swamp or a variety of landscape types that frame large bodies of open water and use the basic design elements of form, line, texture, color and repetition to create an aesthetically pleasing view shed.
g. Kennish (2001) characterized anthropogenic impacts to coastal wetlands in the U.S. During the past century as human modification of environmental systems has greatly accelerated tidal salt marsh deterioration and shoreline retreat in many coastal regions worldwide. As a result, more than 50 percent of the original tidal salt marsh habitat in the U.S. has been lost. Human impacts at the local scale include those that directly modify

or destroy salt marsh habitat such as dredging, spoil dumping, grid ditching, canal cutting, leveeing, and salt hay farming. Indirect impacts, which can be even more significant, typically are those that interfere with normal tidal flooding of the marsh surface, alter wetlands drainage, and reduce mineral sediment inputs and marsh vertical accretion rates. These impacts usually develop over a greater period of time. At the regional scale, subsidence caused by subsurface withdrawal of groundwater, oil, and gas has submerged and eliminated hundreds of square kilometers of salt marsh habitat in the Chesapeake Bay, San Francisco Bay, and Gulf of Mexico.

h. Deegan et al. (1984); Sasser et al. (1986); Swenson and Turner (1987); Delaune et al. (1989); Turner (1990); White and Morton (1997); Bryant and Chabreck (1998); and Kennish (2001) characterize Human activities potentially threaten the viability of salt marsh systems on local, regional, and global scales. Direct impacts include those that result from the physical alteration and immediate loss of habitat during construction of bulkheads, dikes, weirs, levees, piers, docks, pipelines, revetments and other hard structures, as well as the excavation of canals, ditches, and oil drill sites

i. The historic modifications of coastal marshes for agricultural purposes (e.g., draining and filling) and their reclamation for domestic and industrial development have substantially reduced viable wetlands habitat area during the past century (Adam, 1990; Anderson et al., 1992). Longer term, indirect impacts are also associated with some of these habitat disturbances. For example, the construction of impoundment dikes, water-control embankments, levees, dams for flood control, as well as canals and their associated spoil banks invariably alters the hydrology of these wetland systems, often interfering with normal tidal flooding and drainage, mollifying overland water flow, decreasing sediment supply to the marsh surface, and arresting vertical accretion.

j. According to Orson et al. (1985) coastal wetlands can respond to increasing sea level rise in three ways: (1) coastline retreat if the rates of coastal submergence exceed the vertical accretion of the wetland surface; (2) remain stable if sediment input from interior regions equals the rate of coastal submergence so that surface elevations are maintained; or (3) they can expand both vertically and laterally if the rate of coastal submergence is less than the sediment accretion rate. The failure of coastal wetlands to keep pace with sea level rise is generally ascribed to insufficient sediment deposition on the wetland surface leading to accretion deficits (i.e., vertical accretion is less than relative sea level rise). Delaune et al. (1983) and others have documented that, throughout coastal Louisiana wetlands are being replaced at an alarming rate by shallow open water.

- Consistent with CEQ steps 5 and 6, the responses of each identified significant resource to change has been documented for each identified significant human and natural resource. In addition, the factors or stressors potentially affecting significant human and natural resources, and if appropriate, their relationship to regulatory thresholds (e.g., air quality standards; designated critical habitat for the piping plover; threatened and endangered sea turtle activity windows for construction. According to the Louisiana Recovery Authority's 2006 "The Rita Report", the devastation Hurricane Rita left behind made it the third most expensive natural disaster in US history (source: http://lra.louisiana.gov/assets/docs/searchable/reports/RitaReportFinal091806.pdf). The Rita Report estimated almost $600 million dollars of damage to agriculture, forestry and fishing. More than 200,000 acres of fresh water and intermediate marshland was inundated with saltwater threatening native species on already-threatened environmentally sensitive wetlands. Hence, the southwest coastal Louisiana area, like the remainder of coastal

Louisiana has been and will continue to be subjected to stresses which will continue the decline of the natural environmental resources.

- Consistent with CEQ step 7, the baseline condition has been documented for each significant human and natural resources including the historic, existing and future without project conditions (Chapter 1). Consistent with CEQ step 8, the most important cause and effect relations include the direct impacts of the proposed action (non-structural risk reduction and ecosystem restoration along with the identified indirect impacts of the proposed actions. These incremental project-induced impacts would be in addition to other actions such as
- Consistent with CEQ step 9, the magnitude and significance of cumulative effects on identified significant resources include:
- Consistent with CEQ step 10, during plan formulation the removal, modification or addition of alternatives to avoid minimize and reduce or mitigate potential significant effects included changes to design, construction and other measures including: removal of hydrology and salinity measures in the Calcasieu River and Sabine Lake because of potential adverse navigation impacts.
- With regard to CEQ step 11—monitoring effects of the proposed action and adaptation of management: an Adaptive Management and Monitoring (AM&M) Plan is included in appendix A annex L. The AM&M Plan will be further refined during the feasibility-level analysis phase based on comments of the Draft Report.

Alternative - Mermentau Small Integrated Restoration
Impacts would be the same as described for the MB component of the TSP.

2.5 Any Irreversible and Irretrievable Commitments of Resources Involved in the Implementation of the tentatively selected PLAN

NEPA requires that environmental analysis include identification of "any irreversible and irretrievable commitments of resources which would be involved in the tentatively selected plan should it be implemented." Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the use of these resources have on future generations. Irreversible effects primarily result from use or destruction of a specific resource (e.g., energy and minerals) that cannot be replaced within a reasonable time frame. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action (e.g., extinction of a T&E species or the disturbance of a cultural site).

The tentatively selected plan would result in the direct and indirect commitments of resources. These would be related mainly to construction components. Energy typically associated with construction activities would be expended and irretrievably lost under all of the alternatives excluding the no action alternative. Fuels used during the construction and operation of dredging equipment and barges would constitute an irretrievable commitment of fuel resources.

For the tentatively selected plan, most resource commitments are neither irreversible nor irretrievable. The dredging of borrow material is considered reversible although it is anticipated that the natural infilling of the borrow pits may take several years. Benthic communities would be removed and lost along with the sediment during dredging operations. Benthic communities would also take several years to recover. Fish and plankton would be entrained in the dredge during the dredging of the borrow areas. These losses would be irretrievable. However, most impacts to fish and plankton are short term and temporary and would only occur during dredging and construction activities. For example, access channels that would be dredged and retention dikes that are constructed would be restored to natural conditions after construction.

Other impacts including disruption of community cohesion that may have a longer effect can be reduced through appropriate enhancement measures and best management practices. There are no irreversible or irretrievable commitments of resources which would preclude formulation or implementation of reasonable alternatives for this project.

2.6 Relationship between Local Short-Term uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

NEPA Section 102(2)(c)(iv) and 40 CFR 1502.16 requires that an EIS include a discussion of the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. This section describes how the tentatively selected plan would affect the short-term use and the long-term productivity of the environment. For the tentatively selected plan, "short-term" refers to the temporary phase of construction of the proposed project, while "long-term" refers to the operational life of the proposed project and beyond. **Chapter 3** of the main report evaluates the direct, indirect, and cumulative effects that could result from the tentatively selected plan. Construction of the tentatively selected plan would result in short-term construction-related impacts within parts of the project area and would include to some extent interference with local traffic, minor limited air emissions, and increases in ambient noise levels, disturbance of fisheries and wildlife, increased turbidity levels, lower DO, and disturbance of recreational and commercial fisheries. These impacts would be temporary and would occur only during construction, and are not expected to alter the long-term productivity of the natural environment.

The NED/NER TSP would assist in the long-term productivity of the 3 Basins ecological community by improving the water quantity, water quality, nutrients, and sediments. This in turn would facilitate the growth and productivity of emergent marsh and the invertebrates, fish, and wildlife that utilize these habitats. The NED/NER tentatively selected plan would also result in enhancing the long-term productivity of the natural communities throughout the region. These long-term beneficial effects would outweigh the impacts to the environment resulting primarily from project construction.

With an increase in the amount wetland habitat and increase in wetland habitat quality, fish populations would experience beneficial impacts. These improvements in productivity would beneficially impact long-term commercial and recreational fishing in the study region.

2.7 Mitigation

Mitigation measures are used to avoid, minimize, or compensate for adverse impacts to environmental resources. The appropriate application of mitigation is to formulate a project that first avoids adverse impacts, then minimizes adverse impacts, and lastly, compensates for unavoidable impacts. No impacts have been identified that would require compensatory mitigation. No wildlife mitigation would be required. To reduce fisheries related impacts all clearing and snagging will adhere to the Stream Obstruction and Removal Guidelines (1983). Air quality and noise impacts can be reduced by utilizing heavy machinery fitted with approved muffling devices that reduce noise, vibration, and emissions. A cultural resources monitoring program is recommended during the project implementation. This monitoring will consist of having a qualified archaeologist present during the clearing and snagging process. The purpose of the monitoring is to assure that no previously known or unknown archaeological sites are impacted during the implementation of this project.

SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex A

Clean Water Act Section 401 Water Quality Certification

Clean Water Act Section 404(b)(1) Evaluation

(Available in final)

*****Note: these documents, associated analyses and coordination will be completed during the feasibility-level analysis phase of this study which would occur following release of the Draft Environmental Impact Statement, and would be included in the Final Environmental Impact Statement

SOUTHWEST COASTAL LOUISIANA INTEGRATED DRAFT FEASIBILITY REPORT AND PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex B

Louisiana Coastal Resources Program Consistency Determination

(Available in final)

*****Note: these documents, associated analyses and coordination will be completed during the feasibility-level analysis phase of this study which would occur following release of the Draft Environmental Impact Statement, and would be included in the Final Environmental Impact Statement

SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex C

Louisiana State Department of Wildlife and Fisheries Scoping Letter

BOBBY JINDAL
GOVERNOR

State of Louisiana

ROBERT J. BARHAM
SECRETARY

DEPARTMENT OF WILDLIFE AND FISHERIES
OFFICE OF SECRETARY

14 April 2009

Ms. Sandra Stiles
U.S. Army Corps of Engineers, CEMVNPM–RS,
P.O. Box 60267,
New Orleans, LA 70160–0267,

RE: Notice of Intent to Prepare a Draft Environmental Impact Statement for the Southwest Coastal Louisiana Feasibility Study

Dear Ms. Stiles

The Louisiana Department of Wildlife and Fisheries is the state agency with responsibility for protecting and enhancing the wildlife and aquatic resources of the state and their dependent habitats. The department also manages over 240, 000 acres is in the southwest portion of the state through the Rockefeller, White Lake, State Wildlife, and Marsh Island refuges. As such, we urge the US Army Corps of Engineers (USACE) and the Office of Coastal Protection and Restoration (OCPR) to minimize enclosure of additional wetlands behind hurricane protection levees.

The EIS shall thoroughly consider and evaluate the potential impacts of hurricane protection features on existing and planned coastal restoration projects. Coordination is required with Louisiana Coastal Area (LCA) Program managers, Coastal Wetlands Planning, Protection and Restoration Act agencies, Coastal Impact Assistance Program (CIAP) representatives and others to insure that ongoing coastal restoration projects are not compromised by the hurricane protection features.

The EIS shall undertake a comprehensive alternatives analysis. Before identifying a preferred hurricane protection alternative the alternatives analysis should evaluate and consider direct and indirect wetland impacts and impacts to rare, threatened and endangered species, natural communities, colonial nesting waterbirds, publicly owned and/or managed lands, and authorized wetland mitigation banks.

The EIS shall develop a comprehensive mitigation plan designed to off-set all impacts to fish and wildlife resources. The mitigation plan shall be developed in coordination with, and be approved by, the resource and regulatory agencies.

LDWF staff attended public scoping meetings in Abbeville and Cameron regarding this project. The general public at those meetings expressed concern about storm drainage issues in the western coastal parishes, saltwater intrusion into the Mermentau basin, and the desire for hurricane protection levees in

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the areas surrounding western Vermilion Bay. We understand that the USACE and the OCPR have retained Dr. Ehab Meselhe to model hydrologic processes in these areas. This is a positive development as historical changes in hydrology in the region coupled with rising sea levels are the major environmental drivers in the system. We urge that the findings of these models be in such a form to be comprehensible to the general public so that the potential consequences of different courses of action are clearly defined. In addition, we urge that the environmental modeling include storm surge and exchange through Atchafalaya, and East and West Cote Blanche Bays to the east of Marsh Island. This is clearly an important physical driver in the Vermilion Bay system.

Further, we urge the USACE and the OCPR to include some consideration of logistical issues that arise with installation/construction of additional culverts, water control structures, gates, etc. We believe a regional approach to water management is the most productive way to reconcile all the needs of the residents of the area.

Thank you for the opportunity to comment on this project.

Sincerely,

J. Heather Warner-Finley
Research and Assessment Division

SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex D

National Marine Fisheries Service Scoping / Planning Aid Letter

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701

November 22, 2013 F/SER46/RS:jk
225/389-0508

Colonel Richard L. Hansen
District Engineer, New Orleans District
Department of the Army, Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-2067

Dear Colonel Hansen:

NOAA's National Marine Fisheries Service (NMFS) is submitting this letter due to recent information provided by the U.S. Army Corps of Engineers' (USACE) Project Delivery Team (PDT) for the Southwest Coastal Louisiana (SWCLA) Feasibility Study, which has transitioned to the SMART (smart, measurable, attainable, risk-informed, and timely) planning process. Based on information provided in PDT meetings, NMFS is concerned insufficient information may be used to assess project effects and select alternatives, and the level of analysis for some measures may not be commensurate with the scale and scope of potential impacts. Some project measures under consideration have the possibility to directly affect wetland health, commercially and recreationally important fisheries resources and user groups, and essential fish habitat (EFH). The NMFS is providing this letter to identify potential concerns regarding sufficiency of the alternatives analysis and the assessment of potential environmental effects which may result from many of the alternatives currently under evaluation.

The study area covers over 4,700 square miles in Louisiana's Chenier plain and encompasses Cameron, Calcasieu, and Vermilion Parishes. The study area includes a wide variety of fishery habitat types ranging from saline to fresh marsh and open water. The study goals are extremely broad in scope, including both National Economic Development (NED) and National Environmental Restoration (NER) objectives. Specific study objectives are to: (1) provide hurricane and storm damage risk reduction, (2) reduce flooding induced by storm surge, and (3) provide ecosystem restoration to achieve ecosystem sustainability. Ecosystem restoration objectives are further defined as: (1) manage tidal flows to improve drainage and prevent salinity from exceeding two parts per thousand (ppt) for fresh marsh and six ppt for intermediate marsh, (2) increase wetland productivity in fresh and intermediate marshes to maintain function by reducing the time water levels exceed marsh surfaces, (3) reduce shoreline erosion and stabilize canal banks to protect adjacent wetlands, and (4) restore critical geomorphologic features, such as marshes and cheniers to maintain their function as wildlife habitat and as protective barriers to inland areas.

To date, the identification, screening and analysis of potential NER measures has relied largely on outputs from predictive models previously developed in conjunction with the Louisiana State Master Plan (SMP). The outputs from the SMP models were used to: (1) screen potential NER measures for further analysis, (2) drive the formulation of alternative arrays, and (3) inform the upcoming selection of a tentatively selected plan (TSP). The SMP model outputs will be used to drive TSP formulation and more detailed future analysis of environmental effects of various measures. We are unaware of any plans by the USACE to utilize additional methods to evaluate the performance of project components prior to the selection of a TSP. Although the SMP model may prove to be a valuable tool for large-scale planning efforts, NMFS cautions the model has not been reviewed by independent scientists or certified by the USACE. It is our understanding the USACE's policies require the use of certified models for all planning studies to ensure the models are technically and theoretically sound, compliant with policy, computationally accurate, and based on reasonable assumptions. Planning models are defined as any models and analytical tools which are used to: (1) define water resources problems and opportunities, (2) formulate potential alternatives to address the problems and take advantage of the opportunities, (3) evaluate potential effects of alternatives, and (4) support decision making. To the contrary, we are unaware of supporting information which would indicate the SMP modeling framework reliably predicts short or long term changes in hydrology, habitat type, vegetative cover, and other information needed to complete a variety of other impact analyses. Therefore, NMFS recommends the USACE either independently assess and certify the SMP models or use a previously USACE certified model for the SWCLA study.

The study currently features seven project alternatives. Hydrology and salinity control measures are included in all but the "No Action Alternative". However, the USACE has not provided data supporting the assumption that hydrologic and salinity control measures are actually effective at reducing wetlands loss rates or are critical components of sustainable ecosystem restoration in the Chenier Plain. Contrarily, there are a large number of studies which demonstrate the installation and operation of water control structures associated with hydrologic and salinity control measures do adversely impact marine fishery productivity. Other studies of areas impacted by the installation of water control structures suggest such actions could also adversely impact wetland health and sustainability. Because such hydrologic control measures are combined with other components which may be more effective in providing ecosystem restoration, their inclusion in every future with project alternative could result in the selection of a TSP which may adversely impact marine fishery production and wetland sustainability while providing limited environmental benefits. The NMFS recommends the USACE conduct further detailed analyses of all hydrological and salinity control measures prior to finalization of the TSP. The analyses should assess site specific hydrology effects of proposed measures, as well as anticipated wetland responses to verify assessed project benefits.

Further, NMFS is concerned there is not sufficient data to fully assess many of the proposed measures. Based on information provided by the PDT, there does not appear to be adequate detail regarding design and future operation of the majority of the hydrologic and salinity control measures. The NMFS believes these measures, designed to affect thousands of acres of aquatic habitats, cannot be assessed for either environmental benefits or impacts without hydraulic and hydrology information, such as current and future hydroperiod (timing, depth and duration of flooding), salinity, and velocity projections at water control structures. The NMFS recommends more in-depth hydrology and salinity modeling be used to evaluate the proposed structures' impacts on the environment.

The NMFS is also concerned potential environmental impacts may not be revealed through the proposed assessment methods. For example, the Wetland Value Assessment (WVA) model was developed to evaluate and compare relatively small scale coastal restoration projects, rather than support large scale civil works alternatives analyses and impact assessments. Therefore, we believe it is inappropriate to utilize WVA models to determine the effects of basin-wide salinity reductions and reduced water exchange on marine fishery production. Any reduction in fisheries production could have secondary socioeconomic effects, which are also not being quantified to assist in the selection of a TSP. We believe these concerns should be incorporated into the decision-making process regarding the selection of the TSP, as well as addressed in any environmental impact statement (EIS) for the SWCLA project.

Some measures potentially to be included in the TSP, such a flood protection levees and ridge construction on marsh, could result in the destruction of wetlands. While it is possible for some environmental restoration measures to serve as compensatory mitigation for adverse impacts, it does not obviate the need for an evaluation of less damaging alternatives required by the Clean Water Act. The mitigation sequence established by the Clean Water Act Section 404(b)(1) Guidelines states impacts must be avoided, then minimized to the maximum extent practicable prior to the consideration of compensatory mitigation. The SWCLA study, on its current path, does not evaluate potential less damaging alternatives as required by the Clean Water Act.

The NMFS believes these and other issues potentially affecting NOAA trust resources should be thoroughly evaluated prior to selection of the TSP. To be in compliance with the National Environmental Policy Act (NEPA), evaluations of direct, indirect and cumulative impacts would be necessary for incorporation into a draft EIS for the project. Lacking such information in an EIS, NMFS does not believe it would be possible to move TSP directly into Pre-construction Engineering and Design (PED) without additional NEPA evaluations.

We do note the NED and some NER measures (i.e., marsh creation and shoreline protection) may be adequately evaluated as envisioned in the current study plan. As such, it may be appropriate to split off such measures, potentially allowing for full environmental compliance to be achieved within the SMART study schedule and furthering those critical measures to PED. The USACE could then reserve the more complex hydrology and salinity control measures for additional analyses. Due to the scope and diversity of measures under consideration, a Programmatic EIS may also be an alternative means to further the study objectives in this important region, while providing opportunity for more detailed evaluations in the future.

NMFS has findings with the USACE New Orleans District (NOD) describing procedures for EFH consultation during the NOD's review of planning and operations activities subject to compliance with provisions of the Magnuson-Stevens Fishery Conservation and Management

Act and NEPA. Under those procedures, the NOD must produce documents containing: (1) a description of the proposed action, (2) an analysis of individual and cumulative effects on EFH, Federally managed fisheries, including major prey species, (3) the NOD's views regarding effects, and (4) proposed mitigation, if applicable. These documents constitute the basis of an EFH assessment. This finding indicates the document required pursuant to NEPA will incorporate all the necessary requirements of an EFH assessment. Based on information provided to us to-date, NMFS does not believe sufficient analyses will be included in an EIS to adequately fulfill the requirements of an EFH assessment.

There is a potential for various project components to impact other NOAA trust resources managed through our Protected Resources Division. As such, we suggest your staff initiate coordination with Mr. David Bernhart by electronic mail at David.Bernhart@noaa.gov or by telephone at (727) 824-5312.

We look forward to receiving your response regarding these concerns in an effort to proceed with completion of this important study effort. If you wish to discuss this project further or have questions concerning our recommendations, please contact Lisa Abernathy at (225) 389-0508, extension 209.

Sincerely,

Virginia M. Fay

Virginia M. Fay
Assistant Regional Administrator
Habitat Conservation Division

c:
NOD, Exnicios, Klein
FWS, Walther, Paille
EPA, Ettinger
LDWF, Balkum
LA DNR, Haydel
F/SER3, Bernhart
F/SER4, Dale, Rolfes
F/SER46, Swafford
Files

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701

October 9, 2009 F/SER46/RH:jk
225/389-0508

Colonel Alvin B. Lee, Commander
New Orleans District
Department of the Army, Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Lee:

NOAA's National Marine Fisheries Service (NMFS) has received your letter dated September 29, 2009, stating the intent of the New Orleans District (NOD) to prepare an environmental impact statement (EIS) for the Southwest Coastal Louisiana Protection and Restoration Feasibility Study. The purpose of the study is to determine the feasibility of providing coastal protection and restoration measures to the parishes of Calcasieu, Cameron and Vermilion, and to recommend an implementation plan.

In your letter, you requested NMFS participate as a cooperating agency in the preparation of the EIS for this study. As per provisions of the National Environmental Policy Act, NMFS accepts the NOD's invitation to become a cooperating agency on the EIS for this project. It should be noted that, due to staffing and travel constraints, our participation in the preparation of the EIS for this project may be limited to our review and comment on the draft EIS, participation on teleconferences, and occasional travel to meetings and field inspections. NMFS staff are unable to take an active role in drafting sections of the EIS.

We appreciate your invitation to serve as a cooperating agency on the EIS for this project. Ms. Rachel Sweeney of our Baton Rouge office should be the point of contact for this effort as she has already been coordinating with NOD staff on project issues and alternatives.

Sincerely,

Richard Hartman

for Miles M. Croom
Assistant Regional Administrator
Habitat Conservation Division

c:
FWS, Lafayette, Soileau
EPA, Ettinger
LA OCPR, Johnson
F/SER46, Swafford
F/SER4, Dale
Files

Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701

April 7, 2009 F/SER46/RH:jk
225/389-0508

Ms. Sandra Stiles
Environmental Planning and Compliance Branch
Planning, Programs, and Management Division
New Orleans District, Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Dear Ms. Stiles:

NOAA's National Marine Fisheries Service (NMFS) has received the Public Scoping Announcement and the Notice of Intent to prepare a Draft Environmental Impact Statement (DEIS) for the **Southwest Coastal Louisiana Feasibility Study for Calcasieu, Cameron and Vermilion Parishes, Louisiana.** The Committee on Transportation and Infrastructure, U.S. House of Representatives, Resolution Docket 2747, Southwest Coastal Louisiana, LA authorized the Secretary of the Army to survey the coast of Louisiana in Cameron, Calcasieu and Vermilion Parishes in reference to the advisability of providing hurricane protection and storm damage reduction, including the feasibility of constructing an armored 12-ft high levee along the Gulf Intracoastal Waterway.

According to the document, alternatives being considered include multi-parish levee alignments, ring levees, ridges and breakwaters to provide multiple lines of defense. Coastal restoration measures, including creation of barrier islands, large-scale marsh creation, salinity control, and hydrologic restoration also are being considered. Non-structural measures to be evaluated include raising structures in-place, property buy-outs, relocating communities and hardening infrastructure.

NMFS understands the desires of the affected public for storm surge risk reduction and is supportive of many of the alternatives being evaluated under this study. NMFS recommends the DEIS include and evaluate potential project impacts to the below identified resources and issues. This should include alternatives to avoid, minimize, and mitigate environmental impacts.

Essential Fish Habitat
This study will evaluate and may propose actions in areas identified as essential fish habitat (EFH) for a variety of federally managed species (see attached table for species, life stages and subcategories of EFH). Detailed information on federally managed fisheries and their EFH is provided in the 2005 generic amendment of the Fishery Management Plans for the Gulf of Mexico prepared by the Gulf of Mexico Fishery Management Council (GMFMC). The generic amendment was prepared as required by the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). The DEIS should include an EFH Assessment that includes: (1) a description of the proposed action; (2) an analysis of the effects, including

cumulative effects of the action, on various categories of EFH, the managed species, and associated life history stage; (3) the federal agency's views regarding the effects of the action on EFH; and, (4) proposed mitigation. While some alternatives may include wetland restoration components, all adverse impacts to various categories of EFH should be identified in the DEIS and a mitigation plan should be developed to fully offset those impacts.

Marine Fishery Resources

Wetlands in the project area consist of fresh, intermediate, brackish, and saline marsh. In addition to being designated as EFH for the species identified in the attached table, these wetlands provide nursery, foraging, and predator refugia habitats that support numerous economically important marine fishery species such as spotted seatrout, sand seatrout, black drum, southern flounder, gulf menhaden, striped mullet, Atlantic croaker, and blue crab. Some of these species also serve as prey for other fish species managed under the Magnuson-Stevens Act by the GMFMC (e.g., mackerels, snappers, and groupers) and highly migratory species managed by NMFS (e.g., billfishes and sharks). The importance of fishery resources to the state of Louisiana and the national economy is shown by the fact that during 2007, 951,240 pounds of seafood was landed at Louisiana ports totaling $259 million dollars in dockside value[a]. To demonstrate the value of the project area to commercial seafood production, ports at Intracoastal City and Cameron placed fifth and seventh, respectively, in the quantity (pounds) of landings as compared to the rest of the nation. More than 85% of these commercial landings are related to the harvest of estuarine dependent species (i.e., species that depend on access to coastal marsh during one or more life stage). NMFS recommends the DEIS fully describe and quantify the value of marine fishery resources in the study area to Louisiana and the nation and the dependence of those resources on access to, and the continued health of, coastal wetlands.

Alternatives Analysis

Sufficient information should be provided in the DEIS to demonstrate compliance with the Clean Water Act Section 404 regulations in determining the least environmentally damaging practicable alternative to provide the authorized project purpose. That project purpose is hurricane protection and storm damage risk reduction. Under the project authority, hurricane protection, storm surge risk reduction, and restoration are to be identified as measures to achieve the project purpose. To that end, a fully informed alternatives analysis should be prepared before indentifying a tentatively selected plan. Such an analysis should include direct and indirect wetland, EFH, and fishery resource impacts; risk and reliability; borrow material sources; cost; and time to construct for all alternatives, including the fulfillment of requisite compensatory mitigation needs. Whether for storm protection or habitat restoration, sediment sources for construction are a limiting resource and therefore represent a programmatic challenge. As with the ongoing updated 100-year protection for the Greater New Orleans Hurricane and Storm Damage Risk Reduction System, NMFS encourages alternatives analyzed for this study fully consider avoiding all wetland impacts for mining fill material.

NMFS agrees that information developed for the Louisiana Coastal Protection and Restoration Project, Final Technical Report would be a starting point for this authority. However, we are concerned that Report did not include wetland restoration measures in this area for a similar

[a] http://www.st.nmfs.noaa.gov/st1/publications.html

project purpose. NMFS recommends the Corps of Engineers (COE) re-evaluate some of the assumptions that resulted in a determination that wetland restoration efforts provided no storm surge risk reduction benefits.

NMFS also is concerned that some levee alternatives could prohibit the identification of a cost-effective project that would meet the objectives of providing hurricane and storm surge protection to the most developed areas while maintaining a natural system in areas where such protection may be less warranted. Combining levee alignments and wetland restoration features that stretch across the study area could result in the identification and selection of a project that is so expensive that funding would be prohibitive. Therefore, NMFS believes an alternative that includes construction of ring levees only around large population centers or important infrastructure, combined with more critical wetland restoration activities, should be included in the list of alternatives for in-depth evaluation.

Secondary Impacts

NMFS is concerned with the potential magnitude of secondary, or indirect, impacts to tidal wetlands that could result from the proposed construction of levees and installation of water control structures. Extensive secondary impacts to wetlands and fishery productivity could occur from enclosing wetlands and from mining sediment for levee construction. Considering the potentially large amount of tidally influenced wetlands and water bodies which would be enclosed within levees for certain alternatives, and the value of those wetlands to Louisiana's recreational and commercial marine fishery harvest, this issue is of paramount importance. Construction of levees and water control structures can impede fishery access to critical nursery and foraging habitats and result in the impoundment or semi-impoundment of those wetlands. The DEIS should quantify the acres of all categories of EFH to be enclosed within the levees or behind structures for all alternatives evaluated. The DEIS also should identify means to minimize the adverse impacts of those actions. This includes designing water control structures and developing operational plans to maximize passage of marine fishery organisms. Structure designs and operational plans should be developed in coordination with the natural resource agencies prior to the completion of the DEIS and described in specific detail in the document.

Enclosing wetlands under potential alternatives could result in landscape level alterations of wetland hydrology. This includes ponding of water on the marsh surface and interruption of the frequency and duration of tidal exchange necessary to help maintain plant health. If sufficient cross-sectional area is not provided at all necessary locations within a leveed system, introduced water from rainfall, runoff drainage or from storm overtopping could take an excessive amount of time to drain, which would increase soil anoxia and decrease plant health. Additionally, levees and water control structures could block the flow of sediments, detritus, and nutrients, which are important for maintaining plant health and soil elevations in a subsiding environment, to wetlands both within and outside the impounded system. This would result in an increase in the loss of wetlands in the affected systems. The DEIS should identify and discuss these issues and identify measures for each alternative necessary to maintain the health of enclosed or adjacent wetlands. NMFS believes that an in-depth, comprehensive hydrologic model will have to be developed to adequately evaluate potential hydrologic impacts and the need for drainage pathways. The DEIS should discuss the need for hydrologic modeling to identify the locations of necessary drainage sites and to quantify the cross-sectional area required to rapidly remove rainfall and storm waters from enclosed wetlands.

The DEIS should evaluate the indirect impacts from the creation of borrow sources. For example, this should include an assessment of impacts on the regional sedimentation processes, impacts on wave refraction/diffraction (if applicable), slope stability, and water quality. Particularly concerning to NMFS would be excavation of continuous borrow pits adjacent to levees. Such an alternative source for fill material would contribute substantially to landscape level alterations to hydrology and likely adversely impact marsh health. If the borrow pits were located outside of the levee, these features can become navigational and hydrologic pathways that could result in erosion of adjacent banklines. While plugs can be constructed in continuous borrow pits to keep this from occurring, such plugs usually are only temporary features in a subsiding and deteriorating environment. The DEIS should address this issue, identify the most likely sources of fill for levee construction, and discuss measures necessary to ensure borrow site locations don't result in adverse impacts to wetland hydrology and marsh health.

Mitigation
The DEIS should contain sufficient information to support a determination of compliance with the Clean Water Act (CWA) Section 404(b)(1) Guidelines. The potential that wetland restoration efforts could offset some or all of the adverse impacts to marsh should not preclude required sequencing to first avoid and then minimize impacts of the proposed action on wetlands. Mitigation requirements for proposed hurricane levee alignments that impact wetlands also should comply with Section 2036 of the Water Resources Development Act (WRDA) of 2007 which requires mitigation for water resources project to comply with the mitigation standards and policies established by the COE regulatory program. In the case of this project, mitigation assessed should be in compliance with the April 10, 2008, CWA Section 404 mitigation regulations, which were issued jointly by the COE and the Environmental Protection Agency. Of primary pertinence is the requirement that mitigation plans include 12 components: objectives, site selection (rationale), site protection instrument, baseline information, determination of credits, mitigation work plan, maintenance plan, performance standards, monitoring requirements, long-term management plan, adaptive management plan, and financial assurances. The need for compensatory mitigation should be recognized in the DEIS, including a discussion of mitigation, and a draft mitigation plan that fully complies with the CWA and WRDA 2007 should be described in the Mitigation section of the document.

In addition to this, wetland restoration and/or flood protection activities are underway under the Louisiana Coastal Protection and Restoration project; the Coastal Wetlands Planning, Protect and Restoration Act; the Louisiana Coastal Area Feasibility Study; the Coastal Protection and Restoration Authority Master Plan; and the Coastal Impact Assessment Program. Additionally, regional sediment management efforts are underway that this study should utilize and adhere to in terms of identifying sediment quantity and quality and priority of its use relative to other programs. The DEIS should identify and discuss all programs that are involved in wetland restoration and flood protection efforts. Furthermore, the COE should make every effort necessary to coordinate planning under this project with those other efforts to facilitate the exchange of information and ensure that activities being undertaken do not compromise the efforts of each.

NMFS is committed to working cooperatively with the COE, the State and other natural resource agencies to facilitate planning on this effort. We appreciate the opportunity to provide these comments for consideration in preparing this DEIS.

Sincerely,

Miles Croom
Assistant Regional Administrator
Habitat Conservation Division

Enclosure

c:
FWS, Lafayette
EPA, Dallas
LA DWF
LA DNR, Consistency
F/SER4
F/SER46, Swafford
Files

EFH Requirements for Species Managed by the Gulf of Mexico Fishery Management Council: Ecoregion 4, Mississippi River Delta (South Pass) to Freeport, Tx, that occur in the study area.

Species	Life Stage	System	EFH
Brown shrimp	larvae/postlarvae	M/E	<82 m; planktonic, sand/shell/soft bottom, SAV, emergent marsh, oyster reef
	juvenile	E	<18 m; SAV, sand/shell/soft bottom, SAV, emergent marsh, oyster reef
White shrimp	larvae/postlarvae	M/E	<82 m; soft bottom, emergent marsh
	juvenile	E	<30 m; soft bottom, emergent marsh
Gulf stone crab	eggs	E/M	<18 m; sand/shell/soft bottom
	larvae/postlarvae	E/M	<18 m; planktonic/oyster reefs, soft bottom
	juvenile	E	<18 m; sand/shell/soft bottom, oyster reef
Red drum	larvae/postlarvae	E	all estuaries planktonic, SAV; sand/shell/soft bottom, emergent marsh
	juvenile	E/M	GOM <5 m Vermilion Bay; all estuaries; SAV,; and/shell/soft/hard bottom, emergent marsh
	adults	E/M	GOM 1-46 m; Vermilion Bay; all estuaries; SAV; sand/shell/soft/hard bottom, emergent marsh
lane snapper	larvae	E/M	4-132 m; reefs; SAV
	juvenile	E/M	<20 m; SAV; mangrove; reefs; sand/shell/soft bottom
bonnethead shark	juvenile/adult	M	inlets; estuaries; coastal waters <25 m; Louisiana to Texas

M=marine, E=estuarine

SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex E

Natural Resources Conservation Service Prime and

Unique Farmlands Coordination

From: Williams, Eric MVN
To: "Walters, Cheryl - NRCS, Alexandria, LA"
Subject: AD-1006, Prime and Unique Farmlands Evaluation - Southwest Coastal Louisiana Study, U.S. Army Corps of Engineers, New Orleans District (UNCLASSIFIED)
Date: Friday, November 22, 2013 3:56:00 PM
Attachments: SW Coastal Louisiana Study AD-1006.pdf
SW Coastal_AD-1006_Chenier Ridge Project Description.pdf
Site_A.dbf
Site_A.prj
Site_A.sbn
Site_A.sbx
Site_A.shp
Site_A.shp.xml
Site_A.shx
Site_B.dbf
Site_B.prj
Site_B.sbn
Site_B.sbx
Site_B.shp
Site_B.shp.xml
Site_B.shx
Site_C.dbf
Site_C.prj
Site_C.sbn
Site_C.sbx
Site_C.shp
Site_C.shp.xml
Site_C.shx
Site_D.dbf
Site_D.prj
Site_D.sbn
Site_D.sbx
Site_D.shp
Site_D.shp.xml
Site_D.shx

Classification: UNCLASSIFIED
Caveats: NONE

Ms. Walters,

Please see the attached form AD-1006 and project description for the subject. The U.S. Army Corps of Engineers is preparing an EIS for the subject project and request that the NRCS provide an evaluation of the prime and unique farmlands for proposed chenier ridge reforestation in southwest Louisiana. The proposed reforestation would convert approximately 1,431 acres of existing chenier ridge from future agricultural or grazing use. Shape files are attached for use in the evaluation. If you have questions regarding the project, the attached form AD-1006, or the shape files, please do not hesitate to contact me at (504) 862-2862.

Please advise if use of email is acceptable, or if in the future we should transmit these requests via another method.

Eric M. Williams

RPEDS, South/CEMVN-PDN-NCR

504/862-2862

Fax: 504/862-2088

eric.m.williams@usace.army.mil

Classification: UNCLASSIFIED
Caveats: NONE

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 11/22/2013
Name of Project Southwest Coastal Louisiana Study	Federal Agency Involved US Army Corp of Engineers
Proposed Land Use Chenier Ridge Reforestation	County and State Cameron and Vermilion Parishes, Louisiana
PART II *(To be completed by NRCS)*	Date Request Received By NRCS / Person Completing Form:

Does the site contain Prime, Unique, Statewide or Local Important Farmland? *(If no, the FPPA does not apply - do not complete additional parts of this form)*	YES ☐	NO ☐	Acres Irrigated	Average Farm Size
Major Crop(s)	Farmable Land In Govt. Jurisdiction Acres: %		Amount of Farmland As Defined in FPPA Acres: %	
Name of Land Evaluation System Used	Name of State or Local Site Assessment System		Date Land Evaluation Returned by NRCS	

PART III *(To be completed by Federal Agency)*	Maximum Points	Alternative Site Rating Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly		672.9	458.7	251.9	29.6
B. Total Acres To Be Converted Indirectly		0	0	0	0
C. Total Acres In Site		672.9	458.7	251.9	29.6
PART IV *(To be completed by NRCS)* Land Evaluation Information					
A. Total Acres Prime And Unique Farmland					
B. Total Acres Statewide Important or Local Important Farmland					
C. Percentage Of Farmland in County Or Local Govt. Unit To Be Converted					
D. Percentage Of Farmland in Govt. Jurisdiction With Same Or Higher Relative Value					
PART V (To be completed by NRCS) Land Evaluation Criterion Relative Value of Farmland To Be Converted (Scale of 0 to 100 Points)					
PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(Criteria are explained in 7 CFR 658.5 b. For Corridor project use form NRCS-CPA-106)*	Maximum Points	Site A	Site B	Site C	Site D
1. Area In Non-urban Use	(15)				
2. Perimeter In Non-urban Use	(10)				
3. Percent Of Site Being Farmed	(20)				
4. Protection Provided By State and Local Government	(20)				
5. Distance From Urban Built-up Area	(15)				
6. Distance To Urban Support Services	(15)				
7. Size Of Present Farm Unit Compared To Average	(10)				
8. Creation Of Non-farmable Farmland	(10)				
9. Availability Of Farm Support Services	(5)				
10. On-Farm Investments	(20)				
11. Effects Of Conversion On Farm Support Services	(10)				
12. Compatibility With Existing Agricultural Use	(10)				
TOTAL SITE ASSESSMENT POINTS	160				
PART VII ***(To be completed by Federal Agency)***					
Relative Value Of Farmland *(From Part V)*	100				
Total Site Assessment *(From Part VI above or local site assessment)*	160				
TOTAL POINTS *(Total of above 2 lines)*	260				

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? YES ☐ NO ☐

Reason For Selection:

Name of Federal agency representative completing this form: Eric M. Williams — Date: 11/22/2013

(See Instructions on reverse side) **Form AD-1006 (03-02)**

STEPS IN THE PROCESSING THE FARMLAND AND CONVERSION IMPACT RATING FORM

Step 1 - Federal agencies (or Federally funded projects) involved in proposed projects that may convert farmland, as defined in the Farmland Protection Policy Act (FPPA) to nonagricultural uses, will initially complete Parts I and III of the form. For Corridor type projects, the Federal agency shall use form NRCS-CPA-106 in place of form AD-1006. The Land Evaluation and Site Assessment (LESA) process may also be accessed by visiting the FPPA website, http://fppa.nrcs.usda.gov/lesa/.

Step 2 - Originator (Federal Agency) will send one original copy of the form together with appropriate scaled maps indicating location(s)of project site(s), to the Natural Resources Conservation Service (NRCS) local Field Office or USDA Service Center and retain a copy for their files. (NRCS has offices in most counties in the U.S. The USDA Office Information Locator may be found at http://offices.usda.gov/scripts/ndISAPI.dll/oip_public/USA_map, or the offices can usually be found in the Phone Book under U.S. Government, Department of Agriculture. A list of field offices is available from the NRCS State Conservationist and State Office in each State.)

Step 3 - NRCS will, within 10 working days after receipt of the completed form, make a determination as to whether the site(s) of the proposed project contains prime, unique, statewide or local important farmland. (When a site visit or land evaluation system design is needed, NRCS will respond within 30 working days.

Step 4 - For sites where farmland covered by the FPPA will be converted by the proposed project, NRCS will complete Parts II, IV and V of the form.

Step 5 - NRCS will return the original copy of the form to the Federal agency involved in the project, and retain a file copy for NRCS records.

Step 6 - The Federal agency involved in the proposed project will complete Parts VI and VII of the form and return the form with the final selected site to the servicing NRCS office.

Step 7 - The Federal agency providing financial or technical assistance to the proposed project will make a determination as to whether the proposed conversion is consistent with the FPPA.

INSTRUCTIONS FOR COMPLETING THE FARMLAND CONVERSION IMPACT RATING FORM

(For Federal Agency)

Part I: When completing the "County and State" questions, list all the local governments that are responsible for local land use controls where site(s) are to be evaluated.

Part III: When completing item B (Total Acres To Be Converted Indirectly), include the following:

1. Acres not being directly converted but that would no longer be capable of being farmed after the conversion, because the conversion would restrict access to them or other major change in the ability to use the land for agriculture.
2. Acres planned to receive services from an infrastructure project as indicated in the project justification (e.g. highways, utilities planned build out capacity) that will cause a direct conversion.

Part VI: Do not complete Part VI using the standard format if a State or Local site assessment is used. With local and NRCS assistance, use the local Land Evaluation and Site Assessment (LESA).

1. Assign the maximum points for each site assessment criterion as shown in § 658.5(b) of CFR. In cases of corridor-type project such as transportation, power line and flood control, criteria #5 and #6 will not apply and will, be weighted zero, however, criterion #8 will be weighed a maximum of 25 points and criterion #11 a maximum of 25 points.

2. Federal agencies may assign relative weights among the 12 site assessment criteria other than those shown on the FPPA rule after submitting individual agency FPPA policy for review and comment to NRCS. In all cases where other weights are assigned, relative adjustments must be made to maintain the maximum total points at 160. For project sites where the total points equal or exceed 160, consider alternative actions, as appropriate, that could reduce adverse impacts (e.g. Alternative Sites, Modifications or Mitigation).

Part VII: In computing the "Total Site Assessment Points" where a State or local site assessment is used and the total maximum number of points is other than 160, convert the site assessment points to a base of 160.
Example: if the Site Assessment maximum is 200 points, and the alternative Site "A" is rated 180 points:

$$\frac{\text{Total points assigned Site A}}{\text{Maximum points possible}} = \frac{180}{200} \times 160 = 144 \text{ points for Site A}$$

For assistance in completing this form or FPPA process, contact the local NRCS Field Office or USDA Service Center.

NRCS employees, consult the FPPA Manual and/or policy for additional instructions to complete the AD-1006 form.

Project Description for the Chenier Reforestation Measure of the National Environmental Restoration Component of the Southwest Coastal Louisiana Study

The proposed activity would consist of planting trees for the reforestation of chenier ridges along the southwest Louisiana coast:

- Original measures included all cheniers and elevated features identified by the *Cheniers and Natural Ridges Study* (Providence Engineering and Environmental Group LLC 2009).
- From these, east/west-oriented cheniers with elevations generally greater than +5 feet NAVD 88 (from LIDAR) were selected. The +5 feet NAVD 88 target elevation is considered a conservative minimum elevation that could sustain tree plantings for the duration of the study period given relative sea level rise, and is taken from Didier (2007) and other professional opinions. The selected cheniers included: Measure 510a - Blue Buck Ridge; Measure 510b - Hackberry Ridge; Measure 510d - Front Ridge; Measure 416 - Grand Chenier Ridge; Measure 509c - Bill Ridge; and Measure 509d - Cheniere Au Tigre.
- Within these measures, reforestation focused specifically on large, continuous, sparsely wooded tracts greater than 5 acres, excluding: areas below +5 feet NAVD 88; areas with residential or industrial development; and sand borrow pits.
- For purposes of the prime and unique farmlands evaluation and to more easily correspond with Form AD-1006, the measures have been grouped as sites A – D. All of the measures discussed are part of the proposed action, and shape files for each *Site* are provided:
    - **Site A**
        - Measure 510a – Blue Buck Ridge: Eight tracts totaling 524.4 acres were identified (from west to east: 16.2, 40.4, 45.6, 141.2, 18.2, 20.4, 202.8, and 39.6- acre tracts).
        - Measure 510b – Hackberry Ridge: Three tracts totaling 148.5 acres were identified (from west to east: 62.7, 72.2, and 13.6-acre tracts). The western two miles (including the 62.7-acre tract) of this measure have been identified by the Louisiana Natural Heritage Program as "Remnant Chenier Forest", but appear to have been damaged by recent hurricanes.
    - **Site B**
        - Measure 510d – Front Ridge: The eastern 3.1 miles of this measure do not encompass large swaths of suitable elevation. Of the remainder, eleven tracts totaling 458.7 acres were identified (from west to east: 35.7, 47.1, 70.0, 125.6, 65.2, 12.3, 22.4, 15.0, 29.8, 13.0, 22.6-acre tracts).
    - **Site C**
        - Measure 416 – Grand Chenier Ridge: The eastern 5.8 miles of this measure do not encompass large swaths of suitable elevation. Of the remainder, nine tracts totaling 251.9 acres were identified (from west to east: 8.5, 11.0, 13.1, 19.4, 85.6, 46.7, 25.7, 29.1, and 12.8-acre tracts).

- **<u>Site D</u>**
  - Measure 509c – Bill Ridge: Three tracts were indentified that encompass 8.8 acres of the northern ridge, and 6.5 and 6.1 acres of the southern ridge. The middle section of the southern ridge was excluded due to insufficient elevation.
  - Measure 509d – Cheniere Au Tigre: The majority of this chenier is forested with the exception of an 8.2 acre tract on the western end. The eastern part of the measure along the Gulf shoreline was removed due to concerns about the sustainability of tree plantings in these exposed areas.

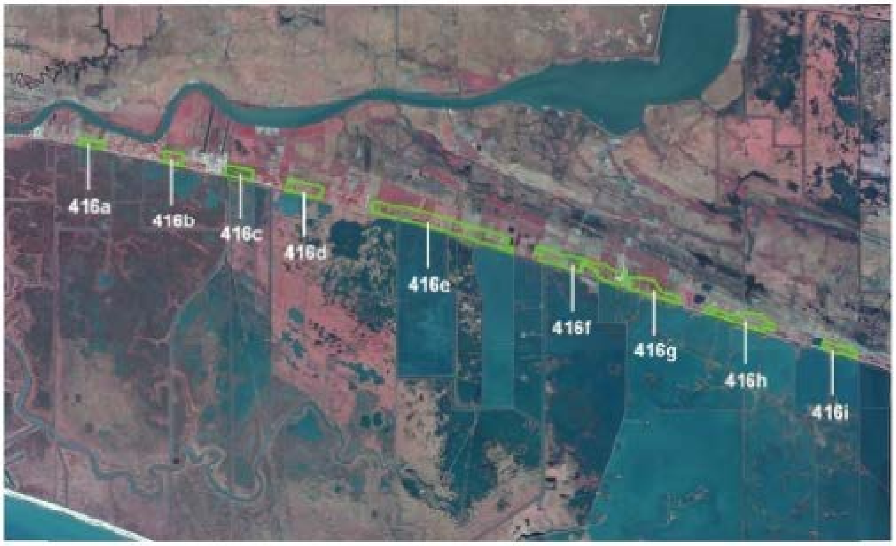

Figure 1. Selected reforestation tracts for Measures 509c, 509d, and 416.

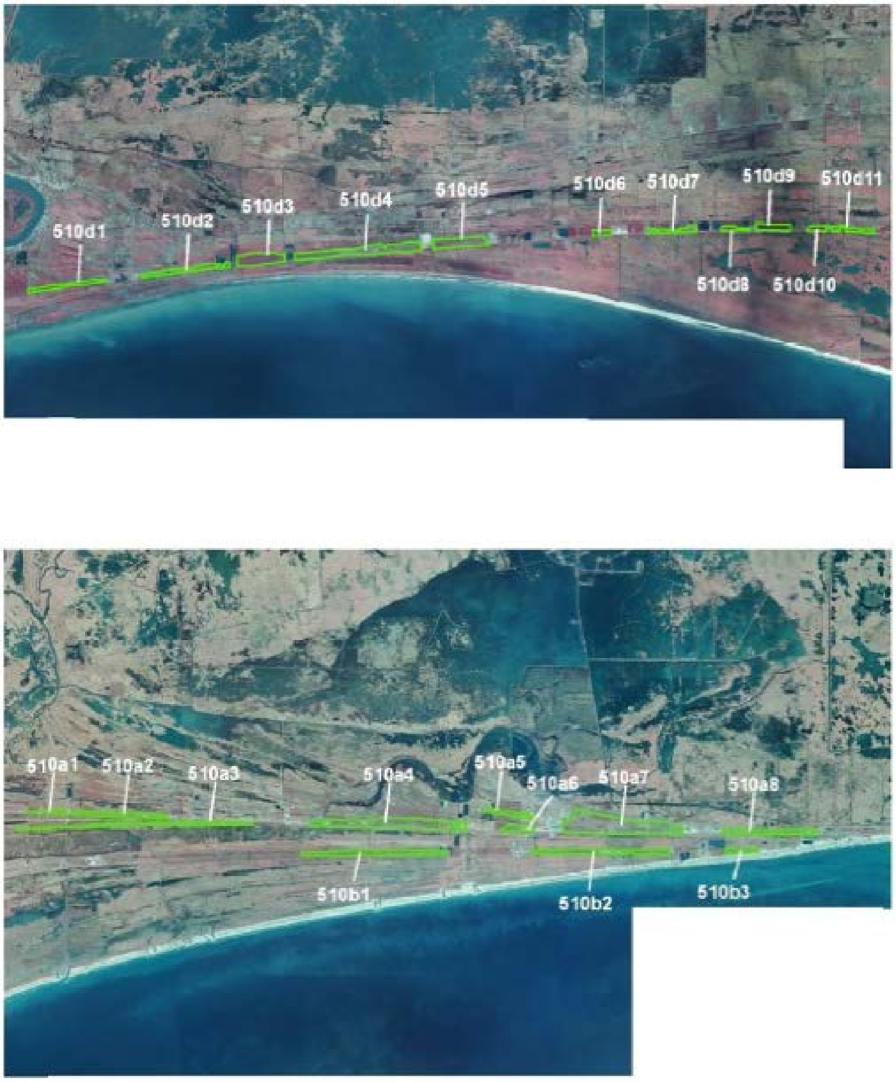

Figure 2. Selected reforestation tracts for Measures 510d, 510a, and 510b.

SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex F

State Historic Preservation Officer (SHPO) and

Tribal Coordination Letters

*****Note: these documents, associated analyses and coordination will be completed during the feasibility-level analysis phase of this study which would occur following release of the Draft Environmental Impact Statement, and would be included in the Final Environmental Impact Statement.

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

REPLY TO
ATTENTION OF

November 27, 2013

Regional Planning and
Environment Division, South

Ms. Pam Breaux
State Historic Preservation Officer
Department of Culture, Recreation and Tourism
Office of Cultural Development
P.O. Box 44247
Baton Rouge, Louisiana 70804

Dear Chairman Bullock:

The United States Army Corps of Engineers (USACE) and the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB) are investigating the feasibility of implementing hurricane and storm damage risk reduction measures as well as ecosystem restoration measures within southwest coastal Louisiana.

The New Orleans District (CEMVN) is preparing a Southwest Coastal Louisiana (SWC LA) Integrated Feasibility Report and Environmental Impact Statement (Integrated Report), which will describe all aspects of the SWC LA study, from its inception through the evolution of the various alternatives, the discussion of potential impacts to applicable natural, socioeconomic and cultural resources, to the decision to recommend a preferred alternative.

The purpose of this letter is to initiate consultation for the SWC LA study, in partial fulfillment of responsibilities under the National Environmental Policy Act and Section 106 of the National Historic Preservation Act. The CEMVN offers you the opportunity to review and comment on the potential of the proposed action to significantly affect historic properties.

<u>Study Authority and History of Investigation</u>

The hurricane and storm damage risk reduction purpose of the SWC LA study was authorized on December 7, 2005, by the Committee on Transportation and Infrastructure, U.S. House of Representatives, Resolution Docket 2747, and the ecosystem restoration purpose was recommended for approval in the 2005 USACE Chief's Report for the Louisiana Coastal Area (LCA) Ecosystem Restoration Program that was authorized in the Water Resources Development Act of 2007. The Feasibility Cost Share Agreement was signed with the CPRAB on January 14, 2009. In 2013 the CEMVN was directed to transition the project to SMART planning.

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Proposed Action

Proposed measures of the National Economic Development plan include residential structure elevation, flood proofing, and the acquisition of qualifying structures. The National Ecosystem Restoration (NER) purpose of SWC LA project is to significantly restore environmental conditions for the Chenier Plain ecosystem. Proposed NER measures include nine marsh restoration measures that would restore approximately 8,579 acres and nourish approximately 4,026 acres, resulting in approximately 8,714 net acres; two hydrologic and salinity control measures to restore approximately 6,092 net acres; five shoreline protection measures spanning approximately 266,884 linear feet to protect approximately 5,509 net acres; the preservation of the historic Sabine oyster reef; and a chenier reforestation program to include the planting of trees on approximately 1,413 acres (please refer to the two enclosed maps of the draft NER TSP). The alternatives will be further developed in the Integrated Report.

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The USACE has determined that the proposed action is an undertaking as defined in 36 CFR § 800.16(y) that has the potential to cause effects on historic properties. This letter initiates formal Section 106 consultation pursuant to 36 CFR § 800.3(c). CEMVN is currently reviewing existing information on historic properties within the study area. Following the preparation of the Integrated Report, CEMVN will schedule a teleconference with consulting parties to discuss the area of potential effects (APE), the existing information on historic properties within the APE, as well as data concerning possible historic properties not yet identified, and the level of effort for the identification and evaluation of historic properties.

Your response to this letter, including any information your office may wish to provide at this time concerning the proposed undertaking and its potential to significantly affect historic properties is greatly appreciated. Please also notify us of any other interested party who may wish to participate in this consultation.

As always, should you have any questions or concerns about the proposed action or the SMART Planning Framework, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; Rebecca.Hill@usace.army.mil. An electronic copy of this letter with enclosures will be provided to Section106@crt.la.gov.

Sincerely,

Sandra Stiles

for Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

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

REPLY TO
ATTENTION OF

November 27, 2013

Regional Planning and
Environment Division, South

Carlos Bullock, Chairman
Alabama-Coushatta Tribe of Texas
571 State Park Rd 56
Livingston, TX 77351

Dear Chairman Bullock:

The United States Army Corps of Engineers (USACE) and the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB) are investigating the feasibility of implementing hurricane and storm damage risk reduction measures as well as ecosystem restoration measures within southwest coastal Louisiana.

The New Orleans District (CEMVN) is preparing a Southwest Coastal Louisiana (SWC LA) Integrated Feasibility Report and Environmental Impact Statement (Integrated Report), which will describe all aspects of the SWC LA study, from its inception through the evolution of the various alternatives, the discussion of potential impacts to applicable natural, socioeconomic and cultural resources, to the decision to recommend a preferred alternative.

The purpose of this letter is to initiate consultation for the SWC LA study, in partial fulfillment of responsibilities under Executive Order 13175, the National Environmental Policy Act, and Section 106 of the National Historic Preservation Act. The CEMVN offers you the opportunity to review and comment on the potential of the proposed action to significantly affect protected tribal resources, tribal rights, or Indian lands.

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Sincerely,

Sandra Stiles

for Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

REPLY TO
ATTENTION OF

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

November 27, 2013

Regional Planning and
Environment Division, South

Brenda Shemayme Edwards, Chairwoman
Caddo Nation of Oklahoma
P.O. Box 487
Binger, OK 73009

Dear Chairwoman Edwards:

The United States Army Corps of Engineers (USACE) and the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB) are investigating the feasibility of implementing hurricane and storm damage risk reduction measures as well as ecosystem restoration measures within southwest coastal Louisiana.

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Sincerely,

Rebecca Hill

for Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

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

REPLY TO
ATTENTION OF

November 27, 2013

Regional Planning and
Environment Division, South

John Paul Darden, Chairman
Chitimacha Tribe of Louisiana
P.O. Box 661
Charenton, LA 70523

Dear Chairman Darden:

The United States Army Corps of Engineers (USACE) and the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB) are investigating the feasibility of implementing hurricane and storm damage risk reduction measures as well as ecosystem restoration measures within southwest coastal Louisiana.

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Sincerely,

Sandra Stiles
for Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

REPLY TO
ATTENTION OF

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

November 27, 2013

Regional Planning and
Environment Division, South

Gregory E. Pyle, Chief
Choctaw Nation of Oklahoma
P.O. Box 1210
Durant, OK 74702-1210

Dear Chief Pyle:

The United States Army Corps of Engineers (USACE) and the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB) are investigating the feasibility of implementing hurricane and storm damage risk reduction measures as well as ecosystem restoration measures within southwest coastal Louisiana.

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Sandra Stiles

for Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

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

REPLY TO
ATTENTION OF

November 27, 2013

Regional Planning and
Environment Division, South

Kevin Sickey, Chief
Coushatta Tribe of Louisiana
P.O. Box 818
Elton, LA 70532

Dear Chief Sickey:

The United States Army Corps of Engineers (USACE) and the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB) are investigating the feasibility of implementing hurricane and storm damage risk reduction measures as well as ecosystem restoration measures within southwest coastal Louisiana.

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Sincerely,

Sandra Stiles

for Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

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

REPLY TO
ATTENTION OF

November 27, 2013

Regional Planning and
Environment Division, South

B. Cheryl Smith, Principal Chief
Jena Band of Choctaw Indians
P.O. Box 14
Jena, LA 71342

Dear Principal Chief Smith:

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Section 106 Consultation

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As always, should you have any questions or concerns about the proposed action or the SMART Planning Framework, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; Rebecca.Hill@usace.army.mil. An electronic copy of this letter with enclosures will be provided to Ms. Dana Masters, Tribal Historic Preservation Officer, Jena Band of Choctaw Indians, jbc.thpo106@aol.com, and Ms. Lillie McCormick, Environmental Director, Jena Band of Choctaw Indians, lmmccormickjbc@centurytel.net.

Sincerely,

Sandra Stiles

for Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

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

REPLY TO
ATTENTION OF

November 27, 2013

Regional Planning and
Environment Division, South

Phyliss J. Anderson, Chief
Mississippi Band of Choctaw Indians
P.O. Box 6257
Choctaw, MS 39350

Dear Chief Anderson:

The United States Army Corps of Engineers (USACE) and the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB) are investigating the feasibility of implementing hurricane and storm damage risk reduction measures as well as ecosystem restoration measures within southwest coastal Louisiana.

The New Orleans District (CEMVN) is preparing a Southwest Coastal Louisiana (SWC LA) Integrated Feasibility Report and Environmental Impact Statement (Integrated Report), which will describe all aspects of the SWC LA study, from its inception through the evolution of the various alternatives, the discussion of potential impacts to applicable natural, socioeconomic and cultural resources, to the decision to recommend a preferred alternative.

The purpose of this letter is to initiate consultation for the SWC LA study, in partial fulfillment of responsibilities under Executive Order 13175, the National Environmental Policy Act, and Section 106 of the National Historic Preservation Act. The CEMVN offers you the opportunity to review and comment on the potential of the proposed action to significantly affect protected tribal resources, tribal rights, or Indian lands.

<u>Study Authority and History of Investigation</u>

The hurricane and storm damage risk reduction purpose of the SWC LA study was authorized on December 7, 2005, by the Committee on Transportation and Infrastructure, U.S. House of Representatives, Resolution Docket 2747, and the ecosystem restoration purpose was recommended for approval in the 2005 USACE Chief's Report for the Louisiana Coastal Area (LCA) Ecosystem Restoration Program that was authorized in the Water Resources Development Act of 2007. The Feasibility Cost Share Agreement was signed with the CPRAB on January 14, 2009. In 2013 the CEMVN was directed to transition the project to SMART planning.

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Sincerely,

Sandra Stiles

for Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

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

REPLY TO
ATTENTION OF

November 27, 2013

Regional Planning and
Environment Division, South

John Berrey, Chairman
Quapaw Tribe of Oklahoma
P.O. Box 765
Quapaw, OK 74363

Dear Chairman Berrey:

The United States Army Corps of Engineers (USACE) and the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB) are investigating the feasibility of implementing hurricane and storm damage risk reduction measures as well as ecosystem restoration measures within southwest coastal Louisiana.

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Sincerely,

Sandra Stiles
for Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

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

REPLY TO
ATTENTION OF

November 27, 2013

Regional Planning and
Environment Division, South

Leonard M. Harjo, Principal Chief
Seminole Nation of Oklahoma
P.O. Box 1498
Wewoka, OK 74884

Dear Principal Chief Harjo:

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Sincerely,

Rebecca Hill

for Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

REPLY TO
ATTENTION OF

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

November 27, 2013

Regional Planning and
Environment Division, South

James Billie, Chairman
Seminole Tribe of Florida
6300 Stirling Road
Hollywood, FL 33024

Dear Chairman Billie:

The United States Army Corps of Engineers (USACE) and the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB) are investigating the feasibility of implementing hurricane and storm damage risk reduction measures as well as ecosystem restoration measures within southwest coastal Louisiana.

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Sincerely,

Sandra Stiles
for Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

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

REPLY TO
ATTENTION OF

November 27, 2013

Regional Planning and
Environment Division, South

Earl J. Barbry, Sr., Chairman
Tunica-Biloxi Tribe of Louisiana
P.O. Box 1589
Marksville, LA 71351

Dear Chairman Barbry:

The United States Army Corps of Engineers (USACE) and the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB) are investigating the feasibility of implementing hurricane and storm damage risk reduction measures as well as ecosystem restoration measures within southwest coastal Louisiana.

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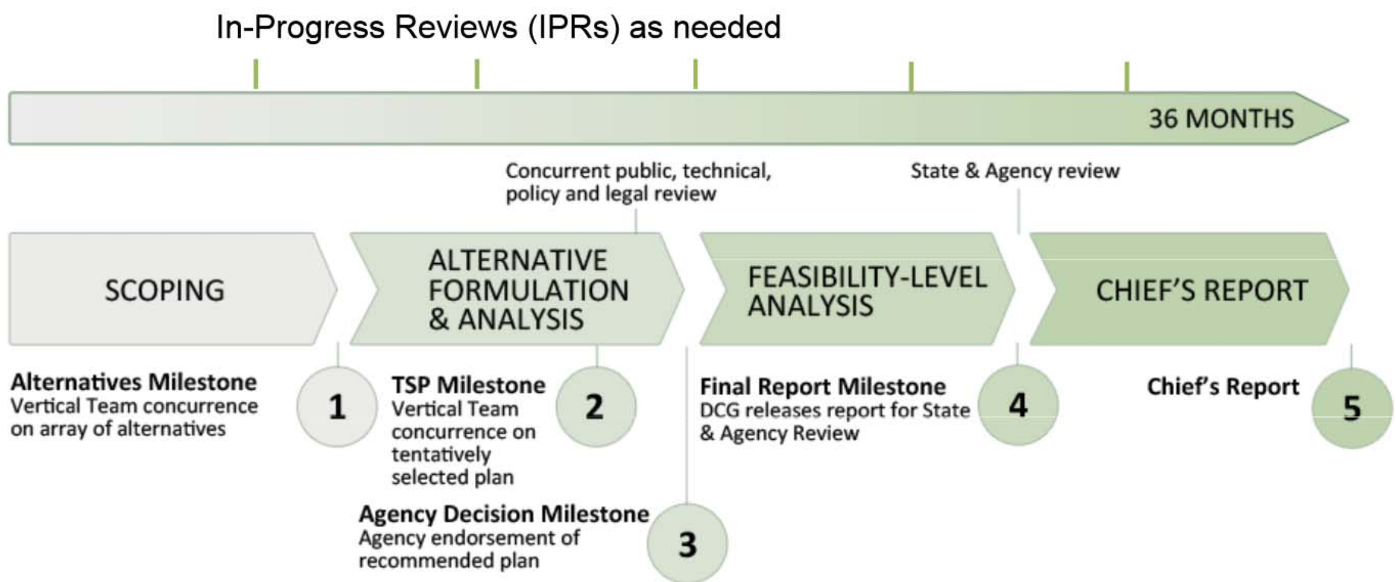
Sincerely,

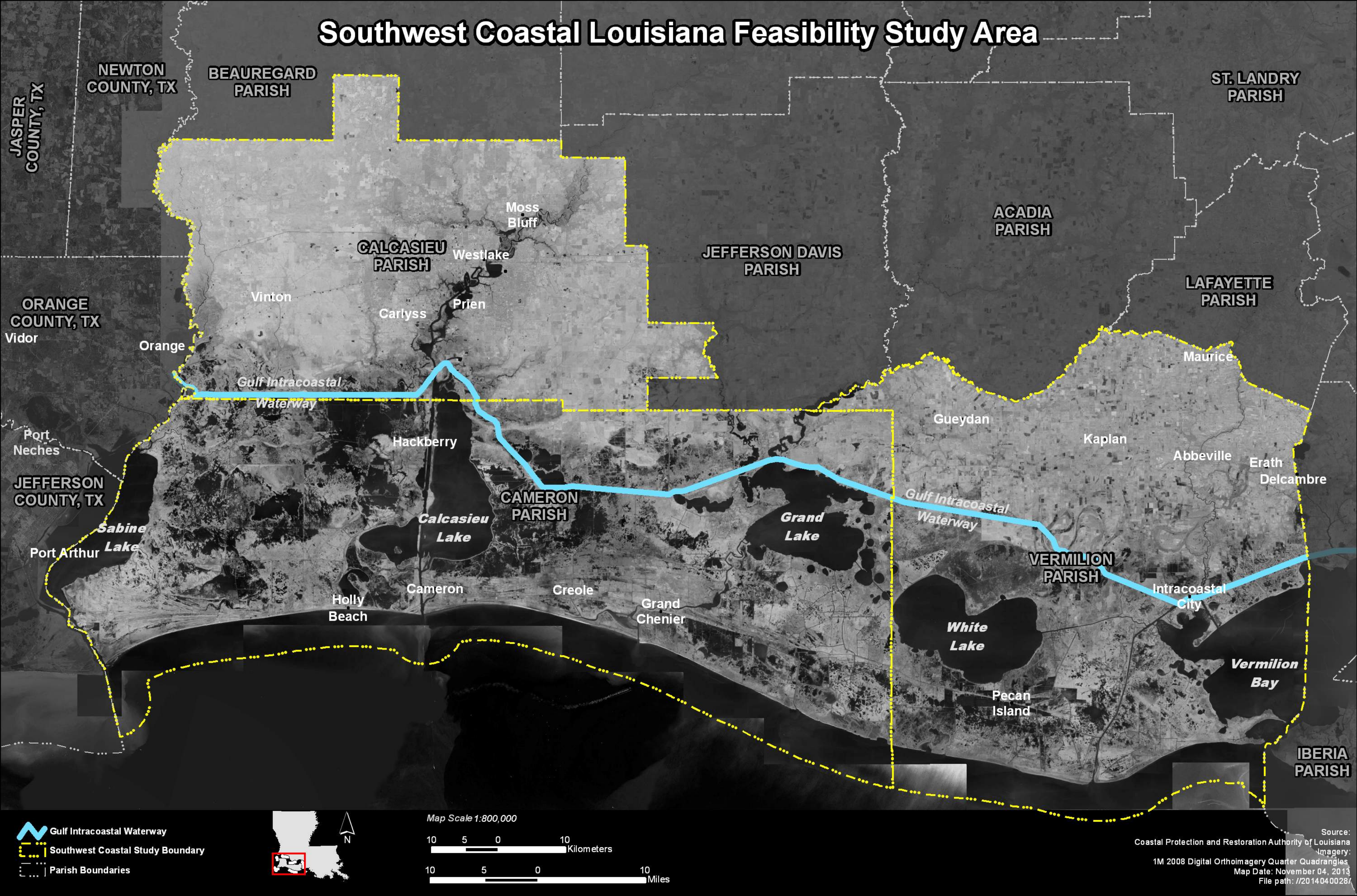
Sandra Stiles

for Joan M. Exnicios
Chief, Environmental Planning Branch

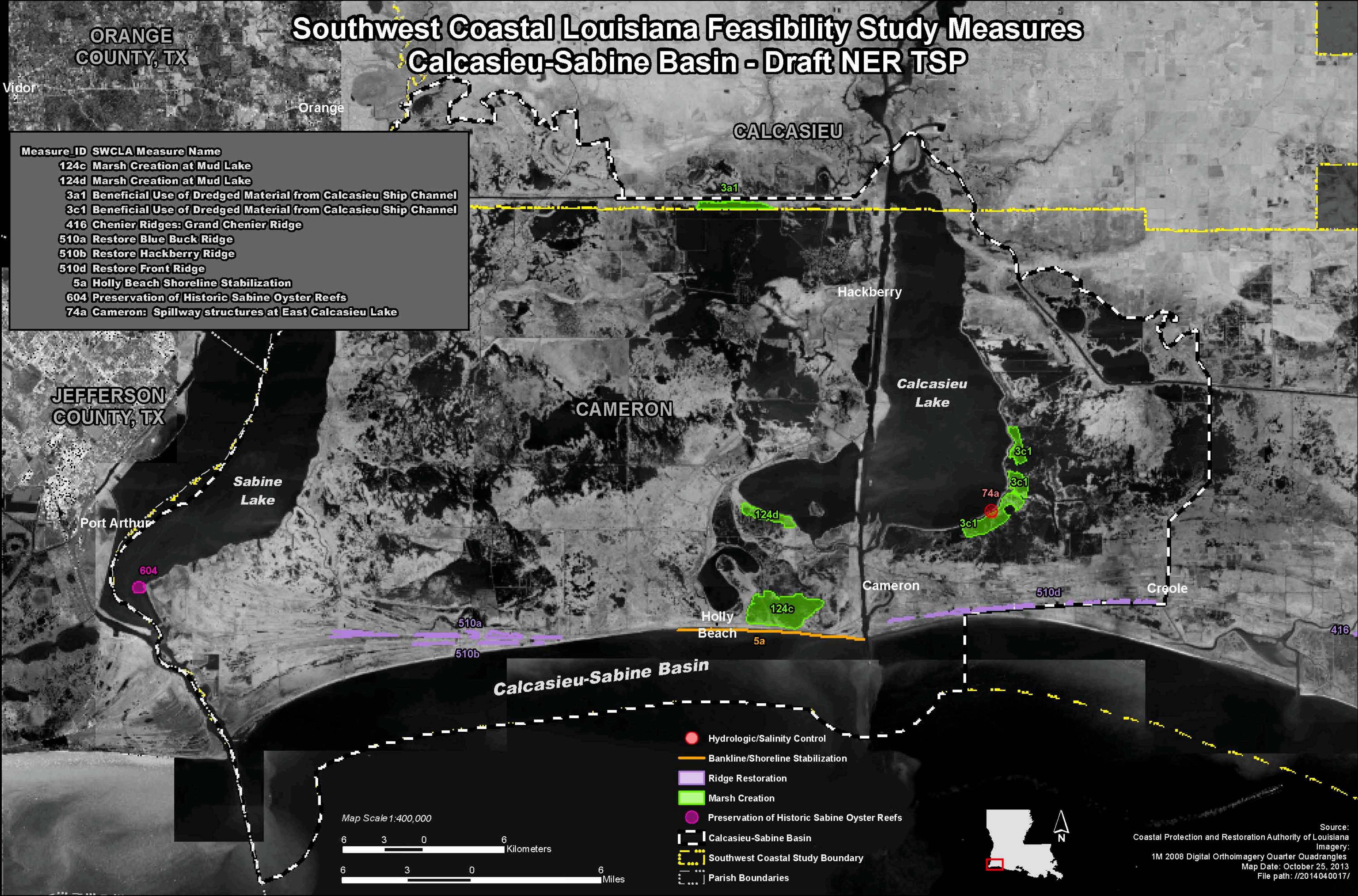
Enclosures

SMART Feasibility Study Process





Southwest Coastal Louisiana Feasibility Study Area
NEWTON COUNTY, TX
BEAUREGARD PARISH
JASPER COUNTY, TX
ST. LANDRY PARISH
Moss Bluff
CALCASIEU PARISH
Westlake
JEFFERSON DAVIS PARISH
ACADIA PARISH
LAFAYETTE PARISH
ORANGE COUNTY, TX
Vidor
Vinton
Carlyss
Prien
Orange
Maurice
Gulf Intracoastal Waterway
Port Neches
Hackberry
Gueydan
Kaplan
Abbeville
Erath
Delcambre
JEFFERSON COUNTY, TX
CAMERON PARISH
Sabine Lake
Calcasieu Lake
Grand Lake
Gulf Intracoastal Waterway
Port Arthur
VERMILION PARISH
Cameron
Creole
Holly Beach
Grand Chenier
Intracoastal City
White Lake
Vermilion Bay
Pecan Island
IBERIA PARISH
Gulf Intracoastal Waterway
Southwest Coastal Study Boundary
Parish Boundaries
N
Map Scale 1:800,000
10 5 0 10 Kilometers
10 5 0 10 Miles
Source:
Coastal Protection and Restoration Authority of Louisiana
Imagery:
1M 2008 Digital Orthoimagery Quarter Quadrangles
Map Date: November 04, 2013
File path: //20140400028/



Southwest Coastal Louisiana Feasibility Study Measures
Calcasieu-Sabine Basin - Draft NER TSP
Measure_ID SWCLA Measure Name
124c Marsh Creation at Mud Lake
124d Marsh Creation at Mud Lake
3a1 Beneficial Use of Dredged Material from Calcasieu Ship Channel
3c1 Beneficial Use of Dredged Material from Calcasieu Ship Channel
416 Chenier Ridges: Grand Chenier Ridge
510a Restore Blue Buck Ridge
510b Restore Hackberry Ridge
510d Restore Front Ridge
5a Holly Beach Shoreline Stabilization
604 Preservation of Historic Sabine Oyster Reefs
74a Cameron: Spillway structures at East Calcasieu Lake
ORANGE COUNTY, TX
Vidor
Orange
CALCASIEU
JEFFERSON COUNTY, TX
CAMERON
Hackberry
Calcasieu Lake
Sabine Lake
Port Arthur
Cameron
Creole
Holly Beach
Calcasieu-Sabine Basin
Hydrologic/Salinity Control
Bankline/Shoreline Stabilization
Ridge Restoration
Marsh Creation
Preservation of Historic Sabine Oyster Reefs
Calcasieu-Sabine Basin
Southwest Coastal Study Boundary
Parish Boundaries
Map Scale 1:400,000
Kilometers
Miles
Source:
Coastal Protection and Restoration Authority of Louisiana
Imagery:
1M 2008 Digital Orthoimagery Quarter Quadrangles
Map Date: October 25, 2013
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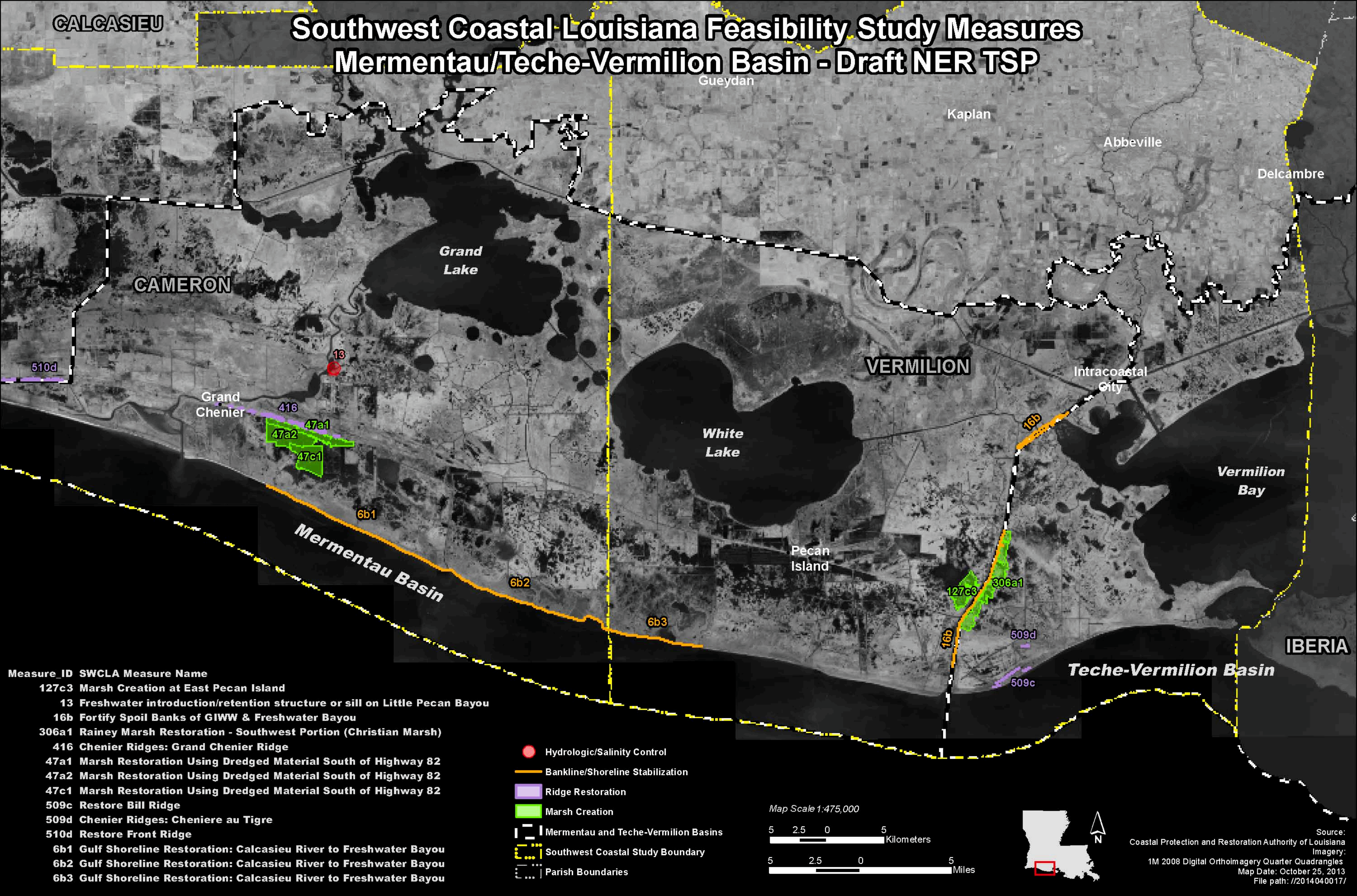
Southwest Coastal Louisiana Feasibility Study Measures
Mermentau/Teche-Vermilion Basin - Draft NER TSP
CALCASIEU
CAMERON
VERMILION
IBERIA
Gueydan
Kaplan
Abbeville
Delcambre
Grand Lake
White Lake
Vermilion Bay
Grand Chenier
Pecan Island
Intracoastal City
Mermentau Basin
Teche-Vermilion Basin
510d
13
416
47a1
47a2
47c1
6b1
6b2
6b3
16b
306a1
127c3
509d
509c
Measure_ID SWCLA Measure Name
127c3 Marsh Creation at East Pecan Island
13 Freshwater introduction/retention structure or sill on Little Pecan Bayou
16b Fortify Spoil Banks of GIWW & Freshwater Bayou
306a1 Rainey Marsh Restoration - Southwest Portion (Christian Marsh)
416 Chenier Ridges: Grand Chenier Ridge
47a1 Marsh Restoration Using Dredged Material South of Highway 82
47a2 Marsh Restoration Using Dredged Material South of Highway 82
47c1 Marsh Restoration Using Dredged Material South of Highway 82
509c Restore Bill Ridge
509d Chenier Ridges: Cheniere au Tigre
510d Restore Front Ridge
6b1 Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou
6b2 Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou
6b3 Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou
Hydrologic/Salinity Control
Bankline/Shoreline Stabilization
Ridge Restoration
Marsh Creation
Mermentau and Teche-Vermilion Basins
Southwest Coastal Study Boundary
Parish Boundaries
Map Scale 1:475,000
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Source:
Coastal Protection and Restoration Authority of Louisiana
Imagery:
1M 2008 Digital Orthoimagery Quarter Quadrangles
Map Date: October 25, 2013
File path: //2014040017/

SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex G

U.S. Fish and Wildlife Service Draft Coordination Act Report

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

December 3, 2013

Colonel Richard L. Hansen
District Commander
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Hansen:

Please reference the ongoing Southwest Coastal Louisiana Feasibility Study currently being finalized by the New Orleans District Corps of Engineers (Corps). The Fish and Wildlife Service (FWS) provided you with a draft Coordination Act Report (CAR) dated November 2013. After we submitted our draft CAR, the Tentatively Selected Plan (TSP) was modified to remove all storm surge protection levees from the array of measures designed to provide storm surge protection for study area communities. Consequently, the Service is providing this Supplemental CAR to address this change and update our recommendations. This supplemental report is submitted in partial fulfillment of the requirements of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). Neither this Supplemental Report, nor our November 2013 draft CAR constitutes the final report of the Secretary of the Interior as required by Section 2(b) of that Act. This Supplemental CAR has been provided to the Louisiana Department of Wildlife and Fisheries and the National Marine Fisheries Service. Their comments on these reports will be incorporated into our final report.

On November 26, 2013, my staff was informed that the Corps had decided to remove all structural protection levee features from the TSP. This is the third change to the TSP that has occurred since the Service began preparing our draft CAR. Not only have these changes required additional time on the part of our staff, but these changes reveal that the Corps' new planning method has resulted in the identification of a TSP before all the necessary information was available. Moreover, the Service is concerned that in the haste to proceed rapidly through the planning process, this new project planning method may result in the rejection of some alternatives and the selection of others without sufficient information, including details on proposed measures which are needed to understand and quantify the environmental benefits and impacts. Therefore, we request that our concerns about this new method be presented to the appropriate policy makers for their consideration.

In our November 2013 draft CAR, the Service identified a number of planning deficiencies with the proposed storm surge protection levees and the inability to properly assess their associated impacts to fish and wildlife. Now that the TSP has been modified to eliminate those proposed levees, the Service hereby updates the recommendations contained in our November 2013 draft CAR to revoke all those recommendations (i.e. recommendations 1 through 5) that reference the proposed storm surge protection levees. All the remaining recommendations and comments remain valid and should be addressed by the Corps to fulfil the requirements of the Fish and Wildlife Coordination Act.

Thank you for the opportunity to update our comments. The above findings and recommendations do not constitute the final report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act. Please contact Mr. Ronny Paille of this office (337/291-3117) if you require additional information.

Sincerely,

Jeffrey D. Weller
Supervisor
Louisiana Ecological Services Office

cc: EPA, Dallas, TX
NMFS, Baton Rouge, LA
Southwest Louisiana National Wildlife Refuges Complex, Bell City, LA
LA Dept. of Wildlife and Fisheries, Baton Rouge, LA
LA Dept. of Natural Resources (CMD), Baton Rouge, LA
LA Office of Coastal Protection and Restoration, Baton Rouge, LA

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

November 5, 2013

Colonel Richard L. Hansen
District Commander
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Hansen:

Attached is the Draft Fish and Wildlife Coordination Act Report on the tentatively selected plan for the Southwest Coastal Louisiana Feasibility Study, Louisiana. That study is evaluating alternatives for providing hurricane protection and storm damage reduction and related purposes in Cameron, Calcasieu, and Vermilion Parishes.

This draft report is transmitted under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and is being coordinated with the Louisiana Department of Wildlife and Fisheries and the National Marine Fisheries Service. Comments by those agencies will be incorporated to our final report.

Should your staff have any questions regarding the enclosed draft report, please have them contact Ronny Paille of this office at 337/291-3117.

Sincerely,

Jeffrey D. Weller
Supervisor
Louisiana Ecological Field Office

Attachment
cc: SW Louisiana Refuges, Bell City, LA
NMFS, Baton Rouge, LA
EPA, Dallas, TX
LA Dept. of Wildlife and Fisheries, Baton Rouge, LA
OCPR, Baton Rouge, LA

Southwest Coastal Louisiana Feasibility Study

DRAFT
FISH AND WILDLIFE COORDINATION ACT REPORT

PROVIDED TO
NEW ORLEANS DISTRICT
U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

PREPARED BY

RONALD PAILLE
SENIOR FISH AND WILDLIFE BIOLOGIST

U.S. FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
LAFAYETTE, LOUISIANA

NOVEMBER 2013

EXECUTIVE SUMMARY

The Corps of Engineers (Corps) was requested to conduct the Southwest Coastal Louisiana Feasibility Study (SWLA Study) via Resolution Docket 2747 adopted on December 7, 2005, by the U.S. House of Representatives Committee on Transportation and Infrastructure. That Docket specifically requested the Secretary of the Army, in accordance with section 110 of the River and Harbors Act, to "survey the coast of Louisiana in Cameron, Calcasieu, and Vermilion Parishes with particular reference to the advisability of providing hurricane protection and storm damage reduction and related purposes to include the feasibility of constructing an armored 12-foot levee along the Gulf Intracoastal Waterway."

Numerous measures to provide storm damage reduction and ecosystem restoration measures were evaluated within the study area. Those measures included construction of levees designed to provide hurricane storm surge protection (including the armored 12-foot levee described above), protection and restoration of coastal wetlands and unique natural ecosystem features (such as cheniers), construction of shoreline protection projects (for navigation canals, interior lakes and bays, and the Gulf of Mexico), and implementation of non-structural protection measures such as structure relocations and buyouts.

The initial list of proposed project measures was derived from existing large-scale coastal protection and ecosystem restoration plans (e.g., the Louisiana Coastal Protection and Restoration Plan [LACPR], the Louisiana Coastal Area Ecosystem Restoration Study Report [LCA], and the Louisiana's Comprehensive Master Plan for a Sustainable Coast [State Master Plan 2012]), public comments received during the project scoping process, and recommendations provided by local representatives and natural resource agencies during the initial planning phase of the project. The initial list of potential project measures was reduced to a more focused and achievable final list of measures based on criteria that were approved by an interagency project delivery team.

The final list of measures was assembled into 6 possible protection levee alternatives and 6 ecosystem restoration alternatives, all of which were evaluated for cost effectiveness. The Lake Charles Eastbank levee, together with non-structural protection measures in select locations, was chosen as the protection measures for inclusion in the Tentatively Selected Plan (TSP). Restoration Alternative 4 (Entry Salinity Control Alternative) was initially chosen as the most cost effective of the comprehensive plans and was included in the TSP. However, subsequent consideration resulted in modifying alternative 4 to eliminate the Sabine Pass and Calcasieu Ship Channel salinity control structures (measures 48 and 7, respectively), and to add the shoreline protection measures on the Gulf shore at Rockefeller Refuge (measures 6B1, 6B2, and 6B3).

In addition to providing hurricane storm surge protection in developed portions of the project area, implementation of the TSP would restore, enhance, and protect substantial areas of coastal marsh and forested chenier habitat. Because many design details regarding the proposed surge protection levees are yet to be developed, additional planning work must be conducted before impacts can be fully determined. Similarly, the proposed ecosystem restoration measures need additional planning work and interagency coordination to finalize estimated benefits and impacts with any degree of certainty. To complete needed planning of project features, to reduce and avoid project-related adverse impacts to fish and wildlife resources, and to enhance the desired ecosystem benefits, the Fish and Wildlife Service provides the following recommendations:

1. The Corps should conduct further planning of the proposed protection levee to reduce and avoid impacts to wetlands and forest habitats. Additional levee planning work should also include the development of measures to avoid interrupted drainage impacts in a manner that reduces or avoids impacts to wetlands and forested habitats. The additional planning work should be coordinated with the Service and other interested natural resource agencies. Any pump stations needed for drainage of the protected area should be designed to discharge into wetlands to reduce adverse effects of discharging runoff directly into open water bodies.

2. The Corps should also determine where levee borrow material will be obtained.

3. To the greatest degree practical, borrow pits for construction of proposed levee and marsh creation measures should be located to avoid and minimize direct and indirect impacts to vegetated wetlands. Efforts should be made to further reduce those direct impacts by hauling in fill material, using sheetpile for the levee crest, deep soil mixing, or other alternatives. Borrow pit construction should also avoid the following:
   a. avoid inducing wave refraction/diffraction erosion of existing shorelines
   b. avoid inducing slope failure of existing shorelines
   c. avoid submerged aquatic vegetation
   d. avoid increased saltwater intrusion
   e. avoid excessive disturbance to area water bottoms
   f. avoid inducing hypoxia

4. Once levee planning has been completed, the Corps should revise estimates of direct and indirect impacts to wetlands and forested habitats, including impacts associated with acquisition of borrow material. That work should be conducted in cooperation with the Service and other interested natural resource agencies.

5. The Corps should conduct a Hazardous, Toxic and Radioactive Waste (HTRW) assessment of tidally influenced levee construction locations and subaqueous marsh creation borrow sites. If those HTRW assessments indicate that contamination exceeds National Oceanic and Atmospheric Administration screening levels, then alternative locations should be considered, or, explanation of the containment methods that would allow levee construction should be provided to the Service and other interested natural resource agencies.

6. For ecosystem restoration measures not being used to mitigate construction impacts, the Service recommends that the Corps conduct monitoring of those features to

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document the degree of success achieved. The Service and other interested natural resource agencies should be involved in developing those monitoring criteria and in the review of subsequent monitoring information and reports. For mitigation features, the Service also recommends that all interested natural resource agencies be involved in the planning of project features, monitoring plans, development of success criteria, and adaptive management plans. In addition, all mitigation plans should address the 12 mitigation requirements in Appendix A.

7. The Corps should obtain a right-of-way from the Service prior to conducting any work on Sabine or Cameron Prairie National Wildlife Refuges, in conformance with Section 29.21-1, Title 50, Right-of-Way Regulations. Issuance of a right-of-way will be contingent on a determination that the proposed work will be compatible with the purposes for which the Refuge was established.

8. All construction or maintenance activities (e.g., surveys, land clearing, etc.) on National Wildlife Refuges (NWRs) will require the Corps to obtain a Special Use Permit from the Refuge Manager of the Southwest Louisiana Refuge Complex; furthermore, all activities on NWRs must be coordinated with the Refuge Manager. Therefore, we recommend that the Corps request issuance of a Special Use Permit well in advance of conducting any work on the refuge. Please contact the Refuge Manager (337/598-2216 or SWLRComplex@fws.gov) for further information on compatibility of proposed ecosystem restoration measures, and for assistance in obtaining a Special Use Permit. Close coordination by both the Corps and its contractor must be maintained with the Refuge Manager to ensure that construction and maintenance activities are carried out in accordance with provisions of any Special Use Permit issued by the NWR.

9. The Corps should contact the Louisiana Department of Wildlife and Fisheries prior to conducting any work on Rockefeller Refuge (337-491-2593).

10. The Corps should continue to coordinate with the Service throughout planning and construction to ensure that the proposed project does not impact waterbird nesting colonies, and threatened or endangered species that may be listed in the future.

Given that the design and evaluation of most project features has been at a programmatic level, the Service cannot fulfill its Fish and Wildlife Coordination Act (FWCA)(48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) responsibilities at this time. Therefore, this draft report is presented in partial fulfillment of that act and does not constitute the final report of the Secretary of Interior as required by Section 2(b) of the FWCA. To complete those assessments, we will require additional funding during the project's pre-construction engineering and design phase. Estimates of those funding needs should be coordinated in advance with the Service, and should be based on the extent of remaining work and the nature and complexity of issues associated with the remaining planning/design issues.

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INTRODUCTION

The Southwest Coastal Louisiana Feasibility Study (SWLA Study) was authorized by Resolution Docket 2747 adopted on December 7, 2005, by the U.S. House of Representatives Committee on Transportation and Infrastructure. That Docket specifically requested the Secretary of the Army, in accordance with section 110 of the River and Harbors Act, to "survey the coast of Louisiana in Cameron, Calcasieu, and Vermilion Parishes with particular reference to the advisability of providing hurricane protection and storm damage reduction and related purposes to include the feasibility of constructing an armored 12-foot levee along the Gulf Intracoastal Waterway." Investigation of area ecosystem restoration measures was authorized via the Water Resources Development Act of 2007 (Title VII, Louisiana Coastal Area program, Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study).

The study area is located within Louisiana's Chenier Plain which is characterized by lakes, bayous, wetlands, cheniers, and coastal beaches. The Mermentau Basin and the Calcasieu/Sabine Basin are the two major hydrologic basins within the Chenier Plain. There are numerous communities within the study area including Abbeville, Cameron, Delcambre, Erath, Gueydan, Hackberry, Kaplan, Lake Arthur, Lake Charles, and Sulphur. Although the approved Southwest Coastal Louisiana Feasibility Study authorization is restricted to Calcasieu, Cameron, and Vermilion Parishes, several project alternatives occurring beyond those parishes were considered because of their anticipated effects on the project area.

Numerous project measures and groups of measures were evaluated. Surge protection alternatives included alternative levee alignments (including the armored 12-foot levee described above), as well as non-structural alternatives. Ecosystem restoration alternatives included various combinations of salinity control/reduction measures, strategic marsh creation measures, strategically located shoreline protection measures, and restoration/reforestation of cheniers.

This report provides a preliminary analysis of the impacts of the Tentatively Selected Plan (TSP) on fish and wildlife resources. The TSP is a combination of structural and non-structural storm surge protection measures, and an array of different types of ecosystem restoration features. The Service conducted a cursory assessment of direct impacts associated with construction of proposed levee alternatives. Because details regarding drainage of the protected area have not yet been developed, this impact assessment is considered preliminary and likely to change. The analysis of ecosystem restoration benefits was conducted by a contracted consulting firm. Because planning details for many of those measures have not yet been developed, and because specifics of those measures have not been made available to the Service and interested natural resource agencies, the Service considers the benefit and impact assessments as preliminary. Since information needed to fully assess project benefits and impacts is not yet available, this draft report is submitted in partial fulfillment of the requirements of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and does not constitute the final report of the Secretary of the Interior as required by Section 2(b) of that Act. This draft report has been provided to the Louisiana Department of Wildlife and Fisheries and the National Marine Fisheries Service. Their comments on this report will be incorporated into our final report.

DESCRIPTION OF STUDY AREA

The study area, which encompasses Calcasieu, Cameron, and Vermilion Parishes, is typically termed the Chenier Plain of Louisiana. The Chenier Plain encompasses the southwestern Louisiana coastal zone from Freshwater Bayou west of Vermilion Bay to Sabine Lake near the Texas-Louisiana border. Cheniers are relict beach ridges that generally parallel the Gulf shoreline, and derive their name from the Cajun word "chene" meaning oak, because oaks are the dominant tree species on the crests of the higher chenier ridges (Penland et al. 1989). Because chenier elevations are higher than the surrounding marshes, they often serve as hydrologic barriers, with varying levels of effectiveness, between saline marshes to the south and freshwater marshes to the north (Corps 2008). The two hydrologic basins encompassed by the study area are the Mermentau and the Calcasieu-Sabine Basins (Figure 1).

Mermentau Basin

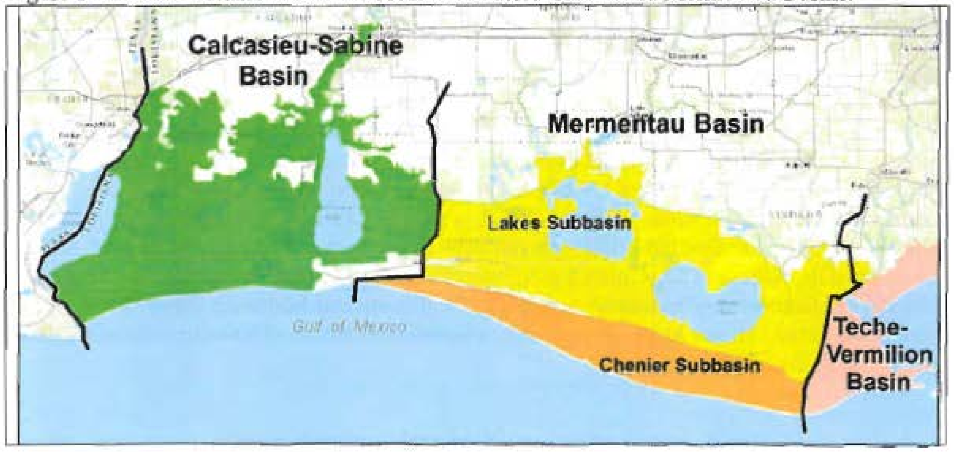
The Mermentau River Basin is located between Freshwater Bayou Canal to the east and that segment of Louisiana Highway 27 east of Calcasieu Lake. The Basin encompasses an area of about 4.2 million acres and contains productive agricultural lands and a variety of natural environments (Corps 1999). The Mermentau Basin is divided into two sub-basins, the Lakes and Chenier Subbasins (Figure 1), both of which occur within the feasibility study boundary. North of the Lakes Sub-basin lies uplands beyond the study boundary and covers an area of 3,683 mi^2 of predominantly agricultural land (Gammill et al. 2002). The principal agricultural products in this region are rice and crawfish, which both require ample supplies of fresh water typically provided via the Corps' management of the Mermentau Basin Project (Corps 1999).

The Lakes Sub-basin is located roughly between the Gulf Intracoastal Waterway (GIWW) and Louisiana Highway 82, and historically functioned as a low-salinity brackish estuary (Corps 2008). Construction of navigation channels, locks, and water control structures has altered the historical north-south river and tidal-driven hydrology and shifted it to an east-west system that drains through the GIWW. The Corps' locks and water control structures that are located along the perimeter of the Lakes Sub-basin regulate both salinity and water level so that the Lakes Sub-basin now functions more as a freshwater reservoir and less as the low-salinity estuary that it was prior to these alterations (Gammill et al. 2002). The demand for a reliable fresh water supply for agricultural use was the primary reason for the development of the Mermentau Basin Project (Corps 1999).

The Mermentau Basin Project involves the operation and management of five navigation locks and control structures: (1) the Calcasieu Lock located on the Gulf Intracoastal Waterway (GIWW) near the intersection of Louisiana Highway 384, (2) the Leland Bowman Lock situated on the GIWW near Intracoastal City, (3) the Freshwater Bayou Lock located on the Freshwater Bayou Canal approximately one mile north of the Gulf of Mexico, (4) the Catfish Point Control Structure located on the southwest side of the basin where the Mermentau River exits Grand Lake, and (5) the Schooner Bayou Control Structure located on the east side of the basin in the old Intracoastal Waterway between Freshwater Bayou and White Lake. The target water level inside the basin is 2.0 feet above mean low Gulf and the five Corps structures are operated in concert to maintain this level and preclude saltwater intrusion (Corps 1999).

The Chenier Sub-basin is located south of the Lakes Sub-basin, between Louisiana Highway 82 and the Gulf of Mexico. Approximately one-third of this sub-basin is comprised of the State-owned and operated Rockefeller Wildlife Refuge. The Chenier Sub-basin is characterized by tidally influenced salt marshes, though hydrology throughout much of the area is managed through impoundments that range in size from hundreds to thousands of acres. The purpose of that management is to control salinity in order to reduce wetland losses and/or sustain recreational and agricultural endeavors (Corps 2008).

Figure 1. Coastal marshes within the coastal Calcasieu-Sabine and Mermentau Basins.



Calcasieu-Sabine Basin

The Calcasieu-Sabine Basin extends from Sabine Lake and River eastward to the Louisiana Highway 27 segment east of Calcasieu Lake. The Calcasieu-Sabine Basin consists of two semi-distinct sub-basins, the Calcasieu River Basin and the Sabine River Basin. When the GIWW was built in the 1920s, it breached the Gum Cove Ridge which had historically formed a partial north-to-south oriented hydrologic barrier between the Calcasieu and Sabine Lake systems. That breach, in combination with several smaller canals, now facilitates water exchange between the sub-basins, and has exacerbated saltwater intrusion problems in the marshes adjacent to the GIWW. The typical water-movement scenario is that south winds push salt water into Calcasieu Lake, westward through the GIWW, and across the Gum Cove Ridge breach. This water is eventually swept down the Sabine River and into Sabine Lake. Currently, salt water that is pushed into Calcasieu Lake remains there because there is little back flow from the Lake. Without the Gum Cove Ridge breach, the current semi-circular flow patterns would not exist, and lake levels would rise more modestly, thus reducing the volume of seawater entering Calcasieu Lake (Lopez et al. 2008).

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The widening and deepening (to -40 feet deep by 400 feet wide) of the Calcasieu River and Pass Ship navigation channel (referred to as the Calcasieu Ship Channel [CSC]), as well as the removal of the channel mouth bar, has increased saltwater and tidal intrusion into the Calcasieu-Sabine Basin, resulting in marsh loss, tidal export of organic marsh substrate, and an overall shift to more saline habitats in the region. In 1968, the Corps completed construction of the Calcasieu River Saltwater Barrier on the Calcasieu River north of the City of Lake Charles. This barrier minimizes the flow of salt water into the upper reaches of the Calcasieu River to protect agricultural water supplies (Gammill et al. 2002). The Corps-maintained Calcasieu Lock, located east of the CSC on the GIWW near its intersection with Louisiana Highway 384, is operated to prevent saltwater intrusion into the Mermentau Basin as part of the Corps' Mermentau Basin Project.

The Sabine River has a drainage area of approximately 9,325 square miles and is the dominant influence across most of the Calcasieu-Sabine Basin in moderating salinity and tidal fluctuations. Sabine Pass was first dredged for navigation in 1880, and has been progressively deepened to its present depth of -40 feet. The Sabine-Neches Canal (later to become the Sabine-Neches Waterway) was constructed in the early 1900s. That channel not only facilitates saltwater intrusion into the area, it also funnels freshwater inflows more directly to the gulf, largely bypassing the adjacent marshes in Louisiana and Texas. A feasibility analysis has been conducted to deepen and widen the Sabine-Neches Ship Channel, but construction has yet to be initiated due to lack of funding. Saltwater intrusion in the Neches River has, in the past, necessitated the release of large quantities of water from the Sam Rayburn Reservoir to prevent saltwater contamination of industrial, agricultural, and municipal freshwater supply for Beaumont, Texas. To remedy those problems, a permanent saltwater barrier in the Neches River at Beaumont was constructed in 2003.

FISH AND WILDLIFE RESOURCE CONDITIONS

Existing Fish and Wildlife Habitats

The Chenier Plain consists of open water ponds and lakes, cheniers, gulf shorelines, and freshwater, intermediate, brackish, and saline marsh (Giron and Perez 2009). Marshes within Louisiana's Chenier Plain began forming about 3,000-4,000 years ago during periods when the Mississippi River occupied a more westerly course (Gosselink et al.1979). Expansive mud flats were created by large quantities of Mississippi River sediment that periodically accreted along the Gulf shoreline. When the river would shift to a more easterly location, erosion would rework the gulf shoreline to form beach ridges parallel to shore (Gammill et al. 2002). These ridges, consisting mainly of sand and shell, were typically higher in elevation than surrounding marshes and were colonized by live oaks (*Quercus virginiana*). Early explorers called the ridges "cheniere," a French word meaning "place of oaks" (Kniffen and Hilliard 1988). Over time, a series of Gulf of Mexico shoreline transgressions and regressions caused by periodic shifting of the Mississippi channel from east to west resulted in the shore-parallel ridge and swale topography that dominates Louisiana's Chenier Plain today (Gammill et al. 2002). Despite substantial hydrologic alterations, wetlands of the Chenier Plain continue to support nationally significant fish and wildlife resources. They provide important habitat for various species of plants, fish and wildlife, and they serve as ground water recharge areas, provide storage areas for storm and flood waters, serve as natural water filtration areas, provide protection from wave action, erosion, and storm damage, and provide various consumptive and non-consumptive recreational opportunities. Predominant habitats and their associated fish and wildlife values are described below.

Forested Habitat

The four major forest types within the study area include swamp, bottomland hardwood, pine-oak forests, and upland chenier forest. Swamps are generally dominated with baldcypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), swamp red maple (*Acer rubrum* var. *drummondii*), and various understory plant species. Coastal swamp forests typically occupy the area between fresh marshes and areas of higher elevation, including the transition zones between bottomland hardwood forests on riverine interdistributary ridges and lower elevation marshes. Healthy cypress swamps occur in fresh water areas experiencing minimal daily tidal action and where the salinity range does not normally exceed 2 parts per thousand (ppt). Salinities of 3 ppt or higher may cause significant stress and mortality of baldcypress. However, short-term exposure to such salinities may be tolerated if it does not penetrate into and persist in the soil (Corps 2009).

Bottomland hardwood forests occur primarily along the floodplains and distributary ridges of the various bayous and rivers within northern portions of the study area. Common tree species include sugarberry (*Celtis laevigata*), water oak (*Quercus nigra*), live oak, nuttall oak (*Quercus nuttallii*), overcup oak (*Quercus lyrata*), bitter pecan (*Carya aquatica*), black willow (*Salix nigra*), American elm (*Ulmus americana*), swamp red maple, box elder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), and baldcypress (Corps 2009).

The suppression of fire within area pine flatwoods has resulted in the conversion of forests to pine-oak forests. These pine-oak forests are generally found on poorly drained flats and depressional areas north of the GIWW and predominantly around the cities of Sulphur and Lake Charles. Common tree species include slash pine (*Pinus elliottii*), longleaf pine (*Pinus palustris*), water oak, laurel oak (*Quercus laurifolia*), sweet bay (*Magnolia virginiana*), sweetgum (*Liquidambar styraciflua*), rough-leaf dogwood (*Cornus drummondii*), and wax myrtle (*Myrica cerifera*). These former pine flatwood communities may also contain a very diverse herbaceous community that can include many state rare species (Corps 2009).

A unique feature of the Chenier Plain is the chenier ridge habitat that formed on abandoned beach ridges. These ancient beaches, composed primarily of sand and shell, were stranded behind prograding shorelines built during periods of sedimentation fed by the Mississippi River. Common tree species on cheniers include live oak, sugarberry, swamp red maple, sweetgum, and water oak. Red mulberry (*Morus rubra*), toothache-tree (*Zanthoxylum clava-herculis*), and sweet acacia (*Acacia farnesiana*) also occur on these ridges (Corps 2009). Cheniers are important storm surge buffers, often serving as hydrologic barriers that limit saltwater intrusion into interior marshes (Corps 2008). Wooded habitats on the cheniers are critically important stopover habitat for neotropical songbirds migrating across the Gulf (Moore and Simons 1992, Moore 1999).

Scrub-Shrub Habitat

Scrub-shrub habitat within the study area often occupies a zone where marshes transition into slightly higher elevation habitats. Scrub shrub habitats are found along bayou ridges and on dredged material embankments, and areas typically bordered by marsh, swamp, or bottomland hardwoods. In saline areas, scrub-shrub communities are dominated by black mangrove (*Avicennia germinans*) on flooded saltmarsh edges, or by marsh elder (*Iva frutescens*) and Eastern baccharis (*Baccharis halimifolia*) on low ridges, bayou banks, and spoil banks and other disturbed areas. Brackish scrub-shrub wetlands are also dominated by eastern baccharis and marsh elder, although wax myrtle (*Morella cerifera*, formerly *Myrica cerifera*) is common on low ridges, bayousides, and spoilbanks as well. Typical scrub-shrub vegetation in intermediate and fresh areas includes elderberry (*Sambucus canadensis*), wax myrtle, buttonbush (*Cephalanthus occidentalis*), rattlebox (*Sesbania drummondii*), Drummond red maple (*Acer rubrum var. drummondii*), Chinese tallow tree (*Sapium sebiferum*), marsh elder, and eastern baccharis. Dwarf palmetto (*Sabal minor*) and prickly pear cactus (*Opuntia spp.*) are common in the understory of Chenier/maritime forest. Yaupon (*Ilex vomitoria*), dwarf palmetto, swamp privet (*Forestiera acuminata*) and Virginia willow (*Itea virginica*) also occur in thickets and the understory of swamps and bottomland hardwood forests (Corps 2009). Those habitats often support a variety of wildlife, depending on local conditions; they provide nesting and feeding sites for wading birds, songbirds and other birds, and wildlife escape cover.

Fresh Marsh

Freshwater marshes are quite heterogeneous, with local species composition governed by frequency and duration of flooding, micro-topography, substrate, current flow and salinity. This marsh type is typically dominated by maidencane, bulltongue, spikerushes, pennywort (*Hydrocotyle* sp.), elephant-ear (*Colocasia esculenta*) and alligatorweed (*Alternanthera philoxeroides*). Other common plants are bullwhip, giant cutgrass (*Zizaniopsis miliacea*), fourchette (*Bidens laevis*) and cattail (*Typha* sp.). Fresh marshes are often very diverse with different species of grasses and broad-leaved annuals waxing and waning throughout the growing season. Chabreck (1972) documented 93 plant species occurring in the fresh marshes of coastal Louisiana. In some areas, fresh marshes consist of nearly pure stands of maidencane. Aquatic plants commonly found in fresh marsh waters are duckweed (*Lemna minor*), coontail (*Ceratophyllum demersum*), Eurasian watermilfoil, southern naiad, water hyacinth (*Eichornia crassipes*), pondweeds (*Potamogeton* spp.), white waterlily (*Nymphaea odorata*), elodea (*Elodea canadensis*), hydrilla (*Hydrilla verticillata*), water celery, water shield (*Brasenia shreberi*), fanwort (*Cabomba caroliniana*), American lotus (*Nelumbo lutea*), and several invasive species of *Salvinia*. Fresh marsh salinity rarely exceeds 2 ppt, with a year-round range of approximately 0.5-1 ppt.

Canal-induced saltwater intrusion has drastically reduced the extent of fresh marsh that historically existed within the Calcasieu-Sabine Basin (Figure 2). However, fresh marsh remains the dominant marsh type within the upper Lakes Sub-basin of the Mermentau Basin (Figure 3).

Figure 2. Marsh types (2007) within the Calcasieu-Sabine Basin.

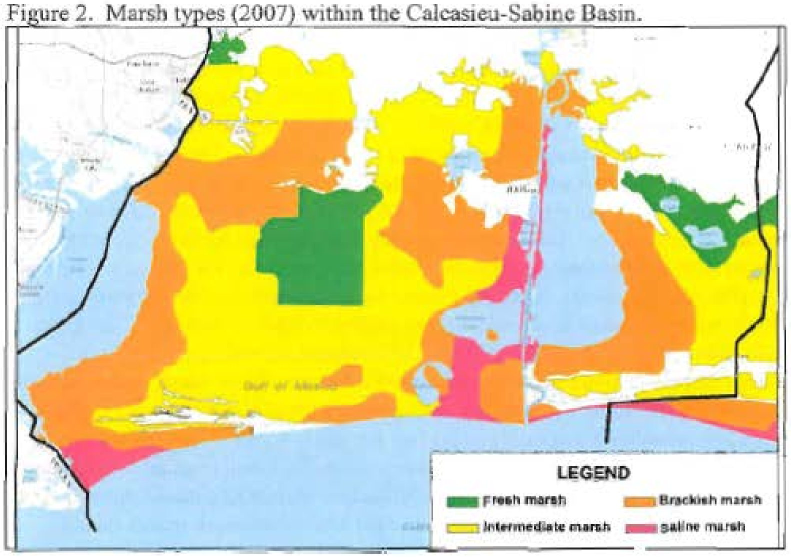
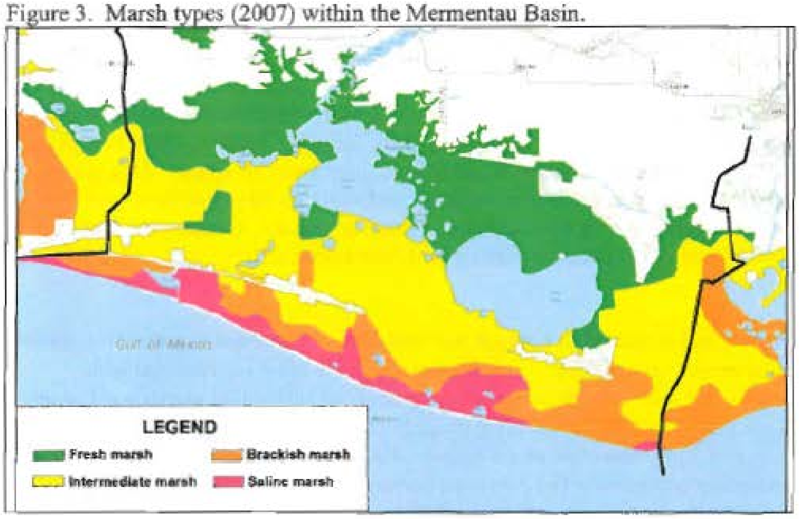


Figure 3. Marsh types (2007) within the Mermentau Basin.



Freshwater marshes support extremely high densities migratory waterfowl and other wildlife. However, because of saltwater intrusion, freshwater marshes have undergone the highest rate of reduction in acreage of any of the marsh type in Louisiana over the past few decades.

7

Intermediate Marsh

Intermediate marsh may occur when annual salinity averages 3 to 4 ppt; but often intermediate marsh salinities may be fresh for much of the year with higher salinity conditions occurring during the late summer and early fall. Chabreck's (1972) identification of 54 species of plants in intermediate marsh indicates that plant species richness is relatively high. The intermediate marsh can be difficult to identify, as it sometimes may appear less as transitional zone between brackish and fresh marshes. Marshhay cordgrass or bulltongue (*Sagittaria lancifolia*) is usually the dominant or co-dominant species. These are commonly accompanied by three-cornered grass, roseau or common reed (*Phragmites australis*), seashore paspalum (*Paspalum vaginatum*), coastal waterhyssop (*Bacopa monnieri*), bullwhip (*Schoenoplectus californicus* formerly *Scirpus californicus*), Walter's millet (*Echinochloa walteri*), sawgrass (*Cladium jamaicense*), deer pea (*Vigna luteola*), rush (*Eleocharis sp.*), dwarf spikerush (*Eleocharis parvula*), and fragrant flatsedge (*Cyperus odoratus*). Aquatic plant species found in intermediate marsh waters include widgeongrass, Eurasian watermilfoil, water celery, and southern naiad (*Najas guadalupensis*). Intermediate marshes are considered extremely important for many wildlife species, such as alligators and wading birds, and serve as important nursery areas for larval marine organisms. Although still a common natural community type in Louisiana, intermediate marsh appears to be declining in aerial extent, which has been attributed to a shift toward brackish marsh due to increased salinity levels. Visser et al. (2000), expanding on previous studies by Penfound and Hathaway (1938) and Chabreck (1970), classified intermediate marsh in the Chenier Plain as a combination of *Cladium jamaicense* (sawgrass), *Spartina patens* (saltmeadow cordgrass), and *Schoenoplectus californicus* (California bulrush).

Intermediate marsh occurs within the more interior portions of the Calcasieu-Sabine Basin where exposure to saltwater intrusion is lessened by distance from saltwater sources. Intermediate marsh may have an irregular tidal regime, with salinity ranging from 3 to 10 ppt. This marsh type is very important to many species of avian wildlife and supports large numbers of wintering waterfowl. It is also critical nursery habitat to larval marine organisms. Gradual changes in salinity conditions can cause this habitat to shift towards brackish marsh.

Brackish Marsh

Inland from salt marsh, and subjected to reduced tidal influence, is brackish marsh. This marsh type is dominated by marsh-hay cordgrass. Brackish marshes are often interspersed with numerous small ponds and water channels and have experienced substantial marsh breakup and degradation in recent years. Salinity levels often range between 0.5 to 5.0 ppt and average salinity is in the range of 8 ppt, however, much higher salinities may occur periodically. In the brackish marsh, marshhay cordgrass is the dominant herbaceous species. Saltgrass, three-cornered grass (*Schoenoplectus americanus*, formerly *Scirpus olneyi*), smooth cordgrass, black needlerush, and leafy three-square (*Schoenoplectus maritimus* formerly *Scirpus maritimus*) are often co-dominant or common in this zone. It should be noted that some of these species also occur in saline marsh, but the order of dominance differs. Chabreck (1972) identified forty species of plants in brackish marsh. Aquatic plants that commonly occur in brackish marsh waters include widgeon grass, Eurasian watermilfoil (*Myriophyllum spicatum*), water celery (*Vallisneria americana*), and horned pondweed (*Zannichellia palustris*). Visser et al. (2000)

classified brackish marsh in the Chenier Plain as a combination of *Spartina patens* (saltmeadow cordgrass), *Schoenoplectus americanus* (chairmaker's bulrush), *Schoenoplectus robustus* (sturdy bulrush).

Brackish marshes occur predominantly along the borders of Calcasieu and Sabine Lakes. Brackish marshes are extremely important as nurseries for fish and shellfish. Wading birds, muskrats and shorebirds are also common in such areas.

<u>Saline Marsh</u>
Salt marshes usually receive regular tidal inundation and occur in the most saline zones along the Gulf of Mexico shoreline and adjacent to the Calcasieu Ship Channel. Smooth cordgrass *(Spartina alterniflora)* is the dominant plant in this marsh type, and often forms near-monotypic stands. Herbaceous vegetation of the saline marsh is typically dominated by smooth cordgrass intermixed with saltgrass (*Distichlis spicata*), marshhay cordgrass, black needlerush (*Juncus roemerianus*), and saltwort (*Batis maritima*). Chabreck (1972) identified 12 species of emergent vegetation typically associated with this marsh type. Within the described marsh zones, many ponds and lakes support submerged and/or floating-leafed aquatic vegetation (SAV). Aquatic vegetation is rare in saline waters along the Louisiana coast (Chabreck, 1972). However, widgeon grass (*Ruppia maritima*) may occur in open water areas of saline marshes bordering on the brackish marsh zone and in saline areas where tidal flow has been decreased by structures or other changes in hydrology. Average salinity is approximately 16 ppt. Relative to other marsh types, salt marsh typically supports fewer terrestrial vertebrates although some species like Seaside Sparrows and Clapper Rails are common (Corps 2009). Salinity levels may range from 5.0 to 18 ppt, however, salinities may occasionally be lower or higher.

Saline marsh habitat exists in the project area closest to the Gulf of Mexico beach rim and along the Lower Lake (i.e., river miles (RMs) 5 to 12) and Calcasieu Pass (i.e., RMs 0 to 5) portions of the Calcasieu Ship Channel. Saline marsh is a regularly tidally-flooded habitat having least plant diversity.

<u>Open Water</u>
Small ponds and shallow open water areas associated with each of the above marsh plant communities are scattered throughout the project area. Some of the more defined open water areas include Lake Charles, Prien Lake, Moss Lake, and Calcasieu Lake along the ship channel. Black Lake, Browns Lake, and Mud Lake are open water areas occurring west of the ship channel. Willow Lake and Sweet Lake occur east of the ship channel.

<u>Submerged Aquatic Vegetation Habitat</u>
Some protected shallow open water habitats within the project area support submerged aquatic vegetation (SAV). Prior to Hurricane Rita concentrations of SAVs densities up to 80 percent coverage occurred within Cameron Prairie National Wildlife Refuge (NWR) and those concentrations are expected to return (personal communication with NWR personnel 2007). Project area SAV habitats may include areas of widgeon grass, duckweeds, coontail, bladderworts, watermilfoil, hydrilla, mermaidweeds, and pondweeds. As these aquatic plants die, their decomposition by bacteria and fungi contribute to the food web by providing detritus

for many aquatic invertebrates. SAVs are very important to wildlife and are utilized by many duck species.

Developed Lands

Developed areas are located on the higher elevations of the Pleistocene terrace along the GIWW and around the Lake Charles area and are typically well drained. They include agricultural lands and commercial and residential developments. Levees are also included in this category. Levees are frequently mowed, and, as such, provide poor wildlife habitat. Some levees are vegetated with an assortment of scrub/shrub species including marsh elder, eastern baccharis, Chinese tallow tree, common reed, and goldenrod. These higher-elevation areas may provide low-to-moderate-value habitat for terrestrial wildlife, including some migratory bird species.

Existing Fishery Resources

The project-area wetlands and associated shallow waters provide nursery and feeding habitat for recreationally and commercially important estuarine-dependent fishes and shellfishes (e.g., red drum, black drum, Atlantic croaker, spot, sand seatrout, spotted seatrout, southern flounder, Gulf menhaden, striped mullet, blue crab, white shrimp and brown shrimp). Commercial shrimp harvests have been positively correlated with the area of tidal emergent wetlands (Turner 1977 and 1982). Future commercial harvests of shrimp and other fishes and shellfishes would likely be adversely impacted by continued losses in estuarine marsh habitat (Turner 1982). Portions of the project area also provide habitat for freshwater fishes that can tolerate low-salinity conditions, including largemouth bass, bluegill, warmouth, gars, freshwater drum, blue catfish and channel catfish.

Salt and brackish marshes serve as nursery areas for myriads of larval and juvenile shrimp, crabs, redfish, seatrout, Gulf menhaden, etc., and greatly enhance the production of marine organisms. Vegetation production rates in estuarine marshes are extremely high, providing an abundance of detritus to support the estuarine food web.

Much of the existing project area-wetlands are subject to permitted structural management that varies from semi-impounded to completely impounded marsh. The majority of the water control structures within the semi-impounded management areas are supposed to be operated to allow ingress and egress of estuarine fishery organisms, especially brown shrimp and white shrimp, except during drawdowns, periods of high salinity, or waterfowl seasons. Unmanaged coastal wetlands are of particular importance due to their relative scarcity within the Calcasieu-Sabine Basin.

Essential Fish Habitat

Estuarine wetlands and associated shallow waters within the project area have been identified as Essential Fish Habitat (EFH) for both postlarval, juvenile and sub-adult stages of brown shrimp, white shrimp, and red drum, as well as the adult stages of those species in the nearshore and offshore reaches. EFH in the nearshore, marine-portion of the project area and in the lower portions of the estuary has also been designated for the following species and their associated life stages: lane snapper, larvae and juvenile life stages; dog snapper, juvenile life stage; and bonnethead shark, juvenile life stage. EFH requirements vary depending upon species and life stage. Categories of EFH in the project area include estuarine emergent wetlands, estuarine water column, submerged aquatic vegetation, and estuarine water bottoms. Detailed information on Federally managed fisheries and their EFH is provided in the 1998 generic amendment of the Fishery Management Plans for the Gulf of Mexico, prepared by the Gulf of Mexico Fishery Management Council (GMFMC). That generic amendment was prepared in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), (P.L. 104-297). Estuarine-dependent species such as those listed above also serve as prey for other species managed under the MSFCMA by the GMFMC (e.g., red drum, mackerels, snappers, and groupers) and highly migratory species (e.g., billfishes and sharks) managed by the NOAA-Fisheries.

Existing Wildlife Resources

The project area supports an array of productive coastal habitats, dominated by intermediate and brackish marshes and associated shallow estuarine waters. The project-area wetlands and adjacent shallow waters, as well as the chenier ridges, support numerous federal-trust wildlife resources, including migratory birds, threatened and endangered species, and various federal and private land holdings that are held or managed to benefit those species.

The chenier and coastal forest habitats associated with the project area provide nesting habitat for songbirds (e.g., the mockingbird, yellow-billed cuckoo, brown thrasher and northern parula), as well as stopover areas for trans-Gulf migrating songbirds. Other avian species found in project area's forested habitats include the American woodcock, common yellow-shafted flicker, belted kingfisher, and several species of raptors (e.g., red-tailed hawk and red-shouldered hawk). Wading bird colonies containing species such as anhinga, great egret, and great blue heron typically occur in wooded wetland and scrub-shrub habitat.

Mammals associated with the project area forested habitats include game species such as eastern cottontail, swamp rabbit, white-tailed deer, and gray and fox squirrels; commercially important furbearers such as river otter, muskrat, and nutria; and other mammal species such as striped skunk, coyote, nine-banded armadillo, and Virginia opossum. Smaller mammals such as the cotton rat, marsh rice rat, and white-footed mouse serve as forage for both mammalian and avian carnivores.

Reptiles which utilize study-area forested habitats include the ground skink, five-lined skink, green anole, and western ribbon snake, and numerous other species. Some of the amphibians expected to be found in study-area forested habitats including small-mouthed salamander, green treefrog, bullfrog, and southern leopard frog.

Wildlife expected to utilize the study-area estuarine marshes include wading birds (e.g., herons, egrets, ibises, and roseate spoonbills), rails, migratory waterfowl (e.g., green-winged teal, bluewinged teal, mottled duck, gadwall, American widgeon, and lesser scaup), raptors, and songbirds. Brackish marshes having abundant submerged aquatic vegetation often support large numbers of puddle ducks. Shorebirds utilizing estuarine marshes include killdeer, American avocet, black-necked stilt, American oystercatcher, common snipe, and various other species. Seabirds include white pelican, brown pelican, black skimmer, herring gull, laughing gull, and several species of terns. Other nongame birds such as boat-tailed grackle, red-winged blackbird, seaside sparrow, olivaceous cormorant, belted kingfisher, and sedge wren also utilize estuarine marshes.

Estuarine marsh wildlife also includes swamp rabbit, nutria, muskrat, mink, river otter, raccoon, white-tailed deer, and coyote. Reptiles are limited primarily to the American alligator in intermediate and brackish marshes, and the diamond-backed terrapin and gulf salt marsh snake in brackish and saline marshes. Juvenile sea turtles may seasonally utilize bays and saline marsh ponds in the lower Calcasieu Estuary.

Threatened and Endangered Species

Federally listed threatened or endangered species that occur within the study area include the piping plover (*Charadrius melodus*), the whooping crane (*Grus americana*), the West Indian manatee (*Trichechus manatus*), and several species of sea turtles which have also been known to occur in the southern portion of Calcasieu Lake. The red knot (*Calidris canutus rufa*) is proposed for federal listing as a threatened species and the Sprague's pipet (*Anthus spragueii*) is a candidate species for federal listing as a threatened or endangered species

The piping plover, federally listed as a threatened species, as well as its designated critical habitat, occur along the Louisiana coast. Piping plovers winter in Louisiana, and may be present for 8 to 10 months annually. They arrive from the breeding grounds as early as late July and remain until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape, because the suitability of a particular site for foraging or roosting is dependant on local weather and tidal conditions. Plovers move among sites as environmental conditions change; and studies have indicated that they generally remain within a 2-mile area. Major threats to this species include the loss and degradation of habitat due to development, disturbance by humans and pets, and predation.

On July 10, 2001, the Service designated critical habitat for wintering piping plovers (Federal Register Volume 66, No. 132). Their designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers. If implementation of the proposed action has the potential to directly or indirectly affect the piping plover or its critical habitat, further consultation with this office will be necessary.

The red knot (*Calidris canutus rufa*), proposed for federal listing as a threatened species, is a medium-sized shorebird about 9 to 11 inches (23 to 28 centimeters) in length with a proportionately small head, small eyes, short neck, and short legs. The black bill tapers steadily from a relatively thick base to a relatively fine tip; bill length is not much longer than head length. Legs are typically dark gray to black, but sometimes greenish in juveniles or older birds in non-breeding plumage. Non-breeding plumage is dusky gray above and whitish below. The red knot breeds in the central Canadian arctic but is found in Louisiana during spring and fall migrations and the winter months (generally September through March).

During migration and on their wintering grounds, red knots forage along sandy beaches, tidal mudflats, salt marshes, and peat banks. Observations along the Texas coast indicate that red knots forage on beaches, oyster reefs, and exposed bay bottoms, and they roost on high sand flats, reefs, and other sites protected from high tides. In wintering and migration habitats, red knots commonly forage on bivalves, gastropods, and crustaceans. Coquina clams (*Donax variabilis*), a frequent and often important food resource for red knots, are common along many gulf beaches. Major threats to this species along the Gulf of Mexico include the loss and degradation of habitat due to erosion, shoreline stabilization, and development; disturbance by humans and pets; and predation. If implementation of the proposed action has the potential to directly or indirectly affect the red knot or its habitat, further consultation with this office will be necessary.

Beginning in 2010, the Louisiana Department of Wildlife and Fisheries, in cooperation with the U.S. Fish and Wildlife Service and the U.S. Geological Survey, began efforts to establish a nonmigratory flock of whooping cranes (*Grus americana*) into historic southwestern Louisiana habitat on the state-owned White Lake Wetlands Conservation Area in Vermilion Parish, Louisiana. This reintroduced population was designated as a nonessential experimental population (NEP) under section 10(j) of the Endangered Species Act of 1973 (ESA), as amended. A NEP population is a reintroduced population believed not to be essential for the survival of the species, but important for its full recovery and eventual removal from the endangered and threatened list. These populations are treated as "threatened" species except that the ESA's section 7 consultation regulations (requiring consultation with the U.S. Fish and Wildlife Service to reduce adverse impacts from Federal actions) do not apply (except where the species occurs within National Parks or National Wildlife Refuges) and critical habitat cannot be designated. The only natural wild population of the endangered whooping crane remains vulnerable to extirpation through a natural catastrophe or contaminant spill, due primarily to its limited wintering distribution along the Texas gulf coast.

The Sprague's pipit (*Anthus spragueii*), is a candidate species for federal listing as a threatened or endangered species. Candidate species are those taxa for which the Service has on file sufficient information regarding biological vulnerability and threat(s) to support issuance of a proposal to list, but issuance of a proposed rule is currently precluded by higher priority listing actions. Sprague's pipit is a small (4 to 6 inches in length) passerine bird with a plain buffy face, a large eye-ring, and buff and blackish streaking on the crown, nape, and under parts. It winters in Louisiana, arriving from its northern breeding grounds in September and remaining until April. Migration and wintering ecology of this species is poorly known, but Sprague's pipit exhibits a strong preference for open grassland (i.e., native prairie) with native grasses of intermediate height and thickness, and it avoids areas with too much shrub encroachment. Its use of an area is dependent upon habitat conditions. This species is a ground feeder and forages mainly on insects but will occasionally eat seeds.

There is currently no requirement under the Endangered Species Act for consultation regarding project impacts on candidate species. In the interest of conserving the Sprague's pipit, we encourage you to avoid project activities that would adversely affect this species or its habitat. Should it be federally listed as threatened or endangered in the future, however, further consultation on project impacts to this species could then be necessary.

West Indian manatees, federally listed as an endangered species, occasionally enter Lakes Pontchartrain and Maurepas, and associated coastal waters and streams during the summer months (i.e., June through September). Manatees have been regularly reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana. They have also been occasionally observed elsewhere along the Louisiana Gulf coast. The manatee has declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals.

All contract personnel associated with the project should be informed of the potential presence of manatees and the need to avoid collisions with manatees, which are protected under the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. All construction personnel are responsible for observing water-related activities for the presence of manatee(s). Temporary signs should be posted prior to and during all construction/dredging activities to remind personnel to be observant for manatees during active construction/dredging operations or within vessel movement zones (i.e., work area), and at least one sign should be placed where it is visible to the vessel operator. Siltation barriers, if used, should be made of material in which manatees could not become entangled, and should be properly secured and monitored. If a manatee is sighted within 100 yards of the active work zone, special operating conditions should be implemented, including: no operation of moving equipment within 50 feet of a manatee; all vessels should operate at no wake/idle speeds within 100 yards of the work area; and siltation barriers, if used, should be re-secured and monitored. Once the manatee has left the 100-yard buffer zone around the work area on its own accord, special operating conditions are no longer necessary, but careful observations would be resumed. Any manatee sighting should be immediately reported to the Service's Lafayette, Louisiana Field Office (337/291-3100) and the Louisiana Department of Wildlife and Fisheries, Natural Heritage Program (225/765-2821).)

The National Marine Fisheries Service (NMFS) is responsible for aquatic marine threatened or endangered species. Please contact Eric Hawk (727/570-5312) in St. Petersburg, Florida, for information concerning this and other sea turtle species in their aquatic environment.

Wildlife Management Areas and Parks

Sabine NWR is comprised of 124,511 acres of coastal marsh west of the Calcasieu Lake, and its primary management objective is to preserve a large area of coastal wetlands for wintering and migrating waterfowl from both the Mississippi and Central Flyways. This refuge is also a major nursery area for many estuarine-dependent marine species as well as being the home for alligators and other reptiles, mammals, and numerous wading, water and marsh birds. Cameron Prairie NWR is located east of Calcasieu Lake. Two units (i.e., the Gibbstown and East Cove units) compose this refuge and provide fresh marsh and brackish to saline marsh habitats to support alligators, cottonmouth snakes, white-tailed deer, rabbits, roseate spoonbills, and more than 200 other birds, as well as shrimp, crabs, and many species of fish. Lacassine NWR is located in the Mermentau Basin, northwest of Grand Lake, and is very heavily used by wintering waterfowl. Should proposed project activities directly or indirectly effect those NWRs, please contact Mr. Don Voros, the Southwest Louisiana National Wildlife Refuge Complex Leader (337-598-2216), to obtain a Compatible-Use Determination, and to ascertain the need for a Special Use Permit that may be required should work be conducted on that NWR. The Rockefeller Wildlife Refuge, owned and operated by the Louisiana Department of Wildlife and Fisheries is located south of Grand Chenier in the Mermentau Basin. This 76,000-acre refuge consists of numerous tidal marsh management units operated to provide habitat for wintering migratory waterfowl. Project activities on Rockefeller Refuge should be coordinated with the Refuge manager (337-491-2593).

Future Fish and Wildlife Resources

Loss of coastal marshes is the primary problem affecting study area fish and wildlife resources. Satellite land acreage data (1985-2010) from the U.S. Geological Survey (USGS) was plotted and linear regressions were used to calculate average annual loss rates in percent of 1985 acres per year. Regression derived acreages were aggregated to generate regional loss rates (Figure 4).

Throughout the study area, an average of 930 acres has been lost per year from 1985 to 2010 (Table 1). Hurricane Rita (2005) and Hurricane Ike (2008) caused substantial marsh losses and have likely driven marsh loss rates higher than the rates that existed prior to those storms.

Table 1. Average annual marsh acres lost (1985 to 2010).

Calcaiseu-Sabine Basin				Mermentau Basin	
West Cal-Sab Marshes	Central Cal-Sab Marshes	East Cal-Sab Marshes	East Calcasieu Lake Marshes	Merm. Lakes Subbasin Marshes	Merm. Chenier Subbasin Marshes
-119	-39	-5	-197	-231	-338
			-361		-569

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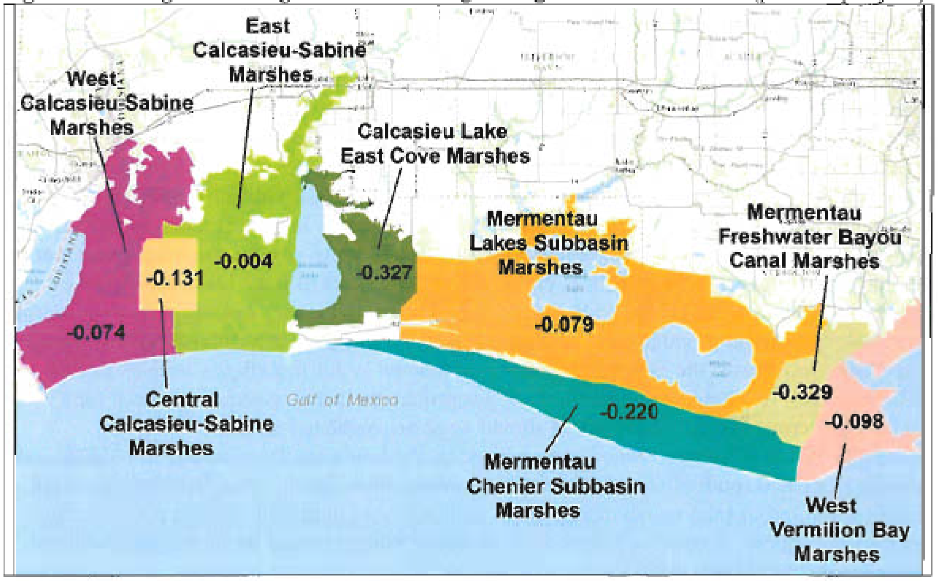
Figure 4. Average annual regional marsh acreage change from 1985 to 2010 (percent per year).



Marsh loss within the West Calcasieu-Sabine marshes is the result of recent rapid losses in the Cameron Meadows Oil and Gas Field north of Johnsons Bayou. Observations suggest that the marsh in this area has drowned and no cause is plausible other than mineral extraction related subsidence and associated drowning of marsh vegetation. Without the recent losses in that area, the regional loss rate would actually be positive (no land loss). Central and East Calcasieu-Sabine regions were relatively stable until impacted by Rita and Ike. Recent marsh creation and dredged material disposal efforts have partially offset hurricane related losses in that east region. Marshes east of Calcasieu Lake and throughout the Mermentau Basin were also adversely impacted by these recent hurricanes.

A major cause of marsh loss in the Calcasieu-Sabine Basin has been saltwater intrusion caused by the construction and enlargement of the Calcasieu River and Pass navigation channel, the GIWW, and the Sabine Neches Waterway (LCWCRTF 1998). Those deep-draft channels increased salinity levels throughout the estuary. The increased salinity stressed fresh and intermediate marsh vegetation, contributing to plant death and ultimately conversion of those marshes to shallow open water. Those hydrology changes resulted in the rapid conversion of interior low-salinity marshes to open water and brackish marshes. Once those losses had occurred, loss rates decreased as the most vulnerable areas had become open water. However, saltwater intrusion continues to impact sensitive low-salinity marsh areas during drought-induced high salinity periods.

Prior to Hurricanes Rita and Ike, the Lakes Subbasin marshes and other study area marshes were relatively stable. However, significant study area marsh loss occurred prior to 1985
Other Mermentau Basin problems include shoreline erosion along the Gulf of Mexico, which is greatest in the vicinity of Rockefeller Refuge where 30 to 40 feet per year is lost to the Gulf (van Beek and Meyer-Arendt 1982 and Williams et al. 1992).

Shoreline erosion is also a problem along the shores of large lakes such as Calcasieu Lake, Sabine Lake, Grand Lake, and White Lake. Ship wakes and wind waves are the predominant mechanism of erosion causing the Calcasieu Ship Channel to widen at an average of 7.5 feet per year in this reach (Fischenich 2004).

Using tide gage data from the Sabine Pass tide gage and U.S. Army Corps of Engineers methods, a subsidence rate of 3.9 mm/year has been calculated and is assumed to be the rate affecting the entire study area. The combination of subsidence and sea level rise is called submergence or relative sea level rise. Submergence causes marshes to become inundated with higher water levels, stressing most non-fresh marsh plants and leading to plant death and conversion of marshes to open water. Other major causes of study-area marsh loss include altered hydrology, storm events, and developments including the direct and indirect impacts of dredge and fill activities (LCWCRTF 1998).

Wetland losses result in increasing acreage of open water. Continued wetland losses are expected to cause significant declines in coastal fish and shellfish production and in the study area's carrying capacity for migratory waterfowl, wading birds, other migratory birds, alligators, furbearers, and game mammals such as white-tailed deer and swamp rabbit. Wetland losses will also reduce storm surge protection of developed lands, and will likely contribute to water quality degradation associated with excessive nutrient inputs.

Aside from marsh loss, salt water intrusion has converted fresh marsh habitats to more brackish communities. Marshes not hydrologically managed will continue to provide habitat for more salt tolerant species. Because of continued saltwater intrusion, habitat quantity and quality for freshwater fishes, waterfowl, alligators, and more freshwater-tolerant estuarine species (i.e., Gulf menhaden, white shrimp) will continue to decrease throughout most of this area. Habitat quantity will increase for species such as brown shrimp, spotted seatrout, and black drum, which prefer brackish and saline conditions (LCWCRTF 1999). However, continued degradation of those brackish and saline marshes may reduce production of those fish and shellfish.

DESCRIPTION OF ALTERNATIVES AND RECOMMENDED PLAN

Project goals are to provide hurricane protection and ecosystem restoration that improves ecosystem sustainability. Specific planning objectives were identified to solve the problems by taking advantage of opportunities (Table 2).

Table 2. Protection and restoration planning objectives.

Objective No.	Objective Description
1	Reduce the risk of damages and losses from hurricane and storm surge flooding in southwest Louisiana
2	Manage tidal flows in southwest coastal Louisiana to improve drainage and prevent salinity from exceeding 2 ppt for fresh marsh and 6 ppt for intermediate marsh
3	Increase wetland productivity in southwest coastal Louisiana in fresh and intermediate marshes to maintain function by reducing the time water levels exceed marsh surfaces.
4	Reduce shoreline erosion and stabilize canal banks in southwest coastal Louisiana areas to protect adjacent wetlands.
5	Restore landscapes, including marsh, shoreline, and cheniers in southwest coastal Louisiana, to maintain their function as wildlife habitat and improve their ability to serve as protective barriers

Storm surge protection alternatives were developed to protect the communities of Lake Charles/Sulphur and Abbeville/Erath/Delcambre (Figures 5, 6, and 7). Each of those alignments was evaluated at levee heights to protect against 0.5 percent, 1.0 percent, and 2.0 percent annual chance of occurrence storms. In addition to those traditional levee alternatives, non-structural alternatives consisting of buyouts and elevating flood prone structures have also been evaluated throughout the study area.

The only protection levee alignment with a benefit/cost ratio greater than one is the Lake Charles Eastbank alignment. In the Abbeville/Erath/Delcambre area, all of the alternative levee alignments had a benefit/cost ratio less than one. Consequently, the Lake Charles Eastbank alignment has been selected for inclusion in the TSP along with non-structural measures also determined to be most cost effective (Figure 8).

Ecosystem restoration measures were classified into either hydrology/salinity control measures, marsh creation measures, shoreline protection measures, chenier restoration/reforestation, or oyster reef restoration measures (to improve wetland hydrology). The hydrology/salinity control measures consist of water control structures and/or navigation locks at Sabine Pass and Calcasieu Pass to reduce saltwater intrusion into the estuary, or control structures to reduce marsh flooding and saltwater intrusion from Calcasieu Lake into interior marshes. Marsh creation and shoreline protection measures were strategically located to protect areas where erosion and marsh loss could result in the establishment of new channels connecting the Gulf of Mexico with interior marshes. Candidate measures were screened based on cost effectiveness, and only the most cost effective measures were retained.

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Figure 5. Lake Charles/Sulphur area alternative levee alignments.

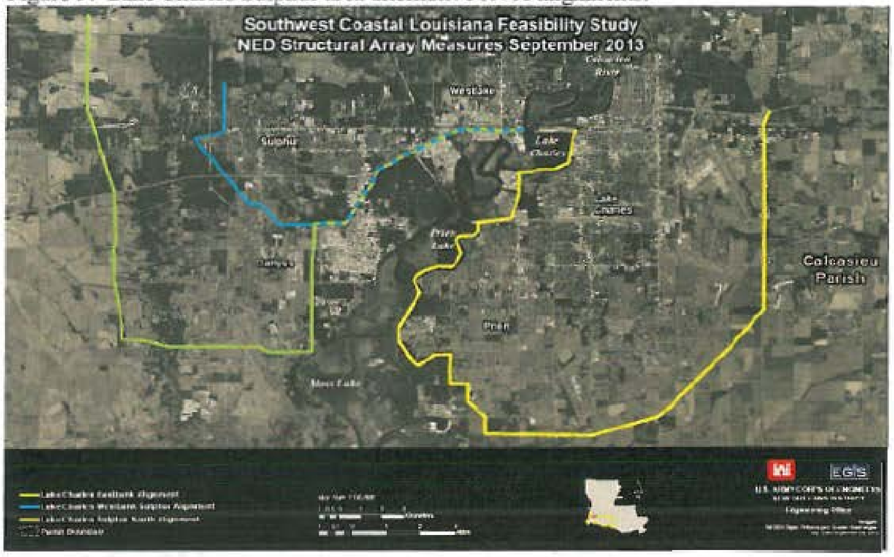

Figure 6. Abbeville/Erath/Delcambre area alternative levee alignments.

Figure 8. Map of non-structural protection reaches included in the TSP.

The retained measures were then combined to create an array of restoration alternatives (Table 3). Alternative 1, the Large Integrated Restoration across Basins plan, incorporates all hydrology/salinity control measures, except the Gum Cove Ridge control structure, plus the full array of marsh creation and shoreline protection features, plus all chenier restoration features. Alternative 2, the Moderate Integrated Restoration plan, is similar to Alternative 1 except that it has a reduced number of marsh creation and shoreline protection features. Alternative 3, the Moderate Integrated Restoration Plan with Gum Cove, is identical to Alternative 2 except that it includes the Gum Cove Ridge water control structure. Alternative 4, the Entry Salinity Control plan, includes the water control structures that regulate exchange with the Gulf (this includes the Catfish Point structure), plus a lesser number of marsh creation and shoreline protection features compared to Alternatives 2 and 3. Chenier restoration is included in this and all alternatives. Alternative 5 is similar to Alternative 4 except that Alternative 5, the Interior Perimeter Control plan, includes hydrology/salinity control measures that are limited to the interior perimeter control structures (including the Catfish Point structure and the Gum Cove Ridge structure). Chenier restoration is included in Alternative 5. Alternative 6, the Marsh and Shoreline plan, includes the same interior perimeter hydrology/salinity control measures, minus the Gum Cove control structure, and it includes all marsh creation measures, most of the shoreline protection measures, and all chenier restoration measures.

Table 3. Ecosystem restoration alternatives evaluated.

Alternative Number	Alternative Description
1	Large Integrated Restoration Across Basins
2	Moderate Integrated Restoration
3	Moderate Integrated Restoration w/ Gum Cove
4	Entry Salinity Control Focus
5	Interior Perimeter Control Focus
6	Marsh & Shoreline Focus

Restoration Alternative 4 (Entry Salinity Control Alternative), minus the Calcasieu Pass control structure, was initially chosen as the most cost effective of the comprehensive plans and was included in the TSP. However, subsequent consideration resulted in modifying alternative 4 to eliminate the Sabine Pass salinity control structure (measure 48) and to add the shoreline protection measures on the Gulf shore at Rockefeller Refuge (measures 6B1, 6B2, and 6B3. TSP measures in the Calcasieu-Sabine and the Mermentau Basins are illustrated in Figures 9 and 10, respectively, and listed in Table 4.

Table 4. Restoration measures comprising the TSP.

Basin	Measure Type	Measure Number	Measure Description
CS	Oyster Reef	604	Preservation of historic Sabine oyster reefs
CS	Hydrology	74a	Cameron spillway structure at east Calcasieu Lake
CS	Marsh Creation	124c	Marsh creation at Mud Lake
CS	Marsh Creation	124d	Marsh creation at Mud Lake
CS	Marsh Creation	3a1	Beneficial use of dredged material from ship channel
CS	Marsh Creation	3c1	Beneficial use of dredged material from ship channel
CS	Shoreline Prot.	5a	Holly Beach shoreline protection
CS	Chenier Rest.	416	Chenier restoration: Grand Chenier
CS	Chenier Rest.	510a	Chenier restoration: Blue Buck Ridge
CS	Chenier Rest.	510b	Chenier restoration: Hackberry Ridge
CS	Chenier Rest.	510d	Chenier restoration: Front Ridge
Merm	Hydrology	13	Freshwater retention sill on Little Pecan Bayou
Merm	Marsh Creation	127c3	Marsh creation at east Pecan Island
Merm	Marsh Creation	306a1	Marsh creation at Rainey marsh (SW portion)
Merm	Marsh Creation	47a1	Marsh creation using dredged material south of Hwy 82
Merm	Marsh Creation	47a2	Marsh creation using dredged material south of Hwy 82
Merm	Marsh Creation	47c1	Marsh creation using dredged material south of Hwy 82
Merm	Shoreline Prot.	16b	Fortify spoil banks of GIWW and Freshwater Bayou
Merm	Shoreline Prot.	6b1	Gulf shore protection: Calc River to Freshwater Bayou
Merm	Shoreline Prot.	6b2	Gulf shore protection: Calc River to Freshwater Bayou
Merm	Shoreline Prot.	6b3	Gulf shore protection: Calc River to Freshwater Bayou
Merm	Chenier Rest.	416	Chenier restoration: Grand Chenier ridge
Merm	Chenier Rest.	509c	Chenier restoration: Bill Ridge
Merm	Chenier Rest.	509d	Chenier restoration: Cheniere au Tigre
Merm	Chenier Rest.	510d	Chenier restoration: Front Ridge

FISH AND WILDLIFE CONCERNS IN THE PROJECT AREA

Major fish and wildlife resource concerns in the study area include ecosystem-wide hydrologic alterations associated with construction of major navigation channels within the study area and the resulting loss of coastal marsh and the conversion of fresher marshes to more saline habitats. Marsh loss due to shoreline erosion along the Gulf of Mexico is also a problem. The Service is also concerned with water-quality degradation from agricultural and urban run-off, and industrial discharges, into upper Calcasieu Basin waterbodies. Forested areas that once provided habitat for neotropical migrants have suffered extensive losses and continue to be lost to development and sea level rise and subsidence.

The coastal marshes of the Calcasieu-Sabine Basin have been identified by the North American Waterfowl Management Plan (NAWMP), Gulf Coast Joint Venture, as a key waterfowl wintering area. The Gulf Coast is the terminus of the Central and Mississippi Flyways and is

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therefore one of the most important waterfowl areas in North America, providing both wintering and migration habitat for significant numbers of the continental duck and goose populations that use both flyways. Aside from being a key waterfowl wintering area, the Chenier Plain provides important year round habitat for over 90 % of the continental population of mottled ducks and serves as a key breeding area for whistling ducks. The goal of the NAWMP, Chenier Plain Initiative is to provide wintering and migration habitat for significant numbers of dabbling ducks, diving ducks, and geese (especially lesser snow and greater white-fronted), as well as year-round habitat for mottled ducks. Because wintering waterfowl prefer fresh and intermediate marshes, and because navigation projects have contributed to substantial reductions in those preferred waterfowl habitats, measures to reduce salinity levels would have a positive impact of waterfowl habitat quantity, quality, and usage.

To counter saltwater intrusion effects resulting from the construction and enlargement of the Calcasieu Ship Channel, and to restore former low-salinity habitats, the U.S. Fish and Wildlife Service installed three water control structures on Sabine National Wildlife Refuge (in 1981) to regulate saltwater intrusion entering marshes west of Calcasieu Lake. Similarly, the U.S. Department of Agriculture's Cameron-Creole Watershed East Cove Unit project (completed in 1989) was constructed to regulate water levels and reduce saltwater intrusion impacts in the fresh and intermediate marsh habitats in the marshes east of Calcasieu Lake. Operation of these water control structures to rectify ecosystem alterations may at times interrupt ingress and egress of estuarine-dependent fish and shellfish, resulting in unintended fisheries impacts. Proposed hydrology restoration measures could also result in additional fisheries impacts. Those impacts could be reduced through water control structure operation plans designed to accommodate fisheries needs to the greatest degree possible, while still achieving salinity control goals.

Concerns exist that a future break of the eroding Gulf of Mexico shoreline into deteriorating interior marshes would create a new tidal pass, and would result in harmful salinity increases within interior marshes. Depending upon the location of such shoreline breaches, the resulting impacts could have ecosystem scale impacts. To avoid such impacts, shoreline protection and marsh creation measures have been proposed in strategic locations where such scenarios appear more likely.

Water quality impacts associated with urban and agriculture runoff are ubiquitous concerns that are difficult to address. However, designing all intercepted drainage pump stations to discharge into wetlands may provide some reduction of those impacts. Borrow canals dredged for levee construction could enhance delivery rates of runoff to wetlands and aggravate such impacts. A more serious concern exists where the proposed levee would be constructed in marshes and waterbottoms contaminated with dioxins, polychlorinated biphenyls and heavy metals. Construction activities might resuspend those contaminants allowing tidal action and rainfall runoff to then distribute the contaminants to other portions of the system.

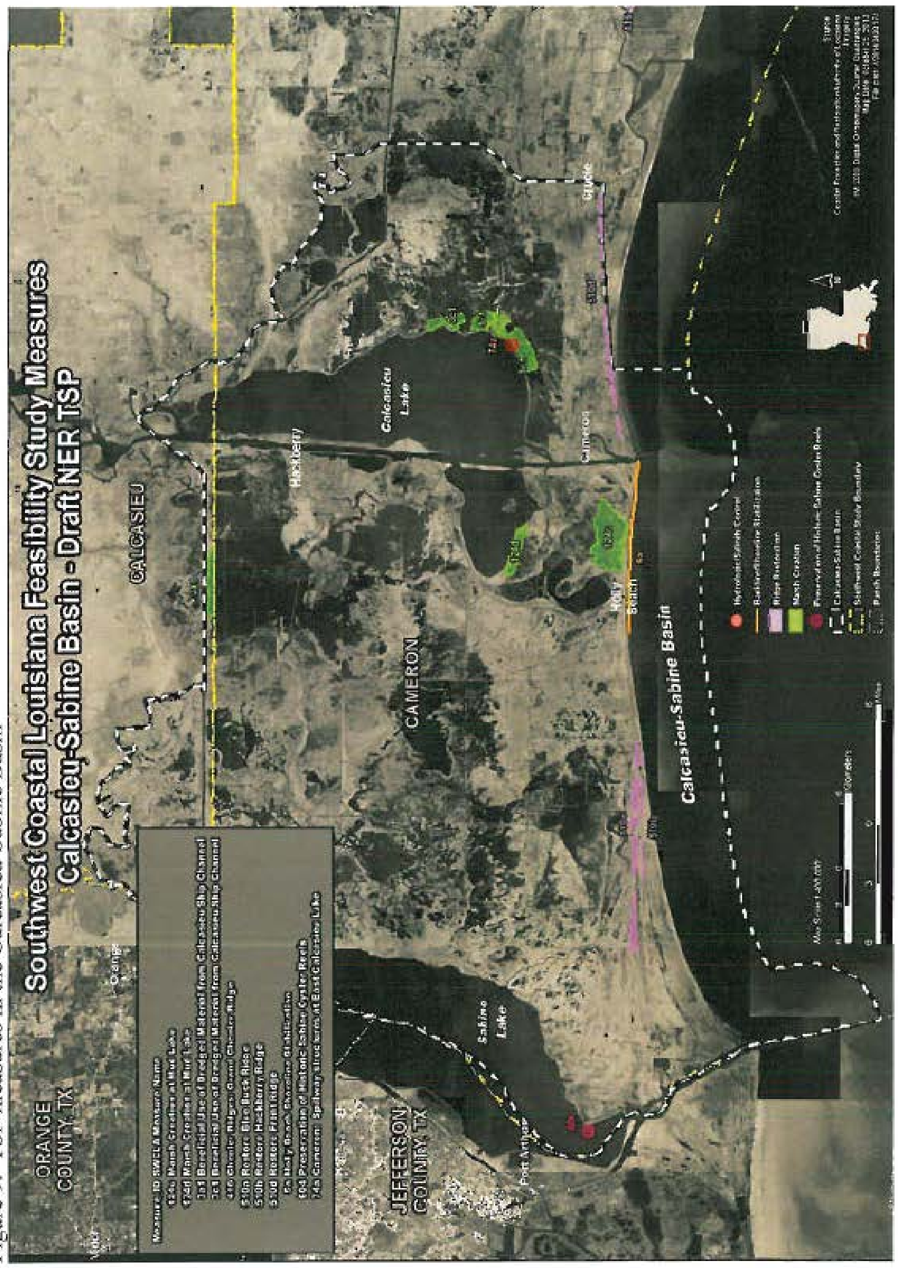

Figure 9. TSP measures in the Calcasieu-Sabine Basin

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Figure 10. TSP measures in the Mermentau Basin.

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Study area chenier ridges were historically forested. Residential and agricultural development has resulted in the clearing of most of the formerly forested areas. Mining of sand has also resulted in additional impacts to the chenier forests and to the chenier landforms. In addition to impeding storm surges, forested cheniers provide important stopover habitat for trans-Gulf neotropical migratory songbirds. Proposed measures to restore forested chenier habitats would benefit those migratory species, many of which have experienced population declines in recent decades.

EVALUATION METHODOLOGY

Levee construction impacts were determined by overlaying levee footprint shapefiles on Bing imagery (dated March 2010 to January 2011). After field inspection of impacted areas (September 3, 2013) to confirm habitat types impacted, the acreage of impacted fish and wildlife habitats was digitized and summarized.

The contractor utilized the Wetland Value Assessment (WVA) methodology to determine benefits for environmental restoration measures (benefits in Average Annual Habitat Units [AAHUs]). However, given the preliminary design status of the proposed restoration measures and the compressed study schedule, the Service has instead focused on the contractor's estimated net wetland acreage benefits at the end of the project's 50-year life (future with project acreage minus future without project acreage). Net acres for marsh creation measures were determined using typical spreadsheet methods and standard assumptions (created marshes lost at 50 percent of the background rate). Shoreline protection net acreage was also determined using spreadsheet methods and the assumption that Gulf shoreline protection features reduced background loss rate 50 percent while interior protection features reduced loss rates 100 percent.

Wetland acreage benefits associated with the proposed hydrology/salinity control structures were determined using the Wetland Morphology, Eco-Hydrology, and Vegetation models developed for evaluating the 2012 State Master Plan to provide a scientifically sound and defensible way to estimate the comprehensive benefits of those measures (Meselhe et al. 2013, Couvillion et al. 2013, and Visser et al. 2013). Because those measures were already analyzed using these models as part of the 2012 State Master Plan formulation, those results were used to screen proposed H&S measures. In general, the H&S measures carried forward in the study were those that had larger-scale benefits, i.e., those that helped maintain greater than 500 net acres as determined by the Master Plan models.

POTENTIAL SIGNIFICANT IMPACTS

The resulting preliminary direct construction impacts to marsh and forested areas are provided below for each levee alignment (Table 5). TSP impacts for the Lake Charles Eastbank levee alignment include 23.04 acres of bottomland hardwoods, 6.4 acres of intermediate marsh, 22.16 acres of brackish marsh, and approximately 383.97 acres of non-wetland forest.

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Table 5. Preliminary direct levee construction impacts to wetlands and forested habitats.

Habitat Type	Lake Charles Sulphur South Alignment (acres)	Lake Charles Westbank Sulphur Alignment (acres)	Lake Charles Eastbank Alignment (acres)	Abbeville to Delcambre Hwy 330 Alignment (acres)	Abbeville Alignment (acres)	Delcambre Erath Alignment (acres)
Pine Plantation	0.00	0.00	39.71	0.00	0.00	0.00
Dry Pine-Oak	161.88	54.92	99.66	0.00	0.00	0.00
Dry Hardwoods	0.00	0.00	0.00	12.78	19.41	7.13
Hydric Pine-Oak	216.76	0.00	284.31	0.00	0.00	0.00
Bottomland Hardwoods	0.00	0.00	23.04	16.63	13.80	4.20
Brackish Marsh	27.79	19.40	22.16	0.00	0.00	0.00
Intermediate Marsh	0.00	0.00	6.40	0.00	0.00	0.00
Swamp	0.00	0.00	0.00	0.00	0.00	45.64
Wetland TOTAL	27.79	19.40	51.60	16.63	13.80	49.83

Construction impacts to non-forested agriculture, residential, industrial, or pasture areas have not been determined. The impacted acreages do not include impacts associated with excavation for borrow material. Some levee reaches may block existing drainage ditches and bayous. As a result, levee construction may cause interrupted drainage impacts to developed property and/or adjacent wetlands. For example, in southwestern Lake Charles, near Graywood Plantation Drive, approximately 2.6 acres of brackish marsh would be impounded if drainage structures are not included to maintain tidal hydrology (Figure 11). Additional marsh impoundment impacts may occur in that area, but those impacts cannot be accurately determined because the planning of levee features has not advanced sufficiently. Tidal marshes, forested wetlands, and other forest habitats might also be impounded if drainage structures are not included to provide drainage and maintain tidal hydrology during non-storm periods. Impoundment impacts might range from destroying these habitats to lesser impacts that would reduce habitat quality. Measures to alleviate such indirect impacts have not been developed, nor have such indirect construction impacts been fully determined.

Although ecosystem restoration measures were evaluated using several different methodologies, net wetland acreage (future with project acres minus future without project acres at the end of the 50-year project life) was computed within each methodology (Table 6). Those net acreage values have been used as the benefit metric to compute the cost per benefit values (i.e., cost per year 50 net acreage) used to select the TSP.

Figure 11. Marshes that might be impounded near Gray Plantation Drive.

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Table 6. Predicted benefits of ecosystem restoration alternatives.

Alternative	Alternative Description	Acres Created	Acres Nourished	Total Acres	Net Acres	AAHU's
1	**Large Integrated Restoration Across Basins**				**31,960**	**17,898**
	Marsh Creation	20,149	5,522	25,671	17,807	8,726
	Shoreline Protection				6,614	1,939
	Hydro & Salinity Control				6,126	6,695
	Chenier Reforestation			1,413	1,413	538
2	**Moderate Integrated Restoration**				**28,077**	**14,905**
	Marsh Creation	16,059	3,306	19,365	13,820	6,916
	Shoreline Protection				4,847	1,559
	Hydro & Salinity Control				7,997	5,892
	Chenier Reforestation			1,413	1,413	538
3	**Moderate Integrated Restoration w/ Gum Cove**				**21,849**	**14,223**
	Marsh Creation	16,059	3,306	19,365	13,820	6,916
	Shoreline Protection				4,847	1,559
	Hydro & Salinity Control				1,769	5,210
	Chenier Reforestation			1,413	1,413	538
4	**Entry Salinity Control Focus**				**20,577**	**9,785**
	Marsh Creation	8,579	4,026	12,605	8,714	4,194
	Shoreline Protection				1,314	268
	Hydro & Salinity Control				9,136	4,785
	Chenier Reforestation			1,413	1,413	538
5	**Interior Perimeter Control Focus**				**12,129**	**5,238**
	Marsh Creation	8,579	4,026	12,605	8,714	4,194
	Shoreline Protection				1,314	268
	Hydro & Salinity Control				688	238
	Chenier Reforestation			1,413	1,413	538
6	**Marsh & Shoreline Focus**				**24,449**	**14,937**
	Marsh Creation	20,149	5,522	25,671	17,807	8,726
	Shoreline Protection				4,895	1,559
	Hydro & Salinity Control				334	4,114
	Chenier Reforestation			1,413	1,413	538

The TSP (see Table 4) is comprised of measures which differ somewhat from those within restoration alternative 4. Estimated acreage benefits of the TSP are provided in Table 7.

Table 7. Estimated benefits of the TSP.

Measure Type	Benefits
Marsh Creation	Net acres = 8714 (create 8579 ac and nourish 4026 acres)
Shoreline Prot.	Net acres = 5509 (266,884 linear feet of protection)
Hydrology	Net acres = 6092 (East Calc. Lake Spillway, Little Pecan Bayou sill)
Chenier Rest.	Reforest 1413 acres

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FISH AND WILDLIFE CONSERVATION MEASURES

The President's Council on Environmental Quality defined the term mitigation in the National environmental Policy Act regulations to include:

a) avoiding the impacts altogether by not taking a certain action or parts of an action;
b) minimizing impacts by limiting the degree or magnitude of the action and its implementation;
c) rectifying the impacts by repairing, rehabilitating, or restoring the affected environment;
d) reducing or eliminating the impacts over time by preservation and maintenance operations during the life of the action; and,
e) compensation for the impacts by replacing or providing substitute resources or environments.

The Service's mitigation policy (Federal Register, Volume 46, Number 15, pages 7656-7663, January 23, 1991) provides guidance to help ensure that the level of mitigation recommended by the Service is consistent with the value and scarcity of the fish and wildlife resources involved. In keeping with that policy, the Service usually recommends that losses of high-value habitats which are becoming scarce be avoided or minimized to the greatest extent possible. Unavoidable losses of such habitats should be fully compensated by replacement of the same kind of habitat value; this is called in-kind mitigation. The mitigation planning goals and associated Service recommendations should be based on the four categories, as shown in Table 8.

Table 8. U. S. Fish and Wildlife Service Resource Categories.

FWS Resource Categories
Resource Category 1 - Habitat to be impacted is of high value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion section. The mitigation goal for this Resource Category is that there should be no loss of existing habitat value.
Resource Category 2 - Habitat to be impacted is of high value for evaluation species and is relatively scarce or becoming scarce on a national basis or in the ecoregion section. The mitigation goal for habitat placed in this category is that there should be no net loss of in-kind habitat value.
Resource Category 3 - Habitat to be impacted is of high to medium value for evaluation species and is relatively abundant on a national basis. FWS's mitigation goal here is that there be no net loss of habitat value while minimizing loss of in-kind habitat value.
Resource Category 4 - Habitat to be impacted is of medium to low value for evaluation species. The mitigation goal is to minimize loss of habitat value.

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Bottomland hardwood forests and coastal marshes are considered by the Service to be aquatic resources of national importance due to their increasing scarcity and high habitat value for fish and wildlife within Federal trusteeship (i.e., migratory waterfowl, wading birds, other migratory birds, threatened and endangered species, and interjurisdictional fisheries). Therefore, the Service recommends that unavoidable losses of those habitats should be compensated via in-kind replacement. Because of schedule constraints, habitat quality assessments could not be conducted and only acreages of impacted habitats are available at this time (see Table 4).

Dry (non-hydric soil) hardwoods, dry (non-hydric soil) pine-oak forest, and hydric soil pine-oak forest habitats impacted by levee construction are considered to be relatively abundant. These are assumed to be Resource Category 3 habitats and impacts to such habitats may be mitigated out of kind, but mitigation should consist of some type of forested habitat. The 1,413 acres of proposed chenier reforestation would likely provide more than adequate compensation for impacted Resource Category 3 forest habitats provided that the chenier reforestation is successful. However, the restored chenier habitats will not likely provide sufficient wetland characteristics to mitigate impacts to hydric soil bottomland hardwoods. Consequently, the Service recommends that impacted bottomland hardwood forests be mitigated through a mitigation bank or through other means.

Construction of the proposed protection levee is anticipated to directly impact 28.56 acres of emergent marsh. Indirect levee impacts to marsh and bottomland hardwoods are likely to occur, but the acreage is not yet known. The 8,579 acres of proposed marsh creation would likely provide more than enough mitigation to compensate for both the direct and indirect marsh impacts. However, the proposed marsh creation measures must also address the need to mitigate the marsh impacts in kind (by habitat type). If the proposed marsh creation measures sufficiently address the in-kind requirements, provide a sufficient quantity of compensation, and if the mitigation is successful, then the proposed marsh creation measures may mitigate the unavoidable impacts associated with levee construction.

SERVICE POSITION AND RECOMMENDATIONS

Because the study schedule has precluded detailed planning and interagency input regarding the proposed levee alignments and ecosystem restoration measures, it is likely that further planning and/or agency and public review may result in modifications to those alignments and proposed restoration measures. The Service recommends that levee alignment modifications be made to further reduce impacts to wetlands and forested habitats, and to avoid or reduce indirect impacts to such habitats through interrupted drainage. To avoid interrupted drainage impacts, additional measures such as runoff collection canals and drainage structures through the levee will be needed to maintain drainage of the protected area. The addition of those drainage measures will likely increase costs and project-related wetland impacts. The Service recommends that the Corps solicit input from the Service and other interested natural resources agencies regarding levee alignment modifications to reduce wetland impacts and to develop features to provide drainage of protected areas. Because borrow locations have not yet been identified, borrow impacts cannot be determined. Additional environmental review and clearance for the borrow sites should be sought once those sites have been determined.

Discharge of polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), dioxins/furans, heavy metals, and other hazardous compounds into Bayou D'Inde, Bayou Verdine, and the upper Calcasieu River has impacted the upper Calcasieu River estuary adjacent to the proposed TSP protection levee feature. Dredging and site preparation associated with levee construction in those areas may resuspend contaminants and increase their bioavailability to fish and shellfish which provide an important food source for other fish, alligators, wading birds, and other migratory birds and wildlife.

The Service recommends that the project sponsors conduct a Hazardous, Toxic and Radioactive Waste (HTRW) assessment of tidally influenced levee construction locations and subaqueous marsh creation borrow sites. If those HTRW assessments indicate that contamination exceeds NOAA screening levels, then alternative locations should be considered, or, special procedures (e.g., use sediment curtains, etc.) should be implemented to reduce or prevent contaminant re-suspension and dispersal into important downstream fish and wildlife habitats.

For the proposed marsh creation measures, details regarding containment dike location and design, fill elevation, spill box locations, dike degradation protocols, vegetative planting protocols, and other details have not yet been made available to the Service or other interested resource agencies. The Service requests that the Corps work with the Service and interested natural resource agencies to finalize those planning details.

Because submerged aquatic vegetation provides food for migratory waterfowl, and provides high quality nursery habitat for estuarine dependent fisheries (Castellanos and Rozas 2001, and Kanouse et al. 2006), the open water areas targeted for marsh creation measures should avoid areas of dense submerged aquatic vegetation to the greatest degree possible.

Details regarding other ecosystem restoration features such as shoreline protection measures have not yet been provided to the Service. The Service requests that the Corps work with the Service and interested natural resource agencies to finalize those planning details. To understand and concur with the estimated benefits for the installation and operation of the proposed salinity control structures, the assumptions used and an explanation of the modeling methods should be provided to the Service and other interested natural resource agencies.

Ecosystem restoration measures could potentially mitigate all project-related direct and indirect construction impacts. For the restoration measures selected to provide mitigation, the Service recommends that the Corps address the 12 mitigation planning requirements (Appendix A) for each selected mitigation feature.

To determine if mitigation measures have been successful, the Service recommends that the Corps utilize the final mitigation performance protocols developed for the Hurricane Storm Damage Risk Reduction Study. For ecosystem restoration measures not being used to mitigate construction impacts, the Service recommends that the Corps conduct monitoring of those features to document the degree of success achieved. The Service and other interested natural resource agencies should be involved in developing those monitoring criteria and in the review of subsequent monitoring information and reports.

Because many design details regarding the proposed surge protection levees are yet to be developed, additional planning work must be conducted before impacts can be fully determined. Similarly, the proposed ecosystem restoration measures need additional planning work and interagency coordination to finalize estimated benefits and impacts with any degree of certainty. To complete needed planning of project features, to reduce and avoid project-related adverse impacts to fish and wildlife resources, and to enhance the desired ecosystem benefits, the Service provides the following recommendations:

1. The Corps should conduct further planning of the proposed protection levee to reduce and avoid impacts to wetlands and forest habitats. Additional levee planning work should also include the development of measures to avoid interrupted drainage impacts in a manner that reduces or avoids impacts to wetlands and forested habitats. The additional planning work should be coordinated with the Service and other interested natural resource agencies. Any pump stations needed for drainage of the protected area should be designed to discharge into wetlands to reduce adverse effects of discharging runoff directly into open water bodies

2. The Corps should also determine where levee borrow material will be obtained.

3. To the greatest degree practical, borrow pits for construction of proposed levee and marsh creation measures should be located to avoid and minimize direct and indirect impacts to vegetated wetlands. Efforts should be made to further reduce those direct impacts by hauling in fill material, using sheetpile for the levee crest, deep soil mixing, or other alternatives. Borrow pit construction should also avoid the following:
    a. avoid inducing wave refraction/diffraction erosion of existing shorelines
    b. avoid inducing slope failure of existing shorelines
    c. avoid submerged aquatic vegetation
    d. avoid increased saltwater intrusion
    e. avoid excessive disturbance to area water bottoms
    f. avoid inducing hypoxia

4. Once levee planning has been completed, the Corps should revise estimates of direct and indirect impacts to wetlands and forested habitats, including impacts associated with acquisition of borrow material. That work should be conducted in cooperation with the Service and other interested natural resource agencies.

5. The Corps should conduct a Hazardous, Toxic and Radioactive Waste (HTRW) assessment of tidally influenced levee construction locations and subaqueous marsh creation borrow sites. If those HTRW assessments indicate that contamination exceeds NOAA screening levels, then alternative locations should be considered, or, explanation

of the containment methods that would allow levee construction should be provided to the Service and other interested natural resource agencies.

6. For ecosystem restoration measures not being used to mitigate construction impacts, the Service recommends that the Corps conduct monitoring of those features to document the degree of success achieved. The Service and other interested natural resource agencies should be involved in developing those monitoring criteria and in the review of subsequent monitoring information and reports. For mitigation features, the Service also recommends that all interested natural resource agencies be involved in the planning of project features, monitoring plans, development of success criteria, and adaptive management plans. In addition, all mitigation plans should address the 12 mitigation requirements in Appendix A.

7. The Corps should obtain a right-of-way from the Service prior to conducting any work on Sabine or Cameron Prairie National Wildlife Refuges, in conformance with Section 29.21-1, Title 50, Right-of-Way Regulations. Issuance of a right-of-way will be contingent on a determination that the proposed work will be compatible with the purposes for which the Refuge was established.

8. All construction or maintenance activities (e.g., surveys, land clearing, etc.) on National Wildlife Refuges (NWRs) will require the Corps to obtain a Special Use Permit from the Refuge Manager of the Southwest Louisiana Refuge Complex; furthermore, all activities on NWRs must be coordinated with the Refuge Manager. Therefore, we recommend that the Corps request issuance of a Special Use Permit well in advance of conducting any work on the refuge. Please contact the Refuge Manager (337/598-2216 or SWLRComplex@fws.gov) for further information on compatibility of proposed ecosystem restoration measures, and for assistance in obtaining a Special Use Permit. Close coordination by both the Corps and its contractor must be maintained with the Refuge Manager to ensure that construction and maintenance activities are carried out in accordance with provisions of any Special Use Permit issued by the NWR.

9. The Corps should contact the Louisiana Department of Wildlife and Fisheries prior to conducting any work on Rockefeller Refuge (337-491-2593).

10. The Corps should continue to coordinate with the Service throughout planning and construction to ensure that the proposed project does not impact waterbird nesting colonies, and threatened or endangered species that may be listed in the future.

Given that the design and evaluation of most project features has been at a programmatic level, the Service cannot fulfill its Fish and Wildlife Coordination Act (FWCA)(48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) responsibilities at this time. Therefore, this draft report is presented in partial fulfillment of that act and does not constitute the final report of the Secretary of Interior as required by Section 2(b) of the FWCA. To complete those assessments, we will require additional funding during the project's pre-construction engineering and design phase.

Estimates of those funding needs should be coordinated in advance with the Service, and should be based on the extent of remaining work and the nature and complexity of issues associated with the remaining planning/design issues.

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APPENDIX A

TWELVE REQUIRMENTS FOR MITIGATION PLANNING
(from the U.S. Army Corps of Engineers & EPA 2008 Final Mitigation Rule in the FEDERAL REGISTER Vol. 73, No. 70, April 10, 2008)

Twelve Requirements for a Compensatory Mitigation Plan

1. Objectives. A description of the resource type(s) and amount(s) that will be provided, the method of compensation (restoration, establishment, preservation etc.), and how the anticipated functions of the mitigation project will address watershed needs.

2. Site selection. A description of the factors considered during the site selection process. This should include consideration of watershed needs, onsite alternatives where applicable, and practicability of accomplishing ecologically self-sustaining aquatic resource restoration, establishment, enhancement, and/or preservation at the mitigation project site.

3. Site protection instrument. A description of the legal arrangements and instrument including site ownership, that will be used to ensure the long-term protection of the mitigation project site.

4. Baseline information. A description of the ecological characteristics of the proposed mitigation project site, in the case of an application for a DA permit, the impact site. This may include descriptions of historic and existing plant communities, historic and existing hydrology, soil conditions, a map showing the locations of the impact and mitigation site(s) or the geographic coordinates for those site(s), and other characteristics appropriate to the type of resource proposed as compensation. The baseline information should include a delineation of waters of the United States on the proposed mitigation project site. A prospective permittee planning to secure credits from an approved mitigation bank or in-lieu fee program only needs to provide baseline information about the impact site.

5. Determination of credits. A description of the number of credits to be provided including a brief explanation of the rationale for this determination.
   - For permittee-responsible mitigation, this should include an explanation of how the mitigation project will provide the required compensation for unavoidable impacts to aquatic resources resulting from the permitted activity.
   - For permittees intending to secure credits from an approved mitigation bank or in-lieu fee program, it should include the

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number and resource type of credits to be secured and how these were determined.

6. Mitigation work plan. Detailed written specifications and work descriptions for the mitigation project, including: the geographic boundaries of the project; construction methods, timing, and sequence; source(s) of water; methods for establishing the desired plant community; plans to control invasive plant species; proposed grading plan; soil management; and erosion control measures. For stream mitigation projects, the mitigation work plan may also include other relevant information, such as planform geometry, channel form (e.g., typical channel cross-sections), watershed size, design discharge, and riparian area plantings.

7. Maintenance plan. A description and schedule of maintenance requirements to ensure the continued viability of the resource once initial construction is completed.

8. Performance standards. Ecologically-based standards that will be used to determine whether the mitigation project is achieving its objectives.

9. Monitoring requirements. A description of parameters monitored to determine whether the mitigation project is on track to meet performance standards and if adaptive management is needed. A schedule for monitoring and reporting monitoring results to the DE must be included.

10. Long-term management plan. A description of how the mitigation project will be managed after performance standards have been achieved to ensure the long-term sustainability of the resource, including long-term financing mechanisms and the party responsible for long-term management.

11. Adaptive management plan. A management strategy to address unforeseen changes in site conditions or other components of the mitigation project, including the party or parties responsible for implementing adaptive management measures.

12. Financial assurances. The DE may require additional information as necessary to determine the appropriateness, feasibility, and practicability of the mitigation project.

Other information. The DE may require additional information as necessary to determine the appropriateness, feasibility, and practicability of the mitigation project.

SOUTHWEST COASTAL LOUISIANA INTEGRATED DRAFT FEASIBILITY REPORT AND PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex H

U.S. Fish and Wildlife Service Scoping / Planning Aid Letter

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506
October 9, 2009

Colonel Alvin B. Lee
District Engineer
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Lee:

Please reference your September 29, 2009, letter requesting our participation as a cooperating agency for the Southwest Coastal Louisiana Protection and Restoration Feasibility Study that would be conducted by the U.S. Army Corps of Engineers (Corps). The study, which would involve the preparation of an environmental impact statement (EIS), would investigate the feasibility of providing Federal hurricane protection and storm damage reduction, as well as restoring and protecting fish and wildlife habitat, in portions of Calcasieu, Cameron, and Vermilion Parishes. The study would include the development of alternative plans (which may incorporate both structural and nonstructural components), identification of significant environmental resources, assessment of beneficial and adverse impacts, and formulation of compensatory mitigation measures, if necessary. The U.S. Fish and Wildlife Service (Service) has reviewed the information provided, and offers the following comments in accordance with the National Environmental Policy Act (NEPA) of 1969 (83 Stat. 852; 42 U.S.C. 4321 et seq.), and the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The Corps and the Service 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 Service would be pleased to serve as a cooperating agency in developing the EIS for the proposed project in accordance with applicable NEPA/Council on Environmental Quality guidance. Our participation will be specifically limited to: 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.

We appreciate the opportunity to assist the Corps during the planning of the proposed feasibility study. If you require further assistance in this matter, please contact Mr. David Soileau, Jr. (337/291-3109) of this office.

Sincerely,

David A. Walther
for James F. Boggs
Supervisor
Louisiana Field Office

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

March 27, 2009

Colonel Alvin B. Lee
District Engineer
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Lee:

The U.S. Fish and Wildlife Service (Service) has reviewed the Department of the Army, Corps of Engineers (Corps), Notice of Intent (NOI) to prepare a Draft Environmental Impact Statement (DEIS) for the Southwest Coastal Louisiana Feasibility Study for Calcasieu, Cameron, and Vermilion Parishes, Louisiana. The NOI was published in the Federal Register (Volume 74, No. 38, pg. 8920) on February 27, 2009 (Department of Interior No. ER09/0228). The study was authorized by a resolution adopted by the United States House of Representatives (House) Committee on Transportation and Infrastructure on December 7, 2005. The Fish and Wildlife Service (Service) submits the following comments in accordance with the National Environmental Policy Act of 1969 (83 Stat. 852, as amended; 42 U.S.C. 4321 et seq.), the Migratory Bird Treaty Act (MBTA, 40 Stat. 755, as amended; 16 U.S.C. 703 et seq.), the Bald and Golden Eagle Protection Act (BGEPA) (54 Stat. 250, as amended, 16 U.S.C. 668a-d), the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), and the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The Corps is conducting a study to determine the feasibility of providing Federal hurricane protection and storm damage reduction for portions of Calcasieu, Cameron, and Vermilion Parishes. A specific focus of that study, which is explicitly mentioned in the above-referenced House Committee resolution, will include an evaluation of the feasibility of constructing an armored 12-foot-high levee along the Gulf Intracoastal Waterway. However, numerous other levee alignments and project alternatives are under consideration, including those that would involve a variety of structural, non-structural, and coastal restoration components.

DESCRIPTION OF FISH AND WILDLIFE RESOURCE CONDITIONS

Most of the fish and wildlife habitat within the proposed study area exists as fresh, intermediate, brackish, and saline marshes. There are numerous rivers, bayous, canals, ponds, lakes, and other open water areas within those marshes that would also be affected by the proposed project. The study-area marshes and cheniers provide habitat for a variety of migratory game and non-game birds such as mallard, gadwall, American wigeon, common pintail, black rail, yellow rail, and little blue heron. Those non-game species have exhibited substantial population declines over the last 30 years, primarily as the result of habitat loss and fragmentation. Numerous reptiles and amphibians inhabit the marshes, bayous, and ponds of the study area including lesser siren, three-toed amphiuma, Gulf Coast toad, eastern narrow-mouthed toad, spring peeper, green treefrog, cricket frog, bullfrog, American alligator, common snapping turtle, alligator snapping turtle, diamondback terrapin, red-eared slider, painted turtle, Mississippi mud turtle, stinkpot, various water snakes, western ribbon snake, speckled kingsnake, and the western cottonmouth. The study area wetlands also help to reduce the impact of storm surges on more inland habitats and infrastructure, and aid in water quality maintenance by reducing excessive dissolved nutrient levels and removing suspended sediments. They provide plant detritus to surrounding estuarine waters, thereby substantially contributing to the detritus-based food web that supports the productivity of commercially and recreationally important fisheries. Brackish and saline marshes support estuarine-dependent (i.e., inter-jurisdictional) fishes and shellfishes (e.g., red drum, Atlantic croaker, Gulf menhaden, blue crab, brown shrimp, and white shrimp). Fresh and intermediate marshes of the study area provide habitat for mammals such as raccoon, mink, and swamp rabbit, and support many commercially and recreationally important fishes such as largemouth bass, black crappie, sunfishes, catfishes, freshwater drum, buffalos, and gars. The numerous cheniers located throughout the proposed project area provide important stopover habitat for as many as 250 species of neotropical migratory songbirds, including a variety of warblers, tanagers, orioles, thrushes, vireos, and grosbeaks.

Most development within the southern portions of the study area is located immediately adjacent to major state highways in the area including Louisiana Highways 82, 27, and 14. The most significant residential, commercial, and industrial developments are within, and immediately surrounding, the cities of Lake Charles and Abbeville. Various types of agriculture, such as sugarcane, rice, crawfish, and livestock production, are also present within the study area.

<u>Threatened and Endangered Species</u>

Federally listed as a threatened species, the piping plover (*Charadrius melodus*), as well as its designated critical habitat, occur along the Louisiana coast. Piping plovers winter in Louisiana, and may be present for 8 to 10 months annually. They arrive from the breeding grounds as early as late July and remain until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape, because the suitability of a particular site for foraging or roosting is dependant on local weather and tidal conditions. Plovers move among sites as environmental conditions change, and studies have indicated that they generally remain within a 2-mile area. Major threats to this species include the loss and degradation of habitat due to development, disturbance by humans and pets, and predation.

On July 10, 2001, the Service designated critical habitat for wintering piping plovers (Federal Register Volume 66, No. 132). Their designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers. Should the proposed project directly or indirectly affect the piping plover or its critical habitat, further consultation with this office will be necessary.

Federally listed as an endangered species, brown pelicans (*Pelecanus occidentalis*) are currently known to nest on Rabbit Island in Calcasieu Lake. Pelicans change nesting sites as habitat changes occur. In spring and summer, nests are built in mangrove trees or other shrubby vegetation, although ground nesting may also occur. Brown pelicans feed along the Louisiana coast in shallow estuarine waters, using sand spits and offshore sand bars as rest and roost areas. Major threats to this species include chemical pollutants, colony site erosion, disease, and human disturbance. Should the proposed project directly or indirectly affect brown pelicans, further consultation with this office will be necessary.

Endangered and threatened sea turtles forage in the nearshore waters, bays and sounds of Louisiana. The National Marine Fisheries Service (NMFS) is responsible for aquatic marine threatened or endangered species. Please contact Eric Hawk (727/824-5312) at the NMFS Regional Office in St. Petersburg, Florida, for information concerning those species in the aquatic environment. When sea turtles leave the aquatic environment and come onshore to nest, however, the Service is responsible for consultation. Accordingly, we recommend that you contact this office if your activities would occur on beach areas during the sea turtle nesting season (depending on the species in question).

<u>Other Federal Trust Species</u>

Forested portions of the study area may provide nesting habitat for the bald eagle (*Haliaeetus leucocephalus*), which was officially removed from the List of Endangered and Threatened Species on August 8, 2007. Bald eagles nest in Louisiana from October through mid-May. Eagles typically nest in mature trees (e.g., bald cypress, sycamore, willow, etc.) near fresh to intermediate marshes or open water. Eagles also winter, and infrequently nest, in mature pine trees near large lakes. 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 will typically defend against intrusion by other eagles, and that they likely return to each year. A territory may include one or more alternate nests that are built and maintained by the eagles, but which may not be used for nesting in a given year. Potential nest trees within a nesting territory may, therefore, provide important alternative bald eagle nest sites. In forested areas, bald eagles often select the tallest trees with limbs strong enough to support a nest. Nest sites typically include at least one perch with a clear view of the water or area where the eagles usually forage. Shoreline trees or snags located near large waterbodies provide the visibility and accessibility needed to locate aquatic prey. 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.

Although the bald eagle has been removed from the List of Endangered and Threatened Species, it continues to be protected under the MBTA and the BGEPA. The Service developed the National Bald Eagle Management (NBEM) Guidelines to provide landowners, land managers, and others with information and recommendations to minimize potential project impacts to bald eagles, particularly where such impacts may constitute "disturbance," which is prohibited by the BGEPA. A copy of the NBEM Guidelines is available at: http://www.fws.gov/southeast/es/baldeagle/NationalBaldEagleManagementGuidelines.pdf. Those guidelines recommend: (1) maintaining a specified distance between the activity and the nest (buffer area); (2) maintaining natural areas (preferably forested) between the activity and nest trees (landscape buffers); and (3) avoiding certain activities during the breeding season. On-site personnel should be informed of the possible presence of nesting bald eagles within the project boundary, and should identify, avoid, and immediately report any such nests to this office. If a bald eagle nest is discovered within or adjacent to the proposed project area, then an evaluation must 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. A copy of that determination should be provided to this office. The Division of Migratory Birds for the Southeast Region of the Service (phone: 404/679-7051, e-mail: SEmigratorybirds@fws.gov) has the lead role in conducting such consultations. Should you need further assistance interpreting the guidelines or performing an on-line project evaluation, please contact this office.

The proposed project would be located in an area where colonial nesting waterbirds may be present. Colonies may be present that are not currently listed in the database maintained by the Louisiana Department of Wildlife and Fisheries (LDWF). That database is updated primarily by monitoring the colony sites that were previously surveyed during the 1980s. Until a new, comprehensive coast-wide survey is conducted to determine the location of newly-established nesting colonies, we recommend that a qualified biologist inspect proposed work sites for the presence of undocumented nesting colonies during the nesting season. To minimize disturbance to colonial nesting birds, the following restrictions on activity should be observed:

1. For colonies containing nesting brown pelicans, all activity occurring within 2,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 15 through March 31). Nesting periods vary considerably among Louisiana's brown pelican colonies, however, so it is possible that this activity window could be altered based upon the dynamics of the individual colony. The LDWF Fur and Refuge Division should be contacted to obtain the most current information about the nesting chronology of individual brown pelican colonies.

2. For 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).

3. For colonies containing nesting gulls, terns, and/or black skimmers, all activity occurring within 650 feet of a rookery should be restricted to the non-nesting period (i.e., September 16 through April 1; 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.

Publicly and Privately Managed Areas

Publicly owned and/or managed lands within the current study area include three National Wildlife Refuges (Sabine, Cameron Prairie, and Lacassine) managed by the Service, the Rockefeller Wildlife Refuge, State Wildlife Management Area, and Rockefeller Refuge Mitigation Bank managed by LDWF, and the Sam Houston Jones State Park managed by the Office of State Parks.

Lands within the study area that managed by non-governmental organizations include the Little Pecan Island Preserve and the Persimmon Gully Mitigation Bank managed by The Nature Conservancy, and the Paul J. Rainey National Audubon Society Preserve managed by the National Audubon Society.

Privately owned and/or managed lands within the current study area include the Gum Cove, Fresh Marsh, Choupique, and Houston River Mitigation Banks (managed by Stream Properties, Inc.), the Bryan Farms Mitigation Bank (managed by Krauss and Managan Timber Company), the Simon and Delaney Mitigation Bank (managed by Mr. Chris Simon), and No Hope Farms Mitigation Bank (managed by Mr. Carl Nabours). There are also two privately owned Wetlands Reserve Program tracts (administered by the Natural Resources Conservation Service) within the study area (Contract #66-7217-9-3386 and Contract #66-7217-1-3616 in Vermilion Parish) that are encumbered by perpetual conservation easements.

Should proposed project alternatives entail work within or adjacent to, or would potentially alter the hydrology of, any of these managed properties, then the respective owner and manager should be contacted. Also, work proposed to occur on National Wildlife Refuge (NWR) lands would require a compatibility determination as mandated by the National Wildlife Refuge System Administration Act of 1966, as amended. (The amended act is now known as the National Wildlife Refuge System Improvement Act of 1997 [16 U.S.C. 668dd]). The Act states that refuge officials (through delegation of authority from the Secretary of the Interior) shall not initiate or permit a new use of a refuge unless the Secretary has determined that it is a compatible use. A compatible use is defined as any use of a refuge that will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of that refuge.

Federal agencies proposing a project that includes features on a NWR are encouraged to contact the refuge staff early in the planning process. Point of contact for the Service's Southwest Louisiana National Wildlife Refuge Complex is Mr. Don Voros, Project Leader (337) 598-2216. Additional activities (e.g., surveys, soil borings, etc.) that may need to occur on the NWR during the planning process may require a Special Use Permit from the Service; furthermore, all activities on that NWR must be coordinated with the Refuge Manager. Therefore, we recommend that the Corps request issuance of a Special Use Permit well in advance of conducting any work/investigations on a NWR.

Estuarine wetlands and associated shallow waters within the project area have been identified as Essential Fish Habitat (EFH). EFH requirements vary depending upon species and life stage. Categories of EFH in the project area include estuarine emergent wetlands, estuarine water column, submerged aquatic vegetation, and estuarine water bottoms. Detailed information on Federally managed fisheries and their EFH is provided in the 1998 generic amendment of the Fishery Management Plans for the Gulf of Mexico, prepared by the Gulf of Mexico Fishery Management Council (GMFMC). That generic amendment was prepared in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA); (P.L. 104-297). Recommendations to minimize and/or avoid impacts to EFH should be developed in coordination with the NMFS.

A portion of the study area lies within units of the Coastal Barrier Resources System. The Coastal Barrier Resources Act (CBRA) restricts Federal expenditures that effectively encourage development of coastal barriers. Coordination with this office should be undertaken to ensure that any proposed project feature is in compliance with the CBRA.

POTENTIAL SIGNIFICANT IMPACTS

Depending on the selected project features, construction of the proposed hurricane protection project has the potential to result in the direct loss of valuable coastal habitats including marsh, swamp, and bottomland hardwood wetlands (including cheniers); those habitats may also sustain losses from secondary impacts related to hydrologic changes in the study area. Developmental pressure on study area wetlands would likely increase should such areas be enclosed by storm-surge protection levees. Reduced water exchange between wetlands enclosed within and those excluded from leveed systems could reduce water quality within the study area by eliminating or reducing the filtering capacity of those wetlands. Wetland habitat losses would reduce populations of resident fish and wildlife, reduce important wintering habitat for waterfowl and other migratory birds, and reduce nursery habitat and detritus input important to the maintenance of estuarine-dependent fish and shellfish production.

PROBLEMS, OPPORTUNITIES, AND PLANNING OBJECTIVES

The most significant fish and wildlife related problem in the study area and throughout coastal Louisiana is the rapid loss of valuable wetland habitat. Since the 1930s, Louisiana has lost over 1,900 square miles of coastal wetlands; and an additional 24 square miles are being lost every year (Louisiana Department of Natural Resources' *Coastal Restoration Annual Project Reviews: December 2005*). The two major hurricanes of 2005 (Katrina and Rita) have significantly contributed to those coastal wetland losses, and their effects have exceeded all such changes in coastal Louisiana from the last 13 years of hurricanes combined, including Hurricanes Andrew (1992) and Lili (2002) (U.S. Geological Survey's *USGS Reports Latest Land-Water Changes for Southeastern Louisiana, February 2006*). As a result of the high rate of land loss and the national significance of coastal Louisiana wetlands, several programs (e.g., Americas Wetlands, Coast 2050, the Coastal Wetlands Planning, Protection, and Restoration Act, the Louisiana Coastal Area Ecosystem Restoration Study, the Coastal Impact Assistance Program [CIAP], and the Louisiana Comprehensive Hurricane Protection and Restoration Study) are being planned or implemented to restore and protect Louisiana's coastal wetland ecosystems. Many of the goals of those restoration programs and those of the current coastal hurricane protection study are interrelated and necessitate an integrated solution. Projects should be designed in collaboration with one another to ensure that a system-wide solution for coastal flood protection and restoration for the study area is achieved.

Water quality deterioration may be minimized by preserving remaining wetlands via limiting urban expansion and associated pollution discharges into wetlands. To that end, in order to discourage further wetland loss, any proposed hurricane protection levees should be located landward of the wetland/non-wetland interface. Should some wetlands be unavoidably enclosed within the levee, the integrity of present hydrologic regimes should be maintained via installation of water control structures in the levee to ensure adequate water circulation. Preservation of enclosed wetlands could be ensured via the purchase of non-development easements or local flood zoning ordinances. Furthermore, any pumping stations associated with the project should not discharge directly into canals or other open water bodies, but rather into wetland systems that can assimilate those nutrients being discharged.

The need for borrow necessary to complete proposed hurricane protection levees may exceed local availability. Often, the searches for levee-building material have been conducted on a project-by-project basis, and have led to the selection of the least-expensive and easiest sources for borrow material, which are usually located within wetlands adjacent to the proposed levee. Use of such on-site sources that adversely impact wetlands is frequently inconsistent with coastal restoration efforts, and is counterproductive to attaining the goal of increasing non-structural hurricane protection within a sustainable ecosystem.

In order to address the above problems and opportunities, the Service recommends that the following planning objectives and constraints be included in any further planning of hurricane protection features for the study area:

1. Avoid and/or minimize impacts to wetlands and fish and wildlife habitat in the study area.

2. The Service's priority selection process for borrow material outlined in our August 7, 2006, letter to the Corps regarding the Greater New Orleans Hurricane and Storm Damage Risk Reduction Project should be utilized.

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3. Coordinate with the LCA Plan near-term restoration planning team, CWPPRA member-agencies, CIAP representatives, and any other pertinent coastal restoration entities to ensure consistency with the objectives of the projects that may have already been constructed, that are proposed for construction, or that have been identified in planning efforts to occur within the subject study area.

4. Avoid impacts to threatened and endangered species and their habitat.

FISH AND WILDLIFE CONSERVATION MEASURES

Implementation of the proposed hurricane protection plan could potentially have significant direct impacts on fish and wildlife resources. Of equal concern is the potential for loss, via future development, of fish and wildlife habitat enclosed by levees constructed as a result of the plan. The Service believes that project plans can be designed to mitigate those negative impacts.

The President's Council on Environmental Quality defined the term "mitigation" in the National Environmental Policy Act regulations to include: (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and (e) compensating for the impact by replacing or providing substitute resources or environments.

If the enclosure of wetlands within the proposed levee is necessary to provide for storm surge protection, mechanisms for protecting enclosed wetlands and for compensating habitat value losses associated with levee construction should be developed. Preservation of enclosed wetlands may be accomplished by installing water control structures in the levee that could be operated to ensure adequate water exchange. Further, protection of enclosed wetlands from future development could be ensured via purchase of non-developmental easements. Compensation for wetland habitat value losses associated with levee construction would likely involve acquisition and/or restoration of in-kind wetland habitats. Detailed mitigation needs will be determined in the feasibility stage.

1. Mitigate impacts to wetlands by:

    a. Incorporating hurricane protection features (e.g., floodwalls, etc.) that would minimize impacts to fish and wildlife habitat;

    b. Requiring that hurricane protection levees are located landward of the wetland/non-wetland interface, and limiting hurricane protection to existing urban developments;

    c. Requiring that borrow material for levee construction be taken from non-forested, non-wetland areas (the Service's priority selection process for borrow material should be utilized);

d. Installing an adequate number of water-control structures in hurricane protection levees that enclose wetlands to maintain normal water exchange and preclude wetland drainage (such structures should be closed only in advance of tropical storms);

e. Acquiring non-development easements on enclosed wetlands to ensure their continued use as floodwater storage areas and to preclude any secondary development;

f. Incorporating water quality improvements by routing urban runoff through enclosed wetlands and discharging any pumped water into floodside wetlands;

g. Ensuring adequate internal drainage exists within the leveed area to prevent levees from compounding existing flooding problems, thus leading to future flood control projects with a resulting loss of wetlands and fish and wildlife resources; and,

h. Implementing measures to compensate for unavoidable losses of wetland habitat values.

2. Avoid impacts to endangered or threatened species and their habitats.

3. Avoid impacts to other Federal trust fish and wildlife resources such as bald eagles and colonial nesting waterbirds.

4. Avoid impacts to public lands, if feasible. If not feasible, coordination with agencies managing the public lands that would be impacted by the proposed project should occur throughout the planning process.

5. Ensure compliance with CBRA where applicable.

FISH AND WILDLIFE COORDINATION ACTIVITIES FOR THE FEASIBILITY STAGE

The following data will be needed to enable the Service to conduct a detailed analysis of project impacts on fish and wildlife resources and to formulate measures to mitigate any losses to those resources.

1. Identification of all alternatives to be considered, including detailed project plans (e.g., a written description and map) for those alternatives.

2. An estimate of current, future-with, and future-without-project development and land loss rates within the project area(s), presented in 10-year intervals, to be impacted by alternatives being considered.

3. Identification of habitats, by type and acreage, to be impacted by various alternatives being considered. That data should also be presented in 10-year intervals.

We look forward to assisting the Corps in the documentation of existing conditions, development of alternatives, and assessment of effects of project alternatives on Federal trust resources during the subsequent feasibility study. Should you have any questions regarding our comments, please contact David Soileau, Jr. (337/291-3109) of this office.

Sincerely,

for James F. Boggs
Supervisor
Louisiana Field Office

cc: DOI, OEPC, Washington, D.C. (Attn.: Loretta Sutton)
DOI, OEPC, Albuquerque, NM (Attn.: Steven Spencer)
FWS, BAP & HC (ERT), Arlington, VA (Attn.: Stefanie Nash)
FWS, Atlanta, GA (Attn.: Jeff Weller)
COE, CEMVN-PM-RS, Attention: Sandra Stiles, New Orleans, LA
EPA, Dallas, TX
NMFS, Baton Rouge, LA
LDWF, Baton Rouge, LA (Attn.: Kyle Balkum)
LDWF, Natural Heritage Program, Baton Rouge, LA

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APPENDIX A

Annex I

Technical, Institutional and Public Significance of Relevant Resources

Resource	Institutionally Significant	Technically Significant	Publicly Significant
Soils, Water bottoms, Prime and Unique Farmlands	Council on Environmental Quality (CEQ) memorandum dated August 11, 1980, entitled "Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act (NEPA)"; Executive Order 11990 - Protection of Wetlands; Agriculture and Food Act of 1981 (Public Law 97-98) containing the Farmland Protection Policy Act (PL 97-98; 7 U.S.C. 4201 *et seq*.).	Technically significant in determining soils engineering and environmental suitability, based on their ph ysical and chemical properties, for proposed activities. Water bottoms are technically significant because the estuarine bottom sediment characteristics (water bottoms) benthic organismal distribution and is an integral component of the benthic boundary layer.	Significant to the public for determining suitability of construction capabilities, agriculture suitability, and suitability for septic tank type disposal of sanitary waste.
Hydrology	NEPA of 1969; Clean Water Act of 1972; Storm damage Control Act of 1944; Coastal Barrier Resources Act of 1982; Rivers and Harbors Act of 1899; River and Harbor and Storm damage Control Act of 1970; Watershed Protection and Storm damage Prevention Act of 1954; Submerged Lands Act of 1953; Coastal Zone Management Act of 1972; Safe Drinking Water Act of 1974; Estuary Protection Act of 1968; Resource Conservation and Recovery Act of 1976; Comprehensive Environmental Response, Compensation and Liability Act of 1980; Executive Order 11988 FloodplainManagement.	Civil Works water resources development projects typically impact (positively or negatively) the interrelationships and interactions between water and its environment.	Publicly significant because the public demands clean water, hazard-free navigation, and protection of estuaries and floodplain management.
Water Quality	Clean Water Act of 1972; Pollution Prevention Act of 1990, the Safe Drinking Water Act of 1974; Water Resources Planning Act of 1965.	Technically significant to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.	Publicly significant because of the desire for clean water and water-related activities such as boating, swimming, fishing, and as a source of potable water.
Coastal Shorelines	Coastal Barrier Resources Act of 1982; Coastal Zone Management Act of 1972; Endangered Species Act of 1973; Estuary Protection Act of 1968l Fish and Wildlife Coordination Act of 1958; Migratory Bird Conservation Act of 1929; Migratory Bird Treaty Act of 1918; Endangered Species Act of 1973; Fish and Wildlife Conservation Act of 1980; Magnuson-Stevens Fishery Conservation and Management Act of 1976.	Technically significant because they are a critical element of the Gulf coastal barrier habitats.	Publicly significant because of the high priority that the public places on their aesthetic, recreational, and commercial value.
Vegetation Resources	Coastal Barrier Resources Act of 1982; Coastal Zone Management Act of 1972; Emergency Wetlands Resources Act of 1986; Estuary Protection Act of 1968; Fish and Wildlife Conservation Act of 1980; Fish and Wildlife Coordination Act of 1958; NEPA of 1969; North American Wetlands Conservation Act of 1989; the Water Resources Development Acts of 1976, 1986, 1990, and 1992; Executive Order 13186 - Migratory Bird Habitat Protection.	Technically significant because they are a critical element of the barrier shoreline habitats. 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.	Publicly significant because of the high priority that the public places on their aesthetic, recreational, and commercial value.
Wildlife Resources	NEPA of 1969; Coastal Zone Management Act of 1972; Estuary Protection Act of 1968; Fish and Wildlife Coordination Act of 1958; Migratory Bird Conservation Act of 1929; Migratory Bird Treaty Act of 1918; Endangered Species Act of 1973; Fish and Wildlife Conservation Act of 1980; North American Wetlands Conservation Act of 1989; Executive Order 13186 - Migratory Bird Habitat Protection; Marine Mammal Protection Act of 1972.	Technically significant because they are a critical element of the barrier shoreline ecosystem, they are an indicator of the health of various coastal habitats, and many wildlife species are important recreation and commercial resources.	Publicly significant because of the high priority that the public places on their aesthetic, recreational, and commercial value.

Aquatic Resources	National Environmental Policy Act of 1969; Coastal Zone Management Act of 1972; Estuary Protection Act of 1968.	Technically significant because plankton provide a major, direct food source for animals in the water column and in the sediments; are responsible for at least 40 percent of the photosynthesis occurring on the earth; important for their role in nutrient cycling; plankton productivity is a major source of primary food-energy for most estuarine systems throughout the world; and phytoplankton production is the major source of autochthonous organic matter in most estuarine ecosystems (Day et al. 1989).	Publicly significant because plankton constitute the lowest trophic food level for many larger organisms important to commercial and recreational fishing. There is also public health concern with noxious plankton blooms (red and brown tides) that produce toxins, and large-scale blooms can lead to hypoxic conditions, which can result in fish kills.
Fisheries	Fish and Wildlife Coordination Act of 1958; Endangered Species Act of 1973; Magnuson-Stevens Fishery Conservation and Management Act of 1976; Coastal Zone Management Act of 1972; Estuary Protection Act of 1968.	Technically significant because they are a critical element of many valuable freshwater and marine habitats, they are an indicator of the health of various freshwater and marine habitats, and many fish species are important commercial resources.	Publicly significant because of the high priority that the public places on their esthetic, recreational, and commercial value. Fisheries resources in the project area include marine and estuarine finfish and shellfish.
Essential Fish Habitat	Magnuson-Stevens Fishery Conservation and Management Act of 1976.	Technically significant because it includes those waters and substrate necessary to Federally-managed fish species for spawning, breeding, feeding or growth to maturity.	Publicly significant because of the high value that the public places on seafood and the recreational and commercial opportunities it provides.
Threatened and Endangered Species	Endangered Species Act of 1973; Marine Mammal Protection Act of 1972; Bald Eagle Protection Act of 1940.	Technically significant because the status of such species provides an indication of the overall health of an ecosystem.	Publicly significant because of the desire of the public to protect them and their habitats.
Cultural and Historic Resources	National Historic Preservation Act of 1966; Abandoned Shipwreck Act of 1987; Archeological Resources Protection Act of 1979; National Environmental Policy Act of 1969.	Technically important because of their association or linkage to past events, to historically important persons, and to design and/or construction values; and for their ability to yield important information about prehistory and history.	Publicly important because preservation groups and private individuals support their protection, restoration, enhancement, or recovery.
Recreational Resources	Federal Water Project Recreation Act of 1965; Land and Water Conservation Fund Act of 1965.	Technically significant because of the high economic value of recreational activities and their contribution to local, state, and national economies.	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
Air Quality	Clean Air Act of 1963, as amended, and the Louisiana Environmental Quality Act of 1983, as amended.	Air quality is technically significant because of the status of regional ambient air quality in relation to the National Ambient Air Quality Standards (NAAQS).	Air quality is publicly significant because of the desire for clean air and public health concerns expressed by many citizens.
Socioeconomic and Human Resources	National Environmental Policy Act of 1969; Estuary Protection Act of 1968; Clean Water Act of 1972; Rivers and Harbors Act of 1899; Watershed Protection and Storm damage Protection Act of 1954. Executive Order 12898 of 1994 – Environmental Justice.	Technically significant because the social and economic welfare of the Nation may be positively or adversely impacted by the proposed action; the social and economic welfare of minority and low-income populations may be positively or disproportionately impacted by proposed actions.	Publicly significant because of the public's concern for health, welfare, and economic and social well-being from water resources projects; also public concerns about the fair and equitable treatment of all people

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APPENDIX A

Annex J

Environmental Compliance Laws

Table J-1: Relevant Environmental Federal Statutory Authorities and Executive Orders. (Note: this list is not complete or exhaustive.)	
Abandoned Shipwreck Act of 1987	Marine Mammal Protection Act of 1972
American Indian Religious Freedom Act of 1978	Marine Protected Areas (EO 13158) of 2000
Anadromous Fish conservation Act of 1965	Marine Protection, Research, and Sanctuaries Act of 1972
Antiquities Act of 1906	Migratory Bird Conservation Act of 1929
Archeological Resources Protection Act of 1979	Migratory Bird Treaty Act of 1918
Archeological and Historical Preservation Act of 1974	Migratory Bird Habitat Protection (EO 13186) of 2001
Bald Eagle Protection Act of 1940	National Environmental Policy Act of 1969
Clean Air Act of 1970	National Historic Preservation Act of 1966
Clean Water Act of 1977	Native American Graves Protection and Repatriation Act of 1990
Coastal Barrier Improvement Act of 1990	Neotropical Migratory Bird Conservation Act of 2000
Coastal Barrier Resources Act of 1982	Noise Control Act of 1972
Coastal Wetlands Planning, Protection, and Restoration Act of 1990	Nonindigenous Aquatic Nuisance Prevention and Control Act of 1996
Coastal Zone Management Act of 1972	North American Wetlands Conservation Act of 1989
Comprehensive Environmental Response, Compensation, and Liability Act of 1980	Oil Pollution Act of 1990
Consultation and Coordination with Indian Tribal Governments (EO 13175) of 2000	Outer Continental Shelf Lands Act of 1953
Emergency Planning and Community Right-to-Know Act of 1986	Pollution Prevention Act of 1990
Emergency Wetlands Restoration Act of 1986	Prime and Unique Farmlands, 1980 CEQ Memorandum
Endangered Species Act of 1973	Protection and Enhancement of the Cultural Environment (EO 11593) of 1971
Environmental Quality Improvement Act of 1970	Protection and Enhancement of Environmental Quality (EO 11991) of 1977
Estuaries and Clean Water Act of 2000	Protection of Children from Environmental Health Risks and Safety Issues (EO 13045) of 1997
Estuary Protection Act of 1968	Protection of Cultural Property (EO 12555) of 1986
Estuary Restoration Act of 2000	Protection of Wetlands (EO 11990) of 1977
Exotic Organisms (EO 11987) of 1977	Reclamation Projects Authorization and Adjustments Act of 1992
Farmland Protection Policy Act of 1981	Recreational Fisheries (EO 12962) of 1995
Federal Actions to Address Environmental Justice in Minority Populations & Low-Income Populations (EO 12898) of 1994	Resource Conservation and Recovery Act of 1976
Federal Emergency Management (EO 12148) of 1979	Responsibilities of Federal Agencies to Protect Migratory Birds (EO 13186) of 2001
Federal Facilities Compliance Act of 1992	Rivers and Harbors Acts of 1899 and 1956
Federal Land Policy and Management Act of 1976	River and Harbor and Flood Control Act of 1970
Federal Water Pollution Control Act of 1972	Safe Drinking Water Act of 1974
Federal Water Project Recreation Act of 1965	Submerged Land Act of 1953
Fish and Wildlife Conservation Act of 1980	Sustainable Fisheries Act of 1996
Fish and Wildlife Coordination Act of 1934	Toxic Substances Control Act of 1976
Flood Control Act of 1944	Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970
Floodplain Management (EO 11988) of 1977	Water Resources Development Acts of 1976, 1986, 1990, 1992, and 2007
Food Security Act of 1985	Water Resources Planning Act of 1965
Greening of the Government Through Efficient Energy Management (EO 13148) of 2000	Watershed Protection & Flood Prevention Act of 1954
Historic Sites Act of 1935	Water Pollution Control Act Amendments of 1972
Historical and Archeological Data-Preservation Act of 1974	Wild and Scenic River Act of 1968
Indian Sacred Sites (EO 13007) of 1996	Wilderness Act of 1964
Invasive Species (EO 13112) of 1999	
Land & Water Conservation Fund Act of 1965	
Magnuson-Stevens Fishery Conservation and Management Act of 1976	

(Note: this list is not complete or exhaustive.)	
Air Control Act Archeological Treasury Act of 1974 Louisiana Coastal Resources Program Louisiana Scenic Rivers Act of 1988	Louisiana Threatened and Endangered Species and Rare & Unique Habitats Protection of Cypress Trees Water Control Act

ENVIRONMENTAL LAWS AND COMPLIANCE (*NEPA REQUIRED)

Federal projects must comply with Federal and state environmental laws, regulations, policies, rules and guidance. The team has coordinated and will continue to coordinate with Federal and state resource agencies during planning of the proposed action. Status of compliance with the various laws is presented below.

Bald and Golden Eagle Protection Act of 1940 (Bald Eagles)

The Bald and Golden Eagle Protection Act protects two eagle species. Bald eagles occur or occasionally occur in the proposed project area. Based on review of existing data and preliminary field surveys, the CEMVN finds that implementation of the TSP would have no effect on bald eagles.

Clean Air Act of 1970

The Clean Air Act (CAA) sets goals and standards for the quality and purity of air. It requires the Environmental Protection Agency to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The project area is in Calcasieu, Cameron and Vermilion Parishes, which are currently in attainment of NAAQS. The Louisiana Department of Environmental Quality is not required by the CAA and Louisiana Administrative Code, Title 33 to grant a general conformity determination.

Clean Water Act of 1977 – Section 401

The Clean Water Act (CWA) sets and maintains goals and standards for water quality and purity. Section 401 requires a Water Quality Certification from the Louisiana Department of Environmental Quality that a proposed project does not violate established effluent limitations and water quality standards. Section 401 compliance will be documented in the final report.

Clean Water Act of 1972 – Section 404(b)(1) (Wetlands)

The USACE administers regulations under Section 404(b)(1) of the CWA, which establishes a program to regulate the discharge of dredged and fill material into waters of the U.S., including wetlands. Potential project-induced impacts subject to these regulations will be evaluated during feasibility level design. A completed 404(b)(1) evaluation will be included in the final report.

Coastal Zone Management Act of 1972 (Coastal Zone Development)

The Coastal Zone Management Act is a partnership structure allowing states and the Federal government to work together for the protection of U.S. coastal zones from environmentally harmful over-development. Potential project-induced impacts will be evaluated during feasibility level design. They will be described in a Consistency Determination that will be submitted to the Louisiana Department of Natural Resources to review for consistency with the Louisiana Coastal Resource Program. The determination and findings will be provided in the final report.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980

Current USACE practice, to minimize the likelihood of issues occurring during later stages of the project and to be consistent with minimal standards for innocent landowner defense under the CERCLA, is to prepare a Phase I Environmental Site Assessment (ESA) following ASTM Standard E 1527-05. An appropriate level of assessment for the presence of HTRW is required for feasibility studies as per Engineering Regulation 1165-2-132 HTRW Guidance for Civil Works Projects. HTRW includes any material listed as a "Hazardous Substance" under CERCLA. Other regulated contaminants include those substances that are not included under CERCLA but pose a potential health or safety hazard, and are regulated. Examples include, but are not limited to, many industrial wastes, naturally occurring radioactive materials (NORM), many products and wastes associated with the oil and gas industry, herbicides, and pesticides. The project area is primarily undeveloped property, consisting of herbaceous and scrub/shrub wetlands, but it contains numerous oil and gas fields and individual production wells, with associated waste pits, and pipelines (Figure 3-7). Parts of the project area are industrialized, mainly the corridor along the Calcasieu River Ship Channel and around Lake Charles, Westlake, and Sulphur where numerous petrochemical plants are located. These industrial facilities have the potential to be chemical discharge sources, which can occur at unpredictable times. Several waterways in the project area are known to be contaminated with various petrochemicals and some of these waterways may be directly affected by the TSP, especially the NED component. The NED component of the TSP will be analyzed during feasibility level project design and a standard Phase I Environmental Site Assessment will be prepared to identify potential Recognized Environmental Concerns. Due to the rural nature, large footprints involving numerous landowners, and wide geographical distribution of the NER components of the TSP, HTRW assessments that are fully compliant with the ASTM Standard will likely not be achievable during the feasibility study phase. However, as many components of the ASTM Standard as possible will be completed during the feasibility phase to identify potential HTRW issues.

Endangered Species Act of 1973 (Threatened & Endangered Species)

The Endangered Species Act (ESA) is designed to protect and recover threatened and endangered (T&E) species of fish, wildlife and plants. The CEMVN is coordinating with the USFWS and the National Marine Fisheries Service (NMFS) to ensure for the protection of those T&E species under their respective jurisdictions. The USFWS identified in their September 20, 2013 email ten listed T&E species, the Red-cockaded woodpecker, Piping plover, Gulf sturgeon, West Indian manatee, Green sea turtle, Hawksbill sea turtle, Kemp's Ridley sea turtle, Leatherback sea turtle and loggerhead sea turtle that are known to occur or occasionally occur in the project area. In addition, designated Piping plover critical habitat also occurs within the project area. No plants were identified as being threatened or endangered in the project area. Based on review of existing data and preliminary field surveys, the CEMVN finds that implementation of the TSP would have no adverse effect on the success of any listed species or their critical habitat.

Louisiana State Threatened and Endangered Species and Rare and Unique Habitat

The Louisiana Department of Wildlife and Fisheries Louisiana Natural Heritage Program lists T&E species, rare, unique and imperiled habitats in the State of Louisiana. Based on review of the LNHP online database, the following rare or unique habitats, animals and plants are found in the project area: Brackish marsh, coastal dune grassland, coastal live oak-hackberry forest, coastal prairie, freshwater marsh, red wolf, crested caracara, snowy plover, piping plover, Wilson's plover, common ground-dove, sandhill crane, diamondback terrapin, brown pelican, roseate spoonbill, glossy ibis, paddlefish, eastern spotted skunk, ornate box turtle, manatee, Gregg's amaranth, A milk-vetch, golden canna, dune sandbur, sand dune spurge, wedge-leaf prairie-clover, wedge-leaf whitlow-grass, slim spike-rush, punctuate cupgrass, narrow-leaved puccoon, grapefruit primrosewilow, saltflat-grass, blue water lily, roundleaf scarf-pea, correll's false dragon-head, wand blackroot, Mexican hat, small's beaksedge, southern beaksedge, sand rose-gentian, brookweed, Elliott sida, Florida bully, powdery thalia, woolly honeysweet, sea oats (LDWF 2013). The CEMVN finds the NER TSP would have long term beneficial impacts on these rare and unique habitats and Louisiana T&E species.

Colonial Nesting Water Birds

The USFWS indicated in their January 9, 2009 coordination letter that the project area is known to support colonial nesting water birds (e.g., herons, egrets, ibis, night-herons and roseate spoonbills). Based on review of existing data and preliminary field surveys, the CEMVN finds that implementation of the TSP would have no effect on colonial nesting water birds.

Farmland Protection Policy Act of 1981 (Farmland)

The Farmland Protection Policy Act (FPPA) is intended to minimize the impact of Federal programs on the unnecessary and irreversible conversion of farmland to nonagricultural uses. Projects are subject to requirements if they may irreversibly convert farmland to nonagricultural use and are completed by a Federal agency or with assistance from a Federal agency. There are approximately 3,200 acres of soils that are classified as prime farmlands in the Lake Charles East levee alignment area (NED). The Lake Charles area is a heavily developed urban area and few areas are currently being used for agriculture or pastureland. Approximately 514 acres of soils classified as prime farmlands are present on chenier ridges that could be removed from current or future agricultural use as a result of proposed reforestation activities. In compliance with the Farmland Protection Policy Act (FPPA), the USACE will consult with the Department of Agriculture – Natural Resources Conservation Service (NRCS) to determine the precise acreages that would be impacted.

Fish and Wildlife Coordination Act of 1934 (Fish & Wildlife)

The Fish and Wildlife Coordination Act (FWCA) provides authority for the USFWS involvement in evaluating impacts to fish and wildlife from proposed water resource development projects. It requires that fish and wildlife resources receive equal consideration to other project features. It requires Federal agencies that construct, license or permit water resource development projects to first consult with the USFWS, NMFS and state resource agencies regarding the impacts on fish and wildlife resources and measures to mitigate these impacts. Section 2(b) requires the USFWS to produce a Coordination Act Report (FWCAR) that details existing fish and wildlife resources in a project area, potential impacts due to a proposed project and recommendations for a project. The draft FWCAR includes the USFWS positions and recommendations. This draft document, CEMVN's responses and coordination planning aid letters are found in Appendix A.

Magnuson-Stevens Fishery Conservation and Management Act of 1976 and the Magnuson-Stevens Act Reauthorization of 2006 (Essential Fish Habitat)

The law and its reauthorization govern marine fisheries management in the U.S. Essential Fish Habitat (EFH) does intersect the proposed NED and NER alignments and does enclosed area of EFH. The CEMVN has determined that the TSP would have significant impacts to EFH due to the NED alignment. The NER alignment will shift the type of EFH, and should overall benefit

EFH. It is not known at this time if there would be a net gain or loss of EFH when both the NED and NER are combined.

Marine Mammal Protection Act of 1972 (Marine Mammals)

The Marine Mammal Protection Act (MMPA) protects whales, dolphins, sea lions, seals, manatees and other species of marine mammals. The CEMVN finds the TSP would have no effect on marine mammals that may occasionally be found in the project area. To avoid "takings" of the West Indian manatee and ensure compliance with the MMPA, the CEMVN commits that 1) all construction personnel will be educated about the MMPA, ESA and species protected by the MMPA, 2) a search for manatees and dolphins in the project area and mitigation areas would be conducted before construction, and 3) best management practices detailed in appendix A to avoid or minimize potential entrapment of manatees and dolphins during construction would be implemented.

Migratory Bird Treaty Act of 1918 and Migratory Bird Conservation Act of 1929 (Migratory Birds)

The Migratory Bird Treaty Act (MBTA) and the Migratory Bird Conservation Act (MBCA) protect migratory birds and their habitat. Many important habitats in the project area provide migratory bird shelter, nesting, feeding and roosting habitat. Seven potentially active colonial nesting water bird rookeries may exist within 1,000 feet of the proposed NER and non-structural features. USFWS and USACE biologists will survey the area before construction to confirm active rookery locations. If active rookeries exist within 1,000 feet or there are active brown pelican nesting colonies within 2,000 feet of the proposed action, this could be a project constraint. USFWS guidelines would be followed to avoid adverse impacts to these species

National Historic Preservation Act of 1966 (Cultural and Historic Resources)

Section 106 of the National Historic Preservation Act (NHPA) and the implementing regulations (36 CFR part 800) require federal agencies to take into account the effects of their undertakings on historic properties, including any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on, the National Register of Historic Places, and to provide the Advisory Council on Historic Preservation a reasonable opportunity to comment. Federal agencies are required to consult with other parties throughout the Section 106 process, including the State Historic Preservation Officer (SHPO) and Indian Tribes that attach traditional religious and cultural significance to historic properties that may be affected by an undertaking. Taking into account the views of consulting parties and the public, the federal agency will determine how to resolve any adverse effects to historic properties prior to the final decision-making. Section 106 consultation has been initiated, and documentation of the Section 106 process will be included in the final report.

Tribal Consultation (Tribal Interests)

In partial fulfillment of E.O. 13175 ("Consultation and Coordination With Indian Tribal Governments"), NEPA and Section 106, consultation has been initiated with the following federally recognized Tribes: Alabama-Coushatta Tribe of Texas, Caddo Nation of Oklahoma, Chitimacha Tribe of Louisiana, Choctaw Nation of Oklahoma, Coushatta Tribe of Louisiana, Jena Band of Choctaw Indians, Mississippi Band of Choctaw Indians, Quapaw Tribe of Oklahoma, Seminole Nation of Oklahoma, Seminole Tribe of Florida and Tunica-Biloxi Tribe of Louisiana. CEMVN has provided Tribes with a summary of the study authority and documentation of completed cultural resource investigations and previously recorded archaeological sites and standing structures within a one-mile buffer of the proposed alternatives, offering Tribes the opportunity to review and comment on the potential of the proposed action to significantly affect protected tribal resources, tribal rights, or Indian lands. Documentation of tribal consultation will be included in the final report.

Wild and Scenic River Act of 1968 (Rivers)

The Wild and Scenic Rivers Act establishes a National Wild and Scenic Rivers System. The Louisiana Scenic Rivers Act recognizes and implements the 1968 Federal law, to preserve, protect and enhance the wilderness qualities, scenic beauties and ecological regimes of rivers and streams. Any construction within 100 feet of a scenic stream requires a scenic streams permit. The TSP would not impact the Blind River, the only scenic river within the project area.

Executive Order 11514, Protection and Enhancement of Environmental Quality

EO 11514 directs Federal agencies to "initiate measures needed to direct their policies, plans and programs so as to meet national environmental goals." The TSP complies with EO 11514.

Executive Order 11988, Floodplain Management

EO 11988 directs agencies to avoid development in floodplains to the maximum extent feasible. The TSP would reduction risk to the existing structures within the floodplain. The CEMVN is providing storm surge information to inform the St. Charles, St. James and St. John the Baptist Parishes Floodplain Administrators in their floodplain management implementation.

Executive Order 11990, Protection of Wetlands

Executive Order 11990 directs Federal agencies to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands, and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. Mitigation planning was integrated into the planning by considering, individually and collectively, each of the NEPA mitigation actions of avoiding, minimizing, reducing and rectifying potential adverse impacts to wetlands to the extent practicable. Implementing the TSP requires compensatory mitigation for unavoidable impacts that will require replacing or providing substitute resources. A mitigation plan will be completed during feasibility level design and will be included in the final report. Unavoidable project-induced impacts will be mitigated in-kind, and hence, the proposed action complies with the EO 11990.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

EO 12898 requires agencies to make achieving environmental justice (EJ) part of their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of programs, policies and activities on minority populations and low-income populations. Potential EJ issues have been considered throughout planning. As part of the NEPA process, public and scoping meetings were held and attention was given to EJ issues. A public meeting specific to EJ issues was held on May 21, 2013 at the Knights of Columbus Hall in Lutcher, Louisiana. During these meetings, information was made available to the public to help assist in the identification of potential EJ issues. The CEMVN has concluded that there would be no potential EJ issues from implementing the TSP. The CEMVN encourages any interested parties to inform the agency of potential EJ concerns.

Executive Order 13112, Invasive Species

EO 13112 directs Federal agencies to prevent the introduction of invasive species; provide for their control; and minimize the economic, ecological and human health impacts that invasive species cause. The TSP is consistent with EO 13112 to the extent practicable and permitted by law and subject to the availability of appropriations, and within Administration budgetary limits. Relevant programs and authorities to prevent the introduction of invasive species would be used during construction. The CEMVN will 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 CEMVN 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.

Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds

EO 13186 directs Federal agencies to take actions to further implement the Migratory Bird Treaty Act. The TSP has been evaluated for potential effects on migratory birds, with emphasis on species of concern. Many important habitats in the project area provide migratory bird shelter, nesting, feeding and roosting habitat.

SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex K

Threatened and Endangered Species

CONTENT

1. THREATENED AND ENDANGERED SPECIES

Historic and Existing Conditions

Eleven threatened and endangered species and one candidate species are known to occur or occasionally enter the Southwest Coastal Louisiana Project area (See Table 1). The proposed project area also contains Piping plover critical habitat.

Table 1. Listed and Candidate Species within the Project Area

Species	Acadia Parish	Calcasieu Parish	Cameron Parish	Vermillion Parish
*Sprague's Pipit	Candidate	Candidate	Candidate	Candidate
Red-Cockaded Woodpecker		Endangered		
Piping Plover			Threatened/ Critical habitat	Threatened/ Critical habitat
Red Knot			Threatened	Threatened
**Whooping Crane				Threatened
West Indian Manatee			Endangered	Endangered
Gulf Sturgeon			Threatened	Threatened
Green Sea Turtle			Threatened	Threatened
Hawksbill Sea Turtle			Endangered	Endangered
Kemp's Ridley Sea Turtle			Endangered	Endangered
Leatherback Sea Turtle			Endangered	Endangered
Loggerhead Sea Turtle			Threatened	Threatened

* Candidate species are those taxa for which the Service has on file sufficient information regarding biological vulnerability and threat(s) to support issuance of a proposal to list

**This is a nonessential population which is considered "threatened". However, the ESA's section 7 consultation regulations do not apply.

Sprague's Pipit: Candidate species

The Sprague's pipit, is a candidate species for federal listing as a threatened or endangered species. Candidate species are those taxa for which the Service has on file sufficient information regarding biological vulnerability and threat(s) to support issuance of a proposal to list, but issuance of a proposed rule is currently precluded by higher priority listing actions. The Sprague's pipit is known to or believed to occur in all parishes within the project area.

Sprague's pipit is a small (4 to 6 inches in length) passerine bird with a plain buffy face, a large eye-ring, and buff and blackish streaking on the crown, nape, and under parts. It winters in Louisiana, arriving from its northern breeding grounds in September and remaining until April. Sprague's pipit exhibits a strong preference for open grassland (i.e., native prairie) with native grasses of intermediate height and thickness, and it avoids areas with too much shrub encroachment. This species is a ground feeder and forages mainly on insects but will occasionally eat seeds (personal coordination USFWS Brigette Firmin).

Red-Cockaded Woodpecker: Endangered species

The red-cockaded woodpecker (RCW) was federally listed as endangered in 1970. Red-cockaded woodpeckers are known to, or believed to occur within the proposed project area, specifically in Calcasieu Parish. Deforestation for timber harvesting and habitat fragmentation for agricultural purposes has been the driving factor in reducing its habitat. Approximately 1% of their range remains. Mature pines in open upland stands are the preferred habitat of the RCW, however habitat selection varies regionally. Observations in Louisiana suggest significant use of bottomland hardwoods (Jones and Hunt).

The RCW is a small bird with a ladder-back, large white cheek patches and a black cap.

The male possesses a tiny patch of red feathers at the margin of the black cap and white cheeks. They roost and nest in cavities they sculpt primarily in pine trees. They feed on arthropods they gather from under tree bark. RCW can be found in Calcasieu Parish year round.

***Piping Plover**:* Threatened species

Hunting in the early 1900s resulted in a drastic reduction of the piping plover population. Ongoing destruction of historical nesting sites further reduced plover populations (USFWS 1988). On December 11, 1985, the USFWS designated the piping plover as endangered in areas of the Great Lakes watershed. The piping plover was designated as threatened, except in those areas where it is listed as endangered. The Piping plover is listed as threatened in Louisiana as well as several other states.

In July of 2001, the USFWS designated specific areas in the United States as critical habitat for wintering piping plovers (Federal Register / Vol. 66, No. 132, 10 July 2001). Piping plover critical habitat is defined by the USFWS as “those elements essential for the primary biological needs of foraging, sheltering, roosting, and the physical features necessary for maintaining the natural processes that support those habitat components. These primary elements are found only in coastal areas with intertidal beaches or flats that are associated with dunes systems.” The USFWS designated a total of 1,798 miles (165,211 acres) of shoreline along the Gulf of Mexico and Atlantic coasts as critical wintering habitat. Critical habitat in Louisiana encompasses 24,950 acres along 342.5 miles of shoreline, which is most of the coast of Louisiana. Piping plovers winter in Louisiana but do not nest on Louisiana’s coast. They arrive from their northern breeding grounds as early as late July and may be present for 8 to 10 months of the year.

In 2006, an international piping plover breeding and wintering census was conducted. The results of the census showed that the piping plovers were found wintering primarily in Texas (53.8%), Florida (11.7%) and the Bahamas (10.7%). The results of the Census showed only 5.8% found wintering in Louisiana (Elliott-Smith et al 2006). In Louisiana, the 2006 census takers recorded 226 piping plovers, almost half of the 2001 census numbers. The substantial decline in numbers can be attributed to habitat damage incurred by Hurricanes Katrina and Rita. Sites in Terrebonne and Cameron Parishes had some of the largest populations of piping plovers in the state: Raccoon (Last) Island, 39 birds; Whiskey Island, 31 birds; Smith Bayou to West Jetty, 35 birds.


General locations of the designated critical habitat for the Wintering Piping Plover.
Calcasieu Parish, LA
Jefferson Davis Parish, LA
Acadia Parish, LA
10
Lake Charles
Abbeville
Constance Beach
Cameron Parish, LA
Vermilion Parish, LA
Sabine Lake
Holly Beach
Cameron
Grand Lk
White Lake
Freshwater Bayou Canal
Rollover Bayou
Sabine Pass
LA-1
LA-1
LA-1
Gulf of Mexico
General Area
AR
MS
AL
TX
LA
Distance: Miles
0
15
30
N
Legend
City / Town
Major Road / Highway
Land
Critical Habitat
Use Constraints: This map is intended to be used as a guide to identify the general areas where Wintering Piping Plover critical habitat has been designated. Included within the designation of critical habitat are all land areas to the mean lower low water. Refer to the narrative unit descriptions as the precise legal definition of critical habitat.
Louisiana Unit: 1
Some locations have been slightly enlarged for display purposes only.

Red Knot*:* Threatened species

The red knot is a medium-sized shorebird about 9 to 11 inches in length with a proportionately small head, small eyes, short neck, and short legs. The black bill tapers steadily from a relatively thick base to a relatively fine tip; bill length is not much longer than head length. Legs are typically dark gray to black, but sometimes greenish in juveniles or older birds in non-breeding plumage. Non-breeding plumage is dusky gray above and whitish below. The red knot can be found in Louisiana during the winter months (generally October through March).

In the southeastern United States, red knots forage along sandy beaches, tidal mudflats, salt marshes, and peat banks. Observations along the Texas coast indicate that red knots forage on beaches, oyster reefs, and exposed bay bottoms and roost on high sand flats, reefs, and other sites protected from high tides. In wintering and migration habitats, red knots commonly forage on bivalves, gastropods, and crustaceans. Coquina clams, a frequent and often important food resource for red knots, are common along many gulf beaches. Major threats to this species along the Gulf of Mexico include the loss and degradation of habitat due to erosion and shoreline stabilization development, disturbance by humans and pets, and predation (personal coordination USFWS Brigette Firmin).

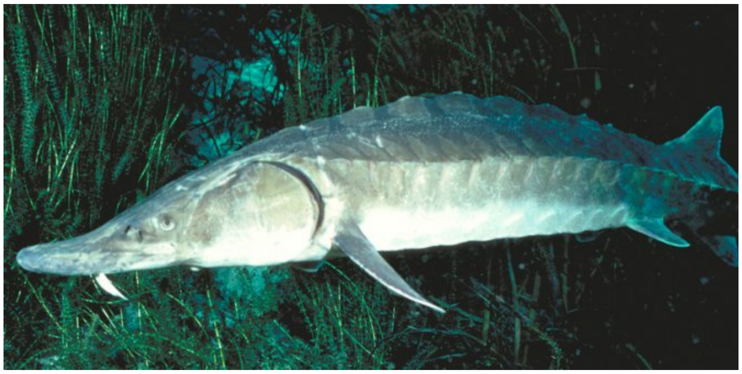
Whooping Crane: Threatened species (nonessential experimental population (NEP))

The whooping crane was listed as endangered in 1970 by the U. S. Fish and Wildlife Service. A NEP was introduced into historic southwestern Louisiana habitat on the state-owned White Lake Wetlands Conservation Area in Vermilion Parish, Louisiana. This reintroduced population was designated as NEP under section 10(j) of the Endangered Species Act of 1973 (ESA), as amended. A NEP population is a reintroduced population believed not to be essential for the survival of the species, but important for its full recovery and eventual removal from the endangered and threatened list. These populations are treated as "threatened" species except that the ESA's section 7 consultation regulations do not apply.

The whooping crane is a large white bird with black wing tips, red on forehead and cheeks, bill and legs are dark gray and eyes are yellow. Whooping cranes nest on the ground in marshy areas with bulrushes, cattails and sedges and will sometimes roost in shallow waters. They feed on insects, crabs, clams, crayfish, frogs, rodents, small birds, berries, acorns and other wild fruit (USFWS).

West Indian Manatee: Endangered species

The manatee was listed as an endangered species in 1967 by the USFWS. Manatees inhabit coastal areas from Florida to the Greater Antilles and suitable habitats in Central and South America. The manatees' range is generally restricted to the southeastern United States; individuals occasionally range as far north as Massachusetts and as far west as Texas. On occasion they have been observed in eastern Louisiana waters. Preferred manatee habitat includes abundant submerged aquatic vegetation, such as sea grasses, which are limited to shallow water near shore, because deep water limits the amount of light which can penetrate the water and reach the vegetation (USFWS 2008). They can feed in brackish or salt water, but require a fresh water source, such as estuaries or natural springs, for drinking. The manatee is known to or believed to occur in Cameron and Vermilion Parishes within the project area.



Gulf Sturgeon: Threatened species

On September 30, 1991, the Gulf sturgeon was listed as a threatened species under the Endangered Species Act (ESA) (56 FR 49653). The Gulf sturgeon is known to or believed to occur in Cameron and Vermilion Parishes within the project area. Gulf sturgeons are rather large fish with bony plates and a hard extended snout. They are brackish/marine water bottom feeders that eat primarily macro invertebrates. Gulf sturgeons spawn in fresh water coastal rivers during the warmer months and move to marine waters during the cooler months. Some of the primary causes of the species' decline are habitat loss due to the construction of water control structures, dredging, poor water quality and irrigation (NOAA-6).

Green Sea Turtle: Threatened species

Green sea turtles were listed as Threatened on July 28, 1978. The green sea turtle is known or believed to occur in Cameron and Vermillion Parishes within the project area. Green sea turtles are found worldwide in oceans and gulfs with water temperatures greater than 20° C. During their first year of life they are primarily carnivorous, feeding mainly on invertebrates. As adults they feed almost exclusively on sea grasses growing in shallow water flats (Fritts et al. 1983). Historically, green sea turtles were fished off the Louisiana coast (Rebel 1974, in Fritts et al. 1983), but exploitation and incidental drowning in shrimp trawls led to the decline of this species and its listing as a threatened species. Sightings or strandings are rare in Louisiana, but do occur. Strandings are defined as turtles that wash ashore, dead or alive, or are found floating dead or alive (generally in a weakened condition). NMFS' records show 6 plus strandings in 2011, 9 plus in 2012 and in 2013 4 plus (NOAA-1).

Hawksbill Sea Turtle: Endangered species

Hawksbill sea turtles were listed as endangered in 1970. The Hawksbill sea turtle is known or believed to occur in Cameron and Vermillion Parishes within the project area. Hawksbills regularly occur in the Gulf of Mexico but mainly in Texas They feed on animals associated with coral reefs, sponges, other invertebrates and algae. There is no record of Hawksbill strandings along Louisiana shorelines (NOAA-2).

Kemp's Ridley Sea Turtle: Endangered species

The Kemp's ridley sea turtle was listed as endangered on December 2, 1970. Inshore areas of the Gulf of Mexico appear to be important habitat for the Kemp's ridley sea turtle. Kemp's ridley turtles in the Gulf of Mexico tend to be concentrated around major river mouths (Frazier 1980). Ridleys are commonly captured by shrimpers off the Texas coast, as well as in heavily trawled areas off the coasts of Louisiana and Alabama (Carr 1980, Pritchard and Marquez 1973). Kemp's ridley turtles are thought to be the most abundant turtle off the Louisiana coast (Gunter 1981, Viosca 1961) as well as the most endangered of the sea turtles. Occurrence of ridleys in bays and estuaries along the Louisiana coast would not be unexpected, since many of their primary food items occur there.

The nesting season for the Kemp's ridley is April through July. The possibility of Kemp's ridley sea turtles nesting in Louisiana has been suggested (Hildebrand 1981, Viosca 1961), but no actual documentation of nesting exists. However, based on information obtained from NMFS, Kemps's ridley sea turtle strandings on the Louisiana coast have been documented and have increased since 2011. In 2013 at lease 145 plus Kemp's ridley sea turtles were recorded along the Louisiana coast compared to 104 plus in 2011. The majority of the sightings were in the spring months and approximately half of the 2013 sightings were along the western Louisiana coastline within the proposed project area (NOAA-3).

Leatherback Sea Turtle: Endangered species

The Leatherback sea turtle was listed as endangered in 1970. It is known to or believed to occur in Cameron and Vermillion Parishes within the project area. Leatherbacks feed on soft-bodied prey like jellyfish. Adult leatherbacks have been sighted in the Gulf of Mexico; however, only one stranding has been recorded along the Louisiana shoreline (NOAA-4).

Loggerhead Sea Turtle: Threatened species

The loggerhead was listed as threatened in 1978 by the USFWS. The loggerhead turtle is distributed worldwide in temperate and tropical waters. Nesting is from April through August, with 90 percent of the nesting effort on the gulf coast, occurring on the south-central coast of Florida (Hildebrand 1981). Nesting in Louisiana is limited almost exclusively to the Chandeleur Island. Loggerhead strandings, although few, have been reported along the Louisiana coast. NMFS' records show 19 plus strandings in 2011, 3 plus in 2012 and 6 plus in 2013 (NOAA-5).

The loggerhead's diet includes molluscs, shrimp, crabs, sponges, jellyfish, squid, sea urchins, and basket stars (Caldwell et al. 1955, Hendrickson 1980). Landry (1986) suggested that they may also feed on the by-catch from shrimp trawling. Adult loggerheads feed in waters less than 50 meters in depth, while the primary foraging areas for juveniles appear to be estuaries and bays (Rabalais and Rabalais 1980).

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SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
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APPENDIX A

Annex L

Adaptive Management and Monitoring Plan

Southwest Coastal Louisiana Feasibility Study

National Ecosystem Restoration (NER)
Draft Adaptive Management and Monitoring Plan

December 2, 2013

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1. INTRODUCTION

Wetland loss in Southwest Louisiana experienced approximately 20 percent of the total wetland loss observed in Louisiana from 1932-2010 (Couvillion et al., 2011). The processes of sea level rise, ground subsidence, saltwater intrusion, and erosion of wetlands have caused significant adverse impacts to the study area (Figure 1). The continued land loss and ecosystem degradation threaten the productivity of the Southwest's ecosystems, the economic viability of its industries, and the safety of its residents. Without action, this highly productive coastal ecosystem, composed of diverse habitats and wildlife, is not sustainable. The goal of the Southwest Coastal Louisiana Feasibility Study is to develop a comprehensive plan Southwest Louisiana for that will provide hurricane and storm damage risk reduction and provide coastal restoration measures to achieve ecosystem sustainability.

Initially, two separate studies were underway in the Southwest Coastal project area—one for coastal restoration under the LCA program and one for hurricane risk reduction following the impacts of Hurricane Rita in 2005. Recognizing the importance of coastal restoration for hurricane risk reduction and to reduce redundancies, the two projects were integrated. The Southwest Coastal project will produce both a National Economic Development (NED) plan for hurricane risk reduction and a National Ecosystem Restoration (NER) plan for ecosystem restoration. Please refer to Chapter 1 Section 7 of the Draft Integrated Feasibility Report and PEIS for additional information on the authorities for the Southwest Coastal Study.

Since the restoration in the Southwest Coastal area is a large-scale project that may influence regional conditions, an Adaptive Management and Monitoring (AM&M) Program will be implemented before, during, and after construction. Such monitoring will allow the USACE to assess the progress of restoration and will provide the necessary information to adjust project performance through adaptive management (AM), if necessary, to better meet project goals and objectives, and will ultimately provide information to better design and maintain coastal resources in the future.

In accordance with the Water Resources Development Act of 2007 Section 2036, Section 2039 and subsequent implementation guidance (CECW-PB Memorandum dated August 31, 2009) AM&M are required for both National Ecosystem Restoration (NER) project components and for any Mitigation Plan required forthe National Economic Development (NED) component. This AM&M Plan describes the monitoring design proposed to evaluate NER project progress towards meeting the restoration objectives, describes the organizational structure for the AM&M process, identifies key uncertainties, and describes potential AM actions. A separate plan is not needed for the NED since no Mitigation is required.

Many factors such as ecosystem dynamics, engineering applications, institutional requirements, and many other key uncertainties can change and/or evolve over a project's life. The AM&M Plan will be regularly updated to reflect monitoring-acquired and other new information as well as resolution of and progress on resolving existing key uncertainties or identification of as any new uncertainties that might emerge. Specifically, this AM&M Plan will be revised and updated during the feasibility level of design phase and further in the pre-construction engineering and design (PED) phase as more detailed project designs are developed and uncertainties are better understood. The AM&M plan will then be used during and after project construction to adjust the project, as necessary, to better achieve goals, objectives, and restoration/management outputs/results.

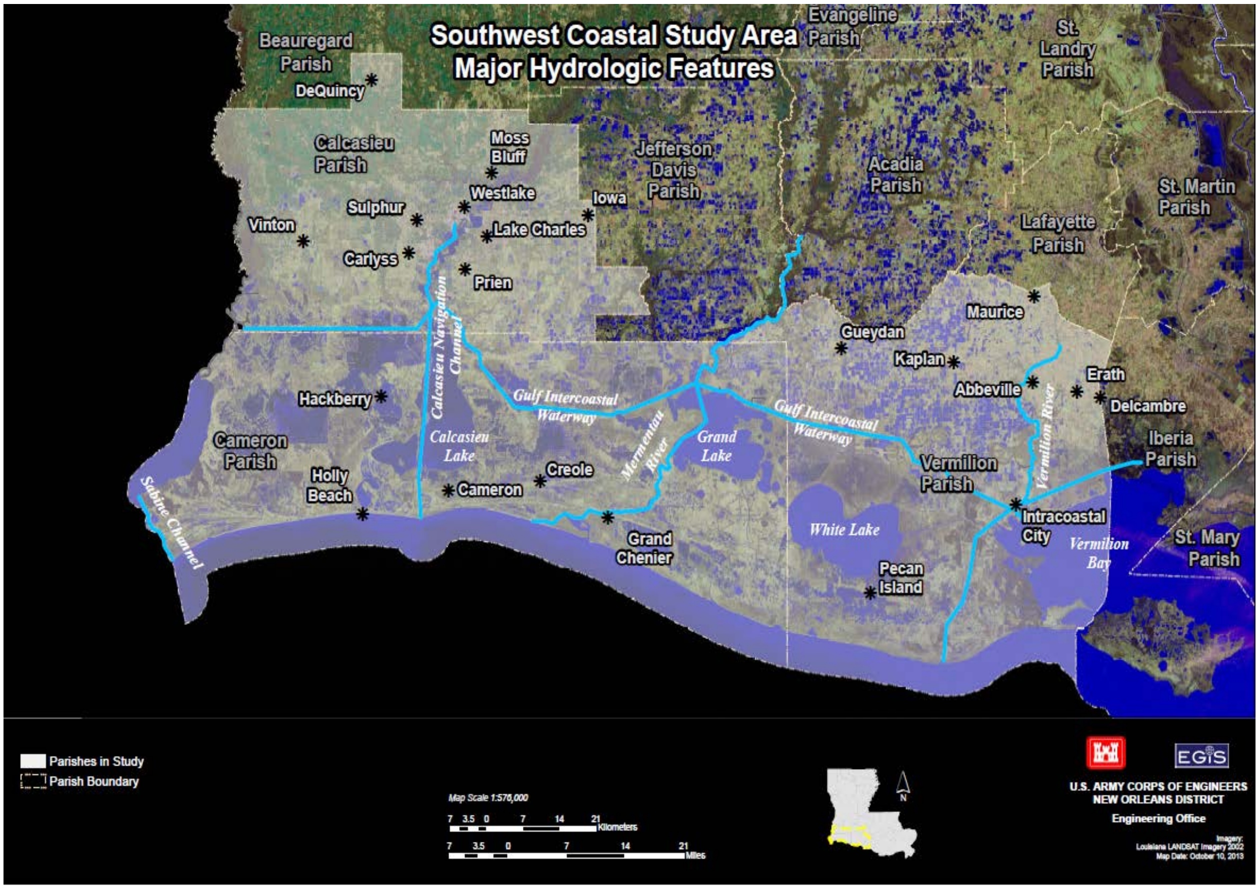

Figure 1. Southwest Coastal Study Area

Introduction to Adaptive Management and Monitoring

Adaptive Management and Monitoring (AM&M) provides a directed iterative approach to achieving restoration project goals and objectives by focusing on strategies promoting flexible decision making that can be adjusted in the face of uncertainties as outcomes from restoration management actions and other events become better understood. Initiating a formal AM&M process early in the study process enables the Project Delivery Team (PDT) to identify and resolve key uncertainties and other potential issues that can positively or negatively influence project outcomes during every stage of the planning and project implementation process. Hence, early implementation of AM and monitoring will result in a project that can better succeed under a wide range of uncertain conditions and can be adjusted as necessary. Furthermore, careful monitoring of project outcomes both advances scientific understanding and helps adjust policies and/or operations as part of an iterative learning process (National Research Council 2004).

Learning from the management experience is certainly not a new idea; but the purposeful and systematic pursuit of knowledge to address identified uncertainties has rarely been practiced.

Adaptive management acknowledges the uncertainty about how ecological systems function and how they may respond to management actions. Nevertheless, AM is not a random trial-and-error process; it is not ad-hoc or simply reactionary. An essential element of AM is the development and execution of a monitoring and assessment program to analyze and understand responses of the system to implementation of the project as restoration progresses. The AM&M Program for the Southwest Coastal Project Ecosystem Restoration/NER components was developed and will be used to:

- Allow scientists and managers to collaboratively design plans for managing complex and incompletely understood ecological systems
- Reduce uncertainty over time
    - Acknowledgement, identification, and characterization of risks and uncertainties
    - Uncertainty can be analyzed and exploited to identify key gaps in information and understanding
- Implement systematic monitoring of outcomes and impacts
    - Scientific information obtained through continued monitoring is used to evaluate and manage uncertainties to achieve desired goals and objectives
    - Explicitly stated goals and measurable indicators of progress toward those goals
    - Demonstrate to others that the project is meeting or exceeding performance goals;"ecological success"
    - Detect detrimental system responses as early as possible in order to minimize the adverse effects of these responses
    - Evaluate hypotheses and performance measures and revise conceptual ecological models as appropriate
- Incorporate an iterative approach to decision-making
    - The monitoring data is used to influence future management decisions
    - Feedback loops are developed so that monitoring and assessment produce continuous and systematic learning that in turn is incorporated into subsequent decision-making
    - Projects and programs can be implemented in phases to allow for course corrections based on new information to allow for management flexibility
- Provide a basis for identifying options for improvements in the design, construction and operation of Southwest Coastal Restoration through AM
- Develop reports on the status and progress of the Southwest Coastal Restoration for the agencies involved, the public, Congress, and stakeholders
- Enhance predictive capability through improvements in simulation models before and after project construction
- Provide information to summarize and develop lessons learned to optimize restoration strategies in the future; "lessons learned"
- Ensure interagency collaboration and productive stakeholder participation as they are key elements to success. AM encourages defining agency objectives for stakeholder involvement, deciding upon a strategy for stakeholder involvement, clearly communicating this to the public, and maintaining long-term collaboration among stakeholders. Continued communication with key stakeholders helps identify and reduce socio-economic uncertainties, measure project progress towards objectives, and adaptively manage projects (Knight *et al*., 2008, Smith *et al*., 2009, Nkhata and Breen 2010)

Adaptive Management and Monitoring Process

The developed AM&M program and process is complimentary to the USACE Project Life Cycle (planning, design, construction and operation and maintenance). The AM&M process is not elaborate or duplicative and enhances activities that already take place. The basic process of AM&M for USACE projects (Figure 2) was adapted from the DRAFT USACE Adaptive Management Technical Guide (USACE 2011) and includes:

- **Planning** a program or project;
- **Designing** the corresponding project;
- **Building** the project (construction and implementation);
- **Operating** and maintaining the project; and
- **Monitoring** and **assessing** the project performance;
- **Continue** project implementation as originally designed; or
- **Adjust** the project if goals and objectives are not being achieved
- **Complete** project if goals and objectives and **success** criteria are achieved, or it is determined the project has **success**fully produced the desired outcomes
- Project **Termination** is possible if project goals and objectives are not being achieved and the decision is made not to adjust the project or no adjustments are possible

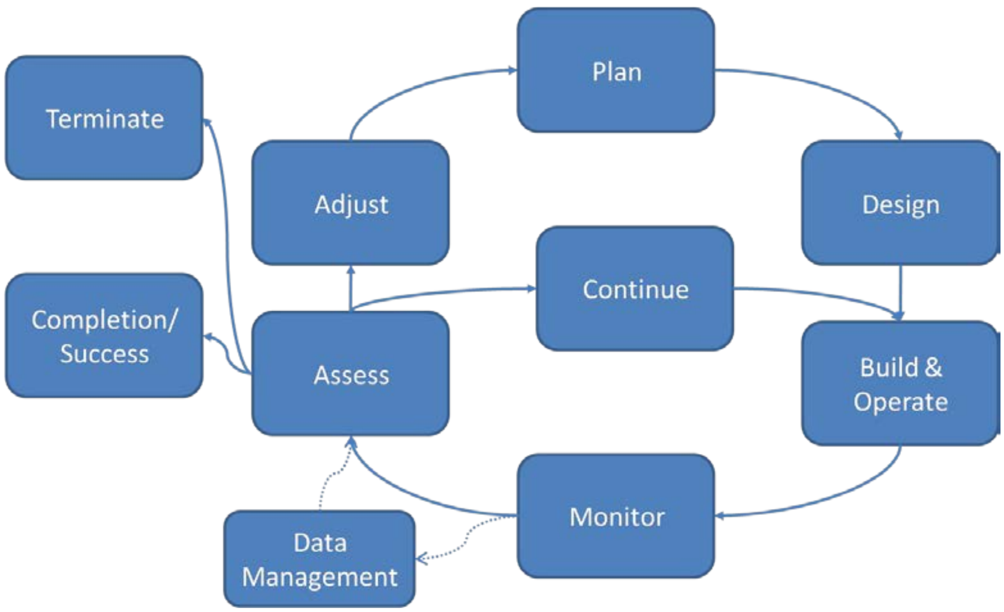

Figure 2. Adaptive Management Monitoring and process for the USACE Civil Works

1.2 Authorization and Implementation Guidance

The WRDA of 2007, Section 2039 of the Water Resources Development Act (WRDA) of 2007 and Implementation guidance for Section 2039, in the form of a CECW-PB Memo dated 31 August 2009; require ecosystem restoration projects to develop a plan for monitoring the success of the ecosystem restoration and to develop an AM Plan (contingency plan).

The Monitoring Plan

- The plan must specify nature, duration, and periodicity of monitoring, disposition of monitoring and analysis, costs, and responsibilities.
- Scope and duration should include the minimum monitoring actions necessary to evaluate success.
- Monitoring plan will be reviewed during Agency Technical Review (ATR) and Independent External Peer Review (IEPR) as necessary.
- Monitoring will be continued until "restoration success" is documented by the USACE District Engineer in consultation with federal and state resource agencies and determined by USACE Mississippi Valley Division Commander.
- Success is determined by an evaluation of predicted outcomes compared to actual results.
- Financial and implementation responsibilities for monitoring will be included in the Project Partnership Agreement (PPA).
- Cost-shared (under Construction) component not to exceed 10 years. Cost shared monitoring costs must be included as part of the project cost and cannot increase the Federal cost beyond the authorized dollar limit. Monitoring can end sooner if success is determined.
- Post Construction monitoring that may be needed beyond 10 years is a 100% non-Federal responsibility.

Adaptive Management/Contingency Plan

- Adaptive management plan must be appropriately scoped to project scale.
- The rationale and cost of AM and anticipated adjustments will be reviewed as part of the decision document.
- Identified physical modifications will be cost-shared and must be agreed upon by the sponsor.
- Changes to the AM plan approved in the decision document must be coordinated with USACE Headquarters (HQUSACE).
- Significant changes needed to achieve ecological success that can't be addressed through operational changes or the AM plan may be examined under other authorities.
- Costly AM plans may lead to re-evaluation of the project.

The importance of Adaptive Management was reinforced with the release of the Civil Works *Strategic Plan 2011-2015: Sustainable Solutions to America's Water Resources Needs* which identified Adaptive Management as a strategy to support the USACE moving towards Integrated Water Resources Management.

1.3 Adaptive Management and Monitoring Program Structure

The U.S. Army Corps of Engineers (USACE), New Orleans District (MVN), Wilmington District (SAW), Louisiana Coastal Protection and Restoration Authority (CPRA), and the US. Geological Survey (USGS) collaborated to establish a general framework for adaptive management to be applied to all USACE Regional Planning Division South (RPDS) restoration projects. The framework for AM&M is consistent with the previously mentioned authority, implementation guidance, and is consistent with and supports the guidance provided by:

- DRAFT U.S. Army Corps of Engineers: A Systems Approach to Adaptive Management USACE Technical Guide (USACE 2011)
- Technical Note: "The Application of Adaptive Management to Ecosystem Restoration Projects" (Fischenich et al., 2012, ERDC TN-EMRRP-EBA-10)

- U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration's (NOAA) "Availability of a Final Addendum to the Handbook for Habitat Conservation Planning and Incidental Take Permitting Process" (Federal Register vol. 65, No. 106 35242)
- Planning Guidance Notebook (Engineering Regulation [ER] 1105-2-100) (USACE 2000)
- Planning Manual (Institute for Water Resources [IWR] Report 96-R-21; (Yoe and Orth 1996), Civil Works Ecosystem Restoration Policy (ER 1165-2-501)
- Ecosystem Restoration – Supporting Policy Information (EP 1165-2-502).

Please note that a Standard Operating Procedure (SOP) providing guidance for integration of Adaptive Management and Monitoring into Ecosystem Restoration and Mitigation Projects is being developed for the USACE Regional Planning & Environmental Division, South and will be incorporated in further versions of this AM&M plan once approved.

Adaptive Management and Monitoring Framework

The AM&M Framework includes both a Set-up Phase (Figure 2) and an Implementation Phase (Figure 3). The Set-up Phase proceeds concurrently with the USACE's traditional six-step planning process. While planners are identifying problems and opportunities, inventorying and forecasting resource conditions, evaluating and comparing alternative formulations, and selecting a recommended plan, the AM&M Plan for the project will be developed concurrently. In addition to the items developed during the planning process a conceptual ecological model (CEM) will be developed, uncertainties will be identified; and performance measures, targets, and decision criteria (triggers and thresholds) will be developed. See subsequent Sections of the AM&M plan for the CEM and performance measures developed thus far.

The implementation phase of the AM&M Framework subsequently puts the developed AM&M Plan into action. Projects will be designed, constructed, monitored and assessed to understand responses of the system to implementation of the project relative to stated targets, goals, objectives and success project criteria. Leadership will then decide whether to alter the project and implement AM actions to improve plan performance based on assessment results. Potential AM actions for the project are identified in Section 6.

Baseline monitoring will begin during PED prior to project construction and be conducted during construction when possible. Although not typical there may be some need for AM actions during construction. Unexpected detrimental events may alter the project site, requiring consideration of corrective measures. For example, a tropical event impacting a project site or invasion of an exotic species may necessitate management actions. A decision will be required on how to address the change in conditions. In addition, since it is expected that construction/implementation will be phased over a long period of time, there is greater potential for changing conditions due to construction methods, deviations from selected methods, or development of new information. It will need to be determined if these need to be corrected, whether they are acceptable, or whether they enhance the site. Using an AM strategy in this situation may increase the chances of overall project success. Design changes during construction may require changes to the AM&M Plan.

Post Construction, the project will enter the iterative cycle of AM where the project will be monitored. The results of the monitoring program will be used to assess system responses to management, evaluate overall project performance, and assemble Assessment Reports and project Report Cards as outlined in the AM&M Plans (Sections 5 & 6). These monitoring results and reports will guide decision making. The projects' Operation and Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) manuals should clearly communicate the AM&M Plans and process including: monitoring parameters, frequency and duration of monitoring and assessment, decision criteria, and options for adjustment to increase project success.

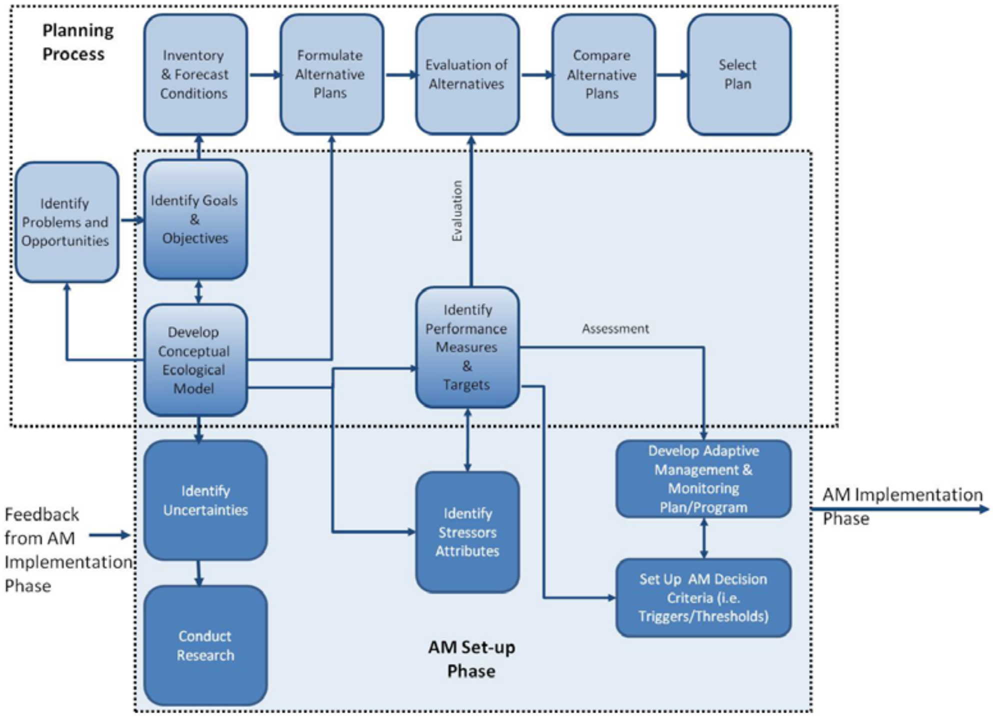

Figure 3. Set-up Phase of Adaptive Management and Monitoring Program Framework.

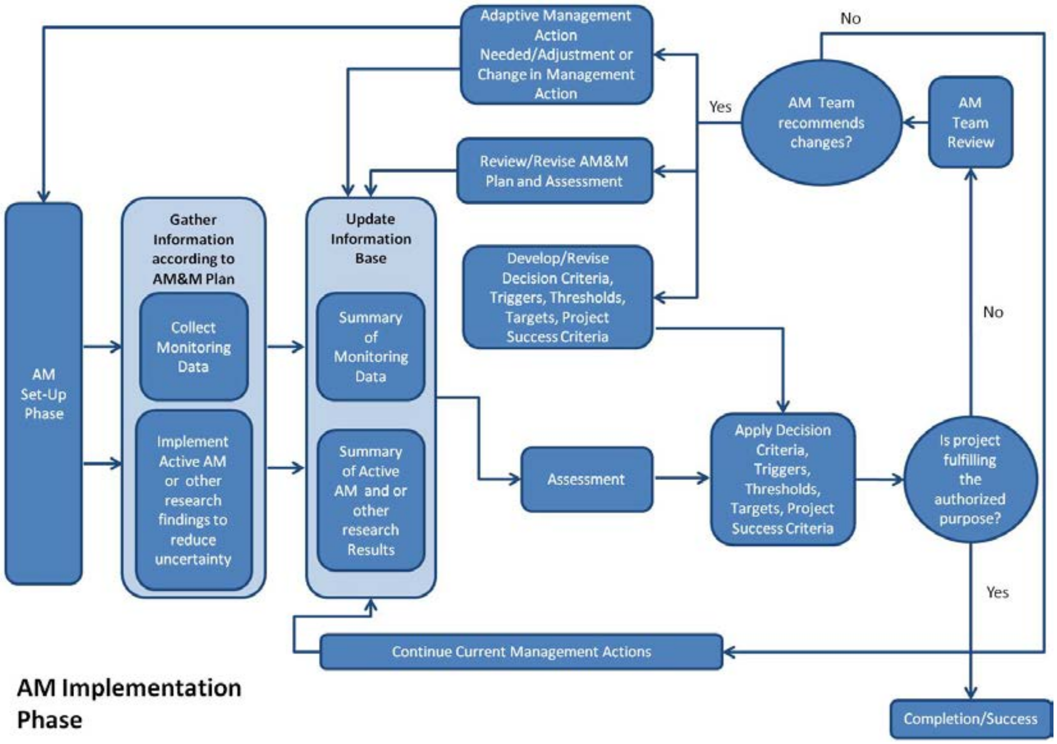

Figure 4. Implementation Phase of Adaptive Management and Monitoring Program Framework.

1.4 Communication Structure for Implementation of Adaptive Management

An implementation structure has been identified (Figure 4) to execute AM&M for USACE Regional Planning Division South (RPEDS) Ecosystem Restoration projects. The structure establishes lines of communication that facilitates coordination between Program Management, the PDT, the Adaptive Management and Monitoring Planning Team, the USACE Science Advisor, and stakeholders. Please note that a detailed governance structure and decision making process for RPEDS AM&M is being developed. This information once approved will be included in subsequent revisions to this AM&M plan.

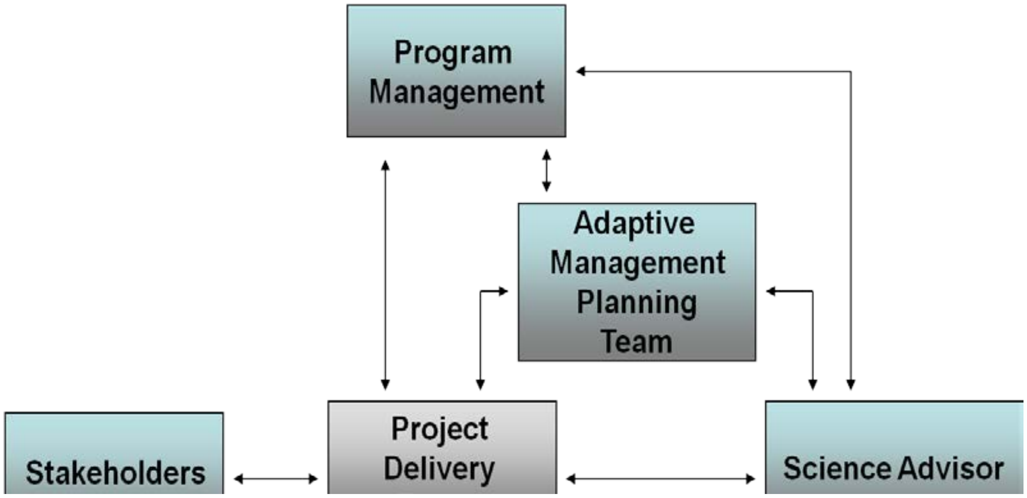

Figure 5. Communication Structure for Implementation of Adaptive Management and Monitoring

Adaptive Management and Monitoring Team- An interagency Adaptive Management and Monitoring Team (AM&M Team) will be established as part of the implementation structure (Figure 4). The AM&M Team, in collaboration with the PDT, will lead all project and program efforts to determine AM and monitoring recommendations. The AM&M Team is responsible for ensuring that monitoring data and assessments are properly used in the AM decision-making process. If the AM&M Team determines specific AM actions are needed, the AM&M Team will coordinate a path forward with the PDT, USACE Science Advisor and Program Management Team. The AM&M Team will also facilitate coordination between restoration projects and coordination among PDTs, and Program Management.

Program Management Team- The Program Management Team is composed of the Executive Director of the non-federal sponsor and the District Commander of USACE-MVN. The Program Management Team will vet program and project level issues, consider recommendations for AM actions, make final decisions on whether AM actions are required, and implement recommended final management actions.

Science Advisor- The purpose of the USACE Science Advisor will be to effectively address system-wide coastal ecosystem restoration needs and to provide a strategy, organizational structure, and process to facilitate integration of science and technology into the system-wide planning and the AM process.

Project Delivery Team- It is not necessary that the PDT, Project Managers, Plan Formulators, Environmental Planners or Engineers to become AM&M experts. However, they need a general understanding of AM&M principles as they are key players in the integration of AM into planning and project development and implementation. The PDT is responsible for the development of the AM&M Plans in coordination with the AM&M Team. The PDT is also responsible for integrating Project-level AM&M activities into Project Management Plans, SMART Planning project documents, Feasibility Reports, NEPA and permit documents, Project Operating Manuals, and other project-related documentation.

To accomplish these tasks, the PDT will:

- lead the discovery of uncertainties;
- lead the engagement of stakeholders;
- consult with Program Management and the AM&M team;
- develop and execute strategies for resolving uncertainties; and
- develop, review, and update the AM&M Plan as necessary.

The PDT will likely be re-established during the project implementation phase to further refine monitoring, assessment and AM decisions; identify new uncertainties; re-evaluate and re-formulate and implement, as necessary, specific or overall project performance and management measures and features.

Stakeholders- Engagement with stakeholders throughout a project's planning and implementation phases is critical to developing and maintaining common understandings of the goals and objectives, expectations of results, and potential commitment of resources. All phases of the AM&M process must be open, transparent and accessible to stakeholders. Such interaction fosters the mutual understanding of events and appreciation of the time and patience required to fully realize the benefits of restoration projects and to manage unrealized expectations. A strong effort must be made to identify and engage all appropriate stakeholders. PDTs should continually seek to identify governmental and non-governmental organizations, groups and other interested parties who could affect, be affected by, and/or be able to contribute knowledge, data, and/or resources to project-related activities (e.g., planning, design, implementation, and monitoring).

2. ADAPTIVE MANAGEMENT AND MONITORING PLANNING

A small team with members from the USACE and the US Geological Survey (USGS) developed the preliminary draft AM&M plan for the project for review by the interagency PDT. The level of detail in this plan is based on currently available project data and information developed during plan formulation as part of the feasibility study. Uncertainties remain concerning the exact project features, monitoring elements, and adaptive management opportunities. As uncertainties are addressed in the latter stages of the feasibility study, the AM&M Team will be formed and a detailed AM&M plan, including detailed cost estimates, monitoring protocols, AM triggers and thresholds and AM actions will be developed.

2.1 Conceptual Ecological Model for Monitoring and Adaptive Management

As part of the AM and project planning process, a conceptual ecological model (CEM; Appendix A; Annex L; Attachment 1) was developed to help explain the general functional relationships among the essential components of the Southwest Coastal Louisiana area. The Director of Civil Works 13 August 2008 Memorandum "Policy Guidance on Certification of Ecosystem Output

Models" adopted recommendations from the Ecosystem Planning Center of Expertise (ECO-PCX) regarding the importance, use and review of conceptual models in ecosystem planning. CEMs are a means of:

(1) simplifying complex ecological relationships by organizing information and clearly depicting system components and interactions;
(2) integrating to more comprehensively implicit ecosystem dynamics;

(3) Aids in identifying which species will show ecosystem response;
(4) interpreting and tracking changes in restoration/management targets; and
(5) communicating these findings in multiple formats.

This CEM assists with identifying those aspects where the project can effect change. Specifically, the CEM identifies those major stressors, ecosystem drivers, and critical thresholds of ecological processes and attributes of the natural system likely to respond to restoration features. This project CEM was used to help identify problems, opportunities, and help refine project objectives and restoration management actions as well as selecting those attributes to be used as performance measures, modeling for alternative analysis, and monitoring for project success. The project CEM represents the current understanding of these factors and will be updated and modified, as necessary, as new information becomes available to assist with developing AM and monitoring during project planning and implementation.

Factors identified for the Southwest Coastal project area are listed below and further detailed in Appendix A, Annex L, Attachment 1.

Drivers

D1: Relative Sea Level Rise (Sea Level Rise and Subsidence)
D2: Numerous *Hurricanes and Storms*
D3: Hydrologic Alteration
D4: Sediment Supply to the Chenier Plain
D5: Mineral and Sediment Extraction

Ecological Stressors

ES1: Increased Flood Duration
ES2: Storm Surge
ES3: Saltwater/Salinity
ES4: Shoreline Erosion
ES5: Marsh fragmentation.
ES6: Increased Tidal Prism or Amplitude.
ES7: Altered Circulation

Ecological Effects

EE1 Wetland Loss
EE2 Decreased Primary Productivity
EE3 Habitat Conversion and Changes in Biological Community Composition
EE4 Loss of Ridges and Cheniers

Attributes and Performance Measures

A1 Land Cover/ Land Change
Performance Measures: Relative Change in Land Cover
A2 Vegetation Distribution and Diversity
Performance Measures: Community Composition and Relative Abundance
A3 Elevation
Performance Measures: Surface Elevation and Vertical Sediment Accretion

2.2 Project Goals, Objectives and Constraints

The study goals, objectives, and constraints were developed to comply with the study authority and to respond to the problems and opportunities for the Southwest Coastal Study Area. In consultation with the non-Federal sponsor and other interested parties, goals and objectives were developed during steps one and two of the planning process. These goals, objectives and constraints, and the CEM were used during the AM&M planning process to develop the performance measures and risk endpoints for the project. See Section 3.1.

Overarching Project Goal: To reduce storm surge flooding and coastal storm damages to provide sustainable ecosystem restoration.

Planning Objectives:

- NED Objective 1. Reduce the risk of damages and losses from hurricane and storm surge flooding.
  Metric: reduction in annual damage costs.
  Data required: average annual expenditures on repairs due to storms and storm surges.
  Data collection: inputs for HEC-FDA, HEC-RAS, state master plan, and ADCIRC.

Please note that Objective 1 is not addressed by the NER components and is not addressed within this AM&M plan.

- NER Objective 2. Manage tidal flows to improve drainage and prevent salinity from exceeding 2 ppt for fresh marsh and 6 ppt for intermediate marsh.

- NER Objective 3. Increase wetland productivity in fresh and intermediate marshes to maintain function by reducing the time water levels exceed marsh surfaces.

- NER Objective 4. Reduce shoreline erosion and stabilize canal banks to protect adjacent wetlands.

- NER Objective 5. Restore landscapes, including marsh, shoreline, and cheniers to maintain their function as wildlife habitat and improve their ability to serve as protective barriers.

Planning Constraints

The NED and NER plans are limited by the following constraints that are to be avoided or minimized:

- Commercial navigation. The Calcasieu and Sabine Ship Channels and the Gulf Intracoastal Waterway (GIWW) carry significant commercial navigation traffic. Measures that would cause shipping delays would result in negative NED impacts. In addition, the ability of authorized navigation projects to fulfill their purpose, such as the operation of locks along the GIWW, may be impacted by project features.
- Federally threatened and endangered species and their critical habitats. Construction schedules may be restricted due to threatened and endangered species such as Piping Plover, Gulf Sturgeon, Red-Cockaded Woodpecker, Red Knot, Whooping Crane, West Indian Manatee, and several species of sea turtles.
- Essential fish habitat (EFH), especially intertidal wetlands. Conversion of one EFH type to another should be done without adversely impacting various fish species.
- Historic and cultural resources. Ninety-nine archeological sites have been identified within a one-mile buffer of NED and NER alternatives, including one historic site (“Arcade Theater”)

listed on the National Register of Historic Places (NRHP) and six potentially eligible prehistoric sites. Twelve historic properties listed on the NRHP have been identified within the one-mile buffer, including the Charpentier (Lake Charles) Historic District, as well as four eligible standing structures. Hundreds of standing structures in the area have a minimum age of 50 years and have not been assessed for eligibility

2.3 Management and Restoration Actions —Tentatively Selected Plan

The PDT performed a thorough plan formulation process to identify and restoration and management actions that best meet project goals and objectives. For more information on the plan formulation process see Chapter 2 of the Feasibility Report. For more information on the NER Tentatively Selected Plan (TSP) see Chapter 4 of the Feasibility Report.
The NER TSP is Alternative C4 M4 including the following:

- Nine marsh features to restore 8,579 acres and nourish 4,026 acres, resulting in net acres of 8,714.
- Two hydrologic and salinity control measures create 6,092 net acres.
- Five shoreline protection measures span 266,884 linear feet and resulting in 5,509 net acres.
- Preservation of the historic Sabine oyster reef located near Sabine Pass.
- Chenier reforestation program on 1,413 acres in Cameron and Vermilion parishes.

2.4 Sources of Uncertainty and Associated Risks

A fundamental tenet underlying AM is decision making and achieving desired project outcomes in the face of uncertainties. The AM&M Program provides a framework for identifying, analyzing and managing the uncertainties for the Southwest Coastal Restoration Project. Scientific uncertainties and technological challenges are inherent with any large-scale restoration project with the principal sources of uncertainty typically including (1) incomplete description and understanding of relevant ecosystem structure and function, (2) imprecise relationships between project management actions and corresponding outcomes, (3) engineering challenges in implementing project alternatives, and (4) ambiguous management and decision-making processes. It is important to determine the type of risk each uncertainty comprises and to discern what constitutes sufficient knowledge to proceed considering those risks.

Identified uncertainties associated with the Southwest Coastal Restoration Project include:

- Relative sea level rise (subsidence plus eustatic variability)
- Climate change, such as drought conditions and variability of tropical storm frequency, intensity, and timing
- Inherent natural variability in ecological and physical processes
- Subsidence, accretion salinity, and water level trends:
    - Subsidence rates (+/-) throughout the project life
    - Accretion rates (+/-) throughout the project life
    - Water level trends (+/-) throughout the project life
    - Variable salinities that impact vegetation
- Wetland water, sediment, and nutrient requirements:
    - Magnitude and duration of inundation
    - Annual sediment requirements
    - Nutrients required for desired productivity
- Impacts to belowground and aboveground biomass due to changes in hydro period and duration

- Ability to infer operational changes based on data collected, especially from variable metrics such as aboveground and belowground biomass measurements
- Socio-economic and cultural
    - Changes to commercial activity
    - Effect on recreational activities
    - Potential impacts to historic and cultural resources
    - Ramifications to traditional activities, especially for indigenous and minority groups
    - Changes to community structure and integrity
- Project feature implementation order and schedule

Issues such as climate change, sea level rise, and regional subsidence are significant scientific uncertainties for all coastal Louisiana projects. These uncertainties were incorporated in the plan formulation process and will be monitored by gathering data on water levels, salinities, and land elevation. Specifically, for relative sea level rise (RSLR) USACE EC-1165-2-21 provides an 18-step process for developing a “low”, “intermediate” and “high” future relative sea level rise scenario and provides guidance to incorporate these potential effects into project management, planning, engineering, design, construction, operation and maintenance. The PDT evaluated the final array of alternatives under three potential future RSLR scenarios in accordance with EC-1165 (See Feasibility Study Engineering Appendix B). This information will be assessed and will inform AM actions (see Section 6).

2.5 Rationale for Adaptive Management/ Uncertainty and Risk Management

The primary reason for implementing AM&M is to increase the likelihood of achieving desired project outcomes given the uncertainties identified in Section 2.4. Adaptive management works best when it is tailored to the specific problem(s), designed to ensure accountability and enforceability, used to promote useful learning, and supported by sufficient funding (Doremus *et al*., 2011). Although all restoration projects are required to consider AM, there may be some projects or increments of project for which AM may not be applicable. AM is warranted when there are consequential decisions to be made, when there is an opportunity to apply learning, when the objectives of management are clear, when the value of reducing uncertainty is high, and when a monitoring system can be put in place to reduce uncertainty (Williams *et al*., 2007). Adaptive management should not be used where or when mistakes may be irreversible, when learning is unlikely on the relevant time scale, or where no opportunity exists to revise or reevaluate decisions (Doremus *et al*., 2011).

Several questions were considered to determine if AM should be applied to the project, given identified uncertainties:

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 readily identified?
3) Are the measures of this restoration project performance well understood and agreed upon by all parties?
4) Can project management actions be adjusted in relation to monitoring results?

A 'NO' answer to questions 1-3 and a "YES" answer to question 4 qualifies the project as a candidate that could benefit from AM. The AM&M Team and the PDT determined that the Southwest Coastal Restoration Project meets these qualifications, and, therefore, is a candidate for AM.

3. MONITORING

Independent of AM, an effective monitoring program is required to determine if project outcomes are consistent with original restoration goals and objectives. The strength of a monitoring program developed to support AM lies in the establishment of feedback between continued project monitoring and corresponding project management. The CECW-PB Memo dated 31 August 2009, requires monitoring that: *"…includes the systemic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether Adaptive Management may be needed to attain project benefits."*

Pre-construction/baseline date, during construction, and post-construction monitoring will be utilized to determine restoration success. Monitoring will continue until the trajectory of ecological change and/or other measures of project success are determined as defined by project-specific objectives. Section 2039 of the WRDA 2007 allows ecological success monitoring to be cost-shared for up to ten years post-construction. Once ecological success has been achieved, which may occur in less than ten years post-construction, no further monitoring would be performed. If ecological success cannot be determined within the ten-year post construction period of monitoring, any additional required monitoring will be a non-Federal responsibility.

Monitoring activities will utilize all existing data where possible and available, such as remotely sensed data, where necessary to assess changes resulting from restoration. When possible, project monitoring and information needs will be integrated with existing monitoring efforts that are underway in coastal Louisiana. For example, the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) program has been monitoring restoration and coastal wetland protection projects in coastal Louisiana since 1990 (Steyer and Stewart 1992, Steyer et al., 1995). The CWPPRA monitoring program incorporates a system-level wetland assessment component called the CRMS (Wetlands, Steyer et al., 2003). CRMS-Wetlands provides system-wide performance measures that are evaluated to help determine the cumulative effects of restoration and protection projects throughout much of coastal Louisiana. Consequently, the project Monitoring Plan incorporates existing monitoring networks to the extent practicable. Such participation can maintain the data consistencies necessary to conduct not only individual restoration project but also coast wide programmatic AM&M. Additional data will be collected as part of Southwest Coastal (1) if required, or (2) only if scientifically defensible to achieve a complete dataset in which to compare post-restoration success.

3.1 Monitoring Plan Elements

Defining and assessing progress towards meeting project objectives are crucial components of the AM&M program. Table 1 outlines the proposed performance measure metrics, desired outcomes and monitoring design needed to measure restoration progress, determine ecological success and support the AM program should changes need to be made to improve project performance. The draft elements described in this section are based on the available project information and will be updated and refined further during the detailed feasibility level of design phase.

Table 1. Proposed NER Performance Measures, Desired Outcomes and Monitoring Design

Objective 1. Reduce the risk of damages and losses from hurricane and storm surge flooding.	
Objective 1 is related to the NED project component and will not be monitored or adaptively managed and thus is not incorporated into this MAM plan design.	
***Objective 2.* Manage tidal flows to improve drainage and prevent salinity from exceeding 2 ppt for fresh marsh and 6 ppt for intermediate marsh.**	
Performance Measure:	Tidal Flows
Desired Outcome:	To improve circulation patterns that facilitate water drainage and reduce intrusion of high salinity events in Cameron Creole Watershed and lower Mermentau Basin
Monitoring Design:	Synoptic hydrologic surveys, using salinity, temperature, dissolved oxygen, and velocity as tracers, will be conducted to track distribution of water. Sampling will be conducted every two months for two years pre-project and two years post-project or until desired outcomes are achieved. Continuous water surface elevation, current velocity, salinity and turbidity will be monitored at six locations within the Cameron Creole Watershed and three locations in the lower Mermentau River. Existing USGS and LDWF monitoring locations will be utilized, as appropriate
Performance Measure:	Salinity
Desired Outcome:	To minimize salinity conditions that stress fresh and intermediate marsh communities in Cameron Creole Watershed and lower Mermentau Basin (hypothesize growing season average less than 2ppt in fresh and 6ppt in intermediate marsh)
Monitoring Design:	Hourly salinity recorders will be deployed in the six hydrological sites in the Cameron-Creole Watershed and three hydrologic sites in the lower Mermentau River and correlated to the soils and vegetation data that will also be collected. The sites will be sampled for a period of 2 years pre-project and for a period of 10 years post-project construction or until desired outcomes are achieved. Hourly salinity measured at existing CRMS stations (fresh and intermediate marsh) throughout the Cameron Creole Watershed and Mermentau Basin will be utilized, as appropriate.
***Objective 3.* Increase wetland productivity in fresh and intermediate marshes to maintain function by reducing the time water levels exceed marsh surfaces.**	
Performance Measure:	Hydroperiod
Desired Outcome:	To reduce depth, duration and frequency of marsh flooding that stress fresh and intermediate marsh communities (hypothesize less than 60% between March 1and September 30) in Cameron Creole Watershed and lower Mermentau Basin
Monitoring Design:	Continuous water-level recorders surveyed to marsh elevation (in NAVD88) will be deployed at all biomass sites to measure hydrologic conditions. Recorders will be established 2 years prior to construction to determine existing conditions and will be monitored for 10 years post-construction or until desired outcomes

	are achieved. Hydroperiod measured at existing CRMS stations (fresh and intermediate marsh) throughout the Cameron Creole Watershed and Mermentau Basin will be utilized, as appropriate.
Performance Measure:	Aboveground biomass
Desired Outcome:	Increase aboveground biomass by 20% in Cameron Creole Watershed and lower Mermentau Basin
Monitoring Design:	Aboveground biomass will be sampled quarterly at 10 vegetation sites (5 in fresh marsh and 5 in intermediate marsh) within the Cameron Creole Watershed and within the Mermentau Basin in proximity to water control structure locations. Permanent vegetation monitoring stations will be established for assessing project area vegetation community and aboveground biomass changes due to salinity and inundation control. These stations will be sampled for community composition and aboveground biomass for a two year period to assess pre-project conditions and sampled during two 2-year periods during the 10-year post-project period. Biomass stations will be co-located at existing CRMS stations if appropriate.
Performance Measure:	Belowground biomass
Desired Outcome:	Increase belowground biomass by 20% in Cameron Creole Watershed and lower Mermentau Basin
Monitoring Design:	Belowground biomass will be sampled quarterly at 10 vegetation sites (5 in fresh marsh and 5 in intermediate marsh) within the Calcasieu/Sabine Basin in proximity to SW Coastal water control structure locations. Permanent vegetation monitoring stations will be established for assessing project area vegetation community and aboveground biomass changes due to salinity and inundation control. These stations will be sampled for community composition and belowground biomass for a two year period to assess pre-project conditions and sampled during two 2-year periods during the 10-year post-project period. Biomass stations will be co-located at existing CRMS stations if appropriate.
Performance Measures:	Elevation, Accretion, Subsidence
Desired Outcome:	Maintain elevation sufficient for marsh establishment
Monitoring Design:	One rod-surface elevation table (SET) and replicate feldspar stations will be established at all biomass sites and sampled semi-annually for a period of 2 years pre-project and for a period of 10 years post-project or until desired outcomes are achieved. Elevation, accretion and subsidence measured at existing CRMS stations (fresh and intermediate marsh) throughout the Cameron Creole Watershed and Mermentau Basin will be utilized, as appropriate.
***Objective 4.* Reduce shoreline erosion and stabilize canal banks to protect adjacent wetlands.**	
Performance Measure:	Shoreline Change
Desired Outcome:	Reduction in shoreline erosion rate below the historic average (1998-2012).
Monitoring Design:	Historic erosion rates will be established from historic aerial photography. Photography and DGPS surveys will be used to determine erosion rates post construction. Shoreline surveys will be conducted in areas with project features and surrounding and reference areas. One pre-construction and four post-construction acquisitions will be obtained.
***Objective 5.* Restore landscapes, including marsh, shoreline, and cheniers to maintain their**	

function as wildlife habitat and improve their ability to serve as protective barriers.	
Performance Measure:	Land Acreage/Habitat and land:water classification
Desired Outcome:	Increase acreage of marsh and shoreline habitats by an average of 10,000 acres per basin (Calcasieu/Sabine, Mermentau, Teche-Vermillion)
Monitoring Design:	Land:water acreage will be classified using Landsat TM scenes collected in 3 pre- and 10 post-project years and vegetated habitats will be classified using digital orthophoto imagery for 1 pre- and 2 post-project years, as well as any available field data in the study area to assess land:water trends and habitat distribution.
Performance Measure:	Chenier Tree Coverage
Desired Outcome:	Increase in chenier tree canopy and understory coverage by 30%.
Monitoring Design:	Diameter at breast height (dbh) and overstory tree cover will be measured two pre-construction years and four post-construction years (within the first 10 years). Understory vegetation (herbaceous, seedling, and sapling) will be measured two pre-construction and four post-construction years (within the first 10 years) to assess regeneration and changes in cover classes.
Desired Outcome:	Survival and increase in diameter of chenier plantings in project area. Planted cypress and tupelo seedlings will have a 70 percent survival rate in target years (TY) 1, 3, and 5, post-construction.
Monitoring Design:	A sample of seedlings will be counted and measured in TY 1 post-construction and at TY 3 and 5 to access percent survival.
Performance Measure:	Oyster Reef Extent
Desired Outcome:	Maintain current oyster reef extent
Monitoring Design:	Existing oyster reefs (width and length) will be surveyed concurrent with DGPS shoreline surveys. One pre-construction and four post-construction acquisitions will be obtained.

4. ASSESSMENT

The assessment phase of the implementation framework (Figure 3) compares the results of the monitoring efforts to the desired project performance measures and/or acceptable risk endpoints (i.e., decision criteria) that reflect the goals and objectives of the management or restoration action.

This assessment process will regularly measure the progress of the project in relation to the stated project objectives, performance measures and desired outcomes. Thorough and complete assessments are critical to the AM&M Program. The assessments will continue through the life of the project or until it is has been determined that the project has successfully achieved (or cannot achieve) its goals and objectives (Figure 2).

4.1 Assessment Process

During PED, the Assessment Team assigned will identify a combination of qualitative (i.e., professional judgment) and quantitative methods for comparing the values of the performance measures produced by monitoring with the selected values of these measures that define criteria for decision-making.

Appropriate statistical comparisons (e.g., hypothesis testing, ANOVA, multivariate methods, etc.) will be used to summarize monitoring data and compare these data with the stated metrics. These continued assessments will be documented as part of the project reporting and data management system.

The Assessment Team will collaborate with project managers and decision-makers to define magnitudes of difference (e.g., statistical differences, significance levels) between the values of monitored performance measures and the desired values that will constitute variances. Meaningful comparisons between monitoring results and desired performance will require characterization of historical and current spatial-temporal variability that define baseline conditions. Variances (or their absence) will be used to recommend AM actions, including (1) continuation of the project without modification, (2) modification of the project within original design specifications, (3) development of new alternatives, or (4) termination of operation of the Southwest Coastal project.

The CEM (Attachment 1) helps describe the linkages between stressors and performance measures and may be used to further define management actions based on the monitored results. The assessments will help determine if the observed responses are linked to the project; if the responses are undesirable (e.g., are moving away from restoration goals); or if the responses have met the specified success criteria. If performance measures are not responding as desired, for example because the stressor has not changed enough in the desired direction, then recommendations should be made for modifications to the project. If the stressor has changed as expected/desired and the performance measure has not, additional research may be necessary to understand why.

During the PED phase, the frequency of assessments for the Southwest Coastal will be determined by the relevant ecological scales of each performance measure. The project technical support staff will identify for each performance measure the appropriate timescale for assessment. An initial project assessment will be completed before construction. There will be post-construction project assessments as needed during the post-construction period; however the level of detail will depend on the timescale of expected responses, and frequency of data collection. At this time it is estimated that assessments will be, on average, every three years.

4.2 Documentation and Reporting

The Assessment Team will document each of the performed assessments and communicate the results of its deliberations to the managers and decision-makers designated for the Southwest Coastal Restoration Project. The Assessment Team will produce periodic reports that will measure progress towards project goals and objectives as characterized by the selected performance measures. The reporting of monitoring results and AM evaluations will be in the form of both Assessment Reports to include a high level of detail and science and management friendly summary Report Cards.

5. DATA MANAGEMENT

Data management is a vital component of the long-term monitoring plan and the overall adaptive management process. To maintain lasting value of the data collected, the data must be stored, organized, and archived in an efficient and intuitive structure, so that it may be used in the Assessment process (Section 4) to determine progress towards meeting project goals and be used to inform decision making and adaptive management actions (Section 6). Each distinct data type collected must comply with its specific data format, delivery, and metadata standard. These standards will be prescribed by the Data Management Team and managed by the AM&M Team. The detailed Data Management Plan will be developed during PED.

6. ADAPTIVE MANAGEMENT AND DECISION MAKING PROCESSES

Scientific, technological, socio-economic, engineering, and institutional uncertainties are challenges inherent with any large-scale ecosystem restoration project. A structured monitoring design for the Southwest Coastal Restoration Project will be implemented to provide the feedback necessary to inform decisions about future project adjustments. The project report card, drafted by the Assessment Team, will be used to evaluate project status and any potential adaptive management needs. The Assessment Team may submit recommendations for AM actions to the AM&M Team. The AM&M Team will investigate and further refine AM recommendations and present them to the Program Management Team. During project implementation and operation, it will be up to the District Commander and Non-Federal Sponsor to make a recommended AM action. If Project monitoring determines that a management trigger has been “activated” then there are three possible response pathways:

1. determine that more data is required and continue (or modify) monitoring;
2. identify and implement a remedial action; or
3. modify project goals and objectives (this option would *only* be considered as a last resort and upon careful consideration by and consensus of the Project Management Team).

Potential adaptive management actions that have been identified in discussions thus far are presented below. These potential AM actions will be further evaluated as project features are further designed and concepts refined for inclusion in the final AM&M plan. The specific triggers and thresholds have not yet been developed for implementing these potential AM opportunities.

- Adaptive Design of Marsh Creation
    - Monitoring results can then be used to inform subsequent marsh creation.
    - Marsh elevation targets can be revised based on amount of compaction and dewatering that occur in different marsh types/soil types/subsidence zones can be refined in out-years.
- Re-nourishment of marsh creation areas
- Additional vegetative plantings for marsh and or Chenier features may be needed.
- Modification of the operation of the water control structures to adjust the amount or timing of freshwater or nutrient inputs.
- Restoration or re-nourishment of the oyster reef
- Project planning was based on the intermediate RSLR scenario. Based on the October 2011 guidance below projects adjustments to high RSLR may fall under AM. Some potential options for AM actions based on RSLR increases include raising wetland elevation to account for an accelerated rate.

CECW Guidance Memorandum “Policy Guidance Request for Addressing Sustainability of Ecosystem Restoration Projects in Louisiana” (October 2011), indicates w*hile different levels of RSLR are evaluated during the course of a study to determine the robustness of the proposed solution, our current investment decisions are based on a discrete level of RSLR. Conceptually, if the rate of RSLR exceeds the rate used as the basis for the investment decision, then* *adaptive management measures above and beyond OMRR&R may be appropriate. This concept will have to be carefully vetted on a project by project basis so as to negate inappropriate transfers of cost from OMRR&R to adaptive management.*

7. LESSONS LEARNED

Collecting, identifying and documenting lessons learned is a goal of the AM&M program. The AM&M Planning Team will help develop and compile lessons learned, best practices and experiences concerning the implementation of the restoration program, technical and organizational challenges, and monitoring and adaptive management. Lessons and experiences will be clearly documented with recommendations where applicable so that they can be easily applied to future ecosystem restoration programs and projects. Documenting the lessons learned ultimately aims to reduce recurring, technical or programmatic issues that negatively impact cost, schedule, restoration project performance and success.

8. COSTS FOR IMPLEMENTATION OF ADAPTIVE MANAGEMENT AND MONITORING

Because uncertainties remain as to the exact project features, monitoring elements, and AM opportunities and management actions and detailed costs estimates, will be need to be developed during the feasibility study in the feasibility level of design phase. For planning purposes cost for AM&M were assumed to be 3% of the total project cost.

As outlined in Section 3, the pre- and post-construction monitoring will be utilized to determine project success. Monitoring will continue until the trajectory of ecological change and/or other measures of project success are determined as defined by the project-specific objectives. This Monitoring Plan includes the minimum monitoring actions determined necessary to evaluate project success. Section 2039 of the WRDA 2007 allows monitoring to be cost-shared for up to ten years post-construction. For cost estimating purposes, the maximum cost-shared period of monitoring will be assumed for all features. Once ecological success has been established, monitoring would cease. The need for additional monitoring would be assessed at the end of the cost-shared period, and any additional required monitoring would be a 100 percent non-Federal responsibility.

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ATTACHEMENT 1. Southwest Coastal Restoration Plan Conceptual Ecological Model

Southwest Coastal Louisiana Feasibility Study

Conceptual Ecological Model

February 2011

Prepared by

J. Craig Fischenich and Soupy Dalyander
Engineer Research Development Center-Environmental Laboratory

and
Tomma K. Barnes
Wilmington District, USACE

1. INTRODUCTION

1.1 Conceptual Ecological Model (CEM) Definition

A conceptual model is a tentative description of a system or sub-system that serves as a basis for intellectual organization and represents the modeler's current understanding of the relevant system processes and characteristics (Fischenich 2008). These models, as applied to ecosystems (Conceptual Ecological Models or CEMs), should be simple, qualitative models, represented by a diagram which describes general functional relationships among the essential components of an ecosystem. CEMs typically document and summarize current understanding of, and assumptions about, ecosystem function. When applied specifically to ecosystem restoration projects, these models can be used as a basis for establishing the "Future-without Project Condition" and the benefits of proposed alternatives. To describe ecosystem function, a CEM usually diagrams relationships between major anthropogenic and natural stressors, biological indicators, and target ecosystem conditions.

A 2008 USACE Ecosystem Planning Center of Expertise White Paper on the certification of ecosystem output models recommended that conceptual models "be developed for all ecosystem restoration projects" (USACE 2008a). Further, they recommended that these models be reviewed as part of the normal ITR process and do not need certification". The 2008 Memorandum on Policy Guidance on Certification of Ecosystem Output Models (USACE) adopted this recommendation (USACE 2008b).

1.2 Purpose and Function of Conceptual Ecological Models

Conceptual Ecological Models have been widely used in other regions of North America in planning several large-scale restoration projects (Rosen et al 1995, Gentile 1996, Chow-Fraser 1998, Ogden and Davis 1999, Ogden et al 2003). The same approach can be used for a variety of restoration scales as the elements of conceptual models are common. CEMs created for restoration programs/projects should include:

- Those physical, chemical, and biological attributes of the system that determine its dynamics;
- The ways in which ecosystem drivers, both internal and external cause change with particular emphasis on those aspects of the system where the proposed project can effect change;
- Critical thresholds of ecological processes and environmental conditions;
- Assumptions and gaps in the state of knowledge, especially those that limit the predictability of restoration outcomes; and
- Current characteristics of the system that may limit the achievement of management outcomes.

The USACE is using CEMs to provide assistance with ecosystem simplification, communication, plan formulation, and science, monitoring, and adaptive management. The CEM format utilized here follows a top-down hierarchy of information using the format established by Ogden and Davis (1999) (Figure 1). It should be noted that CEM development is an iterative process, and that CEMs developed for USACE projects during early plan formulation may be modified through the life of the project.

1.2.1 Model Components

The schematic organization of the CEM is depicted in Figure 1 and includes the following components:

Drivers - This component includes major external driving forces that have large-scale influences on natural systems. Drivers may be natural (e.g., eustatic sea level rise) or anthropogenic (e.g., hydrologic alteration) in nature.

Ecological Stressors - This component includes physical or chemical changes that occur within natural systems, which are produced or affected by drivers and are directly responsible for significant changes in biological components, patterns, and relationships in natural systems.

Ecological Effects - This component includes biological, physical, or chemical responses within the natural system that are produced or affected by stressors. CEMs propose linkages between one or more ecological stressors and ecological effects and attributes to explain changes that have occurred in ecosystems.

Attributes- This component (also known as indicators or end points) is a prudent subset of all potential elements or components of natural systems representative of overall ecological conditions. Attributes may include populations, species, communities, or chemical processes. Performance measures and restoration objectives are established for each attribute. Post-project status and trends among attributes are measured by a system-wide monitoring and assessment program as a means of determining success of a program in reducing or eliminating adverse effects of stressors.

Performance Measures - This component includes specific features of each attribute to be monitored to determine the degree to which attribute is responding to projects designed to correct adverse effects of stressors (i.e., to determine success of the project).

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

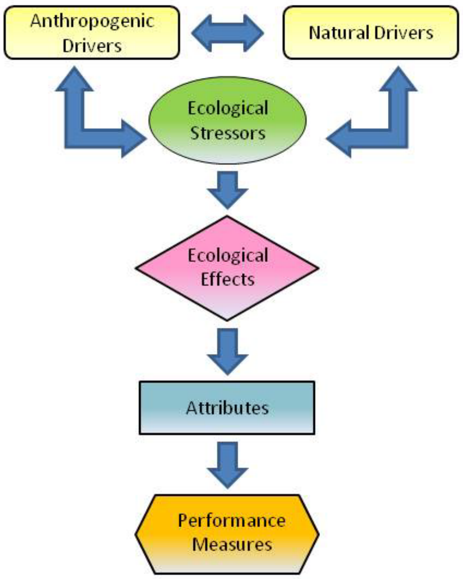

Figure 1. Conceptual Ecological Model Schematic Diagram

2. PROJECT BACKGROUND

2.1 Project Goals and Objectives

The goal of the study is to formulate a comprehensive plan for Southwest Coastal Louisiana that provides hurricane and storm damage risk reduction and coastal restoration measures to achieve ecosystem sustainability. Specific objectives include:

- Objective 1. Reduce the risk of damages and losses from hurricane and storm surge flooding. Metric: reduction in annual damage costs.
- Objective 2. Manage tidal flows to improve drainage and prevent salinity from exceeding 2 ppt for fresh marsh and 6 ppt for intermediate marsh.
- Objective 3. Increase wetland productivity in fresh and intermediate marshes to maintain function by reducing the time water levels exceed marsh surfaces.
- Objective 4. Reduce shoreline erosion and stabilize canal banks to protect adjacent wetlands.
- Objective 5. Restore landscapes, including marsh, shoreline, and cheniers to maintain their function as wildlife habitat and improve their ability to serve as protective barriers.

The project area of the Southwest Coastal Louisiana study includes the Parishes of Cameron, Calcasieu, and Vermilion (Figure 2). This area includes approximately 4.700 square miles and a population of 117,100.

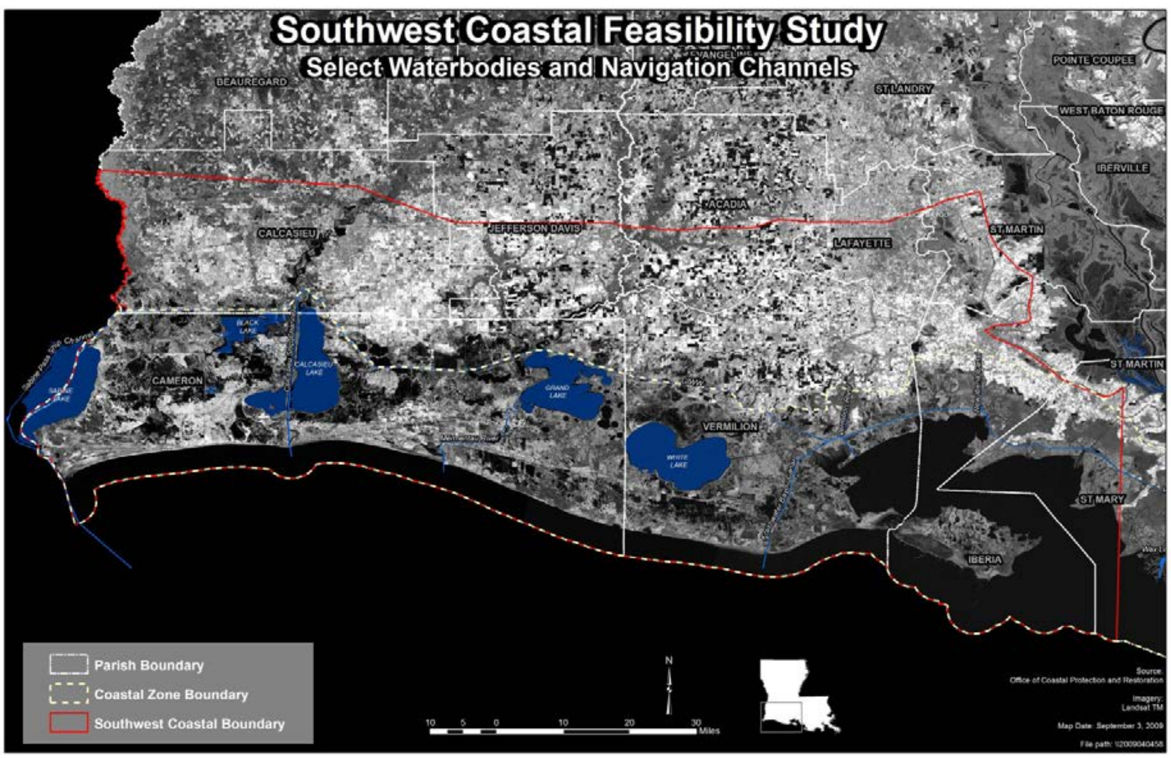

Figure 2: Southwest Coastal Louisiana – Case Study Area Map

3. CONCEPTUAL ECOLOGICAL MODEL DEVELOPMENT

The Southwest Coastal Louisiana CEM was developed by a New Orleans District led interagency team assisted by the Engineer Research and Development Center (ERDC) Environmental Lab. Prior to development of the model, the team reviewed existing information on ecological conditions in the project area. Using a workshop format, the team met to identify and discuss anthropogenically and naturally-driven alterations in the study area, stressors caused by these alterations, and consequent ecological effects. Additionally, key ecological attributes and indicators of project success were identified, along with potential performance measures. This information was used to form a set of working hypotheses and to consider the importance of each relationship **(Table 1**).

The project team used these hypotheses and lists of components to develop the model and to prepare this supporting narrative document to explain the organization of the model and science supporting the hypotheses.

Table 1. Working Hypotheses

NATURAL DRIVERS	
Hurricanes and Storms	The storm surge associated with hurricanes and storms causes increased erosion and subsequently a direct loss of the ridge /Chenier barrier system.
	The storm surge associated with hurricanes and storms causes increased saltwater intrusion to the coastal system which results in reduced primary productivity.
	Increased frequency and intensity of hurricanes and storms results in fragmentation of and eventually loss of wetlands.
Relative Sea Level Rise	The combination of sea level rise and subsidence leads to an amplification of the tidal prism/amplitude which can result in wetland degradation and an eventual conversion to open water.
	The combination of sea level rise and subsidence over the long term leads to saltwater intrusion into areas that would otherwise be fresh or brackish. This will cause changes in the biological community composition and an eventual conversion of marsh habitat to open water.
	The combination of sea level rise and subsidence over the long term leads to marsh fragmentation and eventually loss of wetlands.
ANTHROPOGENIC DRIVERS	
Hydrologic Alteration	Alterations in the natural hydrology of coastal Louisiana, including the creation of navigation channels and water control structures, have resulted in altered circulation patterns which have led to habitat conversion and changes in the biological community composition.
	Alterations in the natural hydrology of coastal Louisiana, including the creation of navigation channels and water control structures, have resulted in an increased tidal prism/amplitude which has led to an increase in wetland loss.
	Alterations in the natural hydrology of coastal Louisiana, including the creation of navigation channels and water control structures, have resulted in saltwater intrusion which has led to habitat conversion and changes in the biological community composition.
	Alterations in the natural hydrology of coastal Louisiana, including the creation of navigation channels and water control structures, have caused an increase in flood duration which has led to habitat conversion and changes in the biological community composition.
	Alterations in the natural hydrology of coastal Louisiana, including the creation of navigation channels and water control structures, have caused an increase in flood duration which has led to a reduction in primary productivity.
	Alterations in the natural hydrology of coastal Louisiana, including the creation of navigation channels and water control structures, have resulted in marsh fragmentation and eventually wetland loss.
Mineral/Sediment Extractions	Mineral and Sediment extractions from the Chenier Plain has resulted in a direct loss of the ridge and Chenier barrier system.
	Mineral and Sediment extractions from the Chenier Plain has resulted in an increase susceptibility to saltwater intrusion into areas that would otherwise be fresh or brackish. This will cause changes in the biological community composition and an eventual conversion of marsh habitat to open water.
	Mineral and Sediment extractions from the Chenier Plain has resulted in an increase susceptibility to storm surge from hurricanes and storms which could result in a direct loss of the ridge and Chenier barrier system.
Sediment Supply	A decrease in sediment supply due to alterations in the Mississippi River for flood control and navigation exacerbates shoreline erosion. This results in an increase in the loss of the ridge and Chenier barrier system and coastal wetlands.
	A decrease in sediment supply due to alterations in the Mississippi River for flood control and navigation contributes to the fragmentation and ultimately the loss of coastal marshes.

4. CONCEPTUAL ECOLOGICAL MODEL

The CEM developed by the team for the Southwest Coastal Louisiana Feasibility Study is presented below (**Figure 3**). The model depicts the series of working hypotheses formed by the team (**Table 1**), arranged in a conceptual diagram. Relationships expressed with thicker or bolder arrows are more certain than those represented by thinner arrows. Model components are identified and discussed in the following subsections along with further explanation of the relationships between the components.

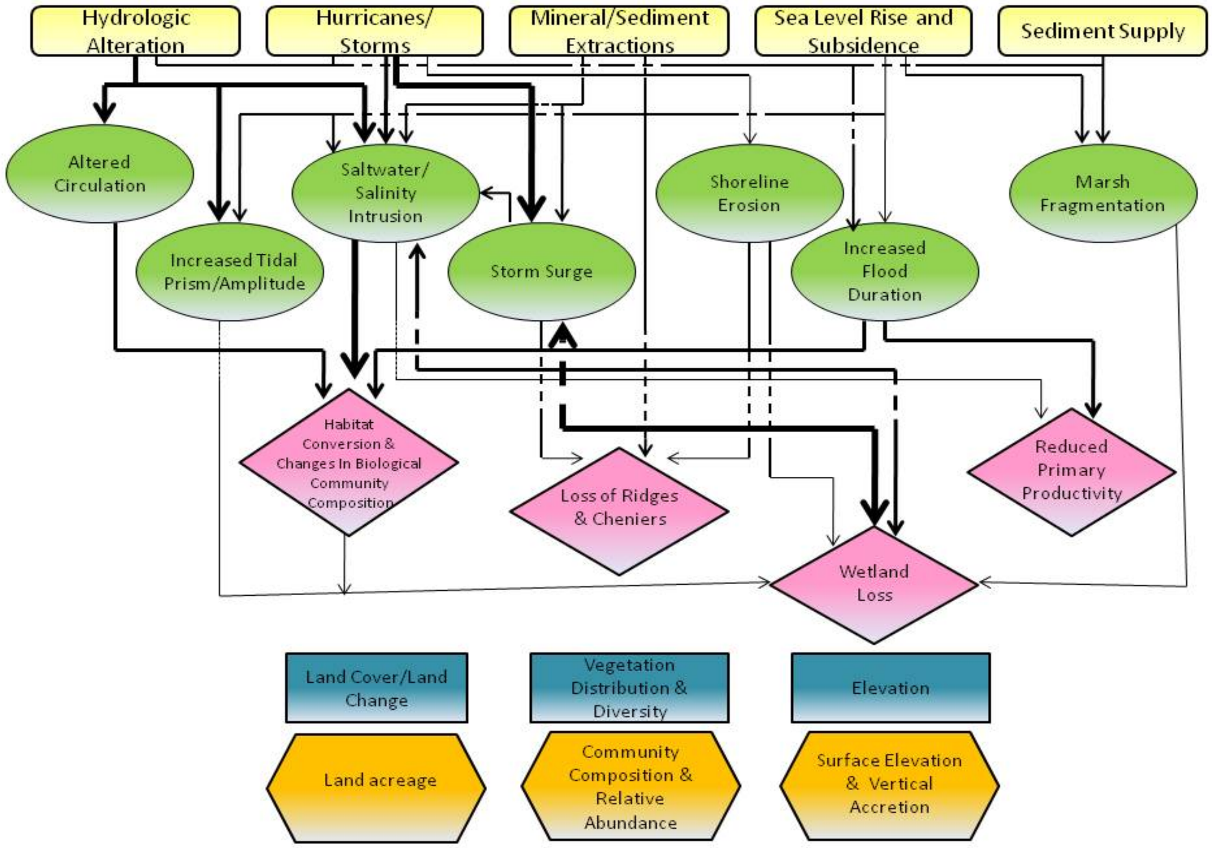

Figure X. Southwest Coastal Louisiana Conceptual Model

4.1 Drivers

Drivers are the major external driving forces that have large-scale influences on Southwest Louisiana's coastal system. Anthropogenic drivers (e.g., hydrologic alteration) provide opportunities for finding solutions to problems. For instance, hydrologic alterations can be undone through modification of channels and canals either temporarily or permanently, and mineral/sediment extraction practices can be changed. Natural drivers, however, cannot be influenced directly; e.g. we cannot change the frequency or intensity of tropical storms or change how high or fast sea level rises. Some drivers are both anthropogenic and natural in nature. On a large, historical scale, sediment deposition has been determined by geological forces. On a local scale, sediments can be brought into the system from outside the system, or can be moved from where they are a hindrance (navigation channels) to where they are beneficial (marsh restoration sites).

The study team identified five main drivers that influence the project area on a large scale.

D1: Relative Sea Level Rise (Sea Level Rise and Subsidence)

D2: Numerous Hurricanes and Storms

D3: Hydrologic Alteration

D4: Sediment Supply to the Chenier Plain

D5: Mineral and Sediment Extraction

4.1.1 Relative Sea Level Rise

Relative sea level rise (RSLR) consists of eustatic sea level rise combined with subsidence. Eustatic sea level rise is defined as the global increase in oceanic water levels primarily due to changes in the volume of major ice caps and glaciers, and expansion or contraction of seawater in response to temperature changes. The International Panel on Climate Change (IPCC) estimates that average eustatic sea level rise since 1961 has been 1.8 mm per year, and since 1993, 3.1 mm per year (IPCC 2007). Additionally, there is a projected rise between 182 and 610 mm in the next century (IPCC 2007). In coastal Louisiana, this rise in sea level is exasperated by rapid changes in land elevation.

Subsidence is the decrease in land elevations due to compaction of Holocene deposits, consolidation of sediments, and faulting. Anthropogenic activities such as sub-surface fluid extraction and drainage for agriculture, flood protection, and development are also contributors to land elevation decreases. Forced drainage of wetlands results in lowering of the water table resulting in accelerated compaction and oxidation of organic material Areas under forced drainage can be found throughout coastal Louisiana and the study area. Each process produces a range of subsidence rates dependent on local environmental factors and each process occurs across a unique set of scale (Reed and Yuill 2009). The mean subsidence rate for Louisiana is 11 mm (0.43inches) per year (Berman 2005).

This combination of sea level rise and rapid subsidence, as well as natural and man induced erosional processes, has resulted in extensive wetland loss in coastal Louisiana. Rates for RSLR along coastal Louisiana are currently estimated to be between 1 to 1.2 m/century (USACE 2004). These are the highest rates of RSLR along the contiguous United States.
RSLR affects project area marshes by gradually inundating marsh plants. Marsh soil surfaces must vertically accrete to keep pace with the rate of relative sea level rise. Changes in land elevation vary spatially along coastal Louisiana, however in areas where subsidence is high and riverine influence is minor or virtually nonexistent wetland habitats sink and convert to open water.

Land elevations increase as a result of sediment accretion (riverine and littoral sources) and organic deposition from vegetation. Vertical accretion in most of the study area, however, is insufficient to offset subsidence. The combination of subsidence and eustatic sea level rise is likely to cause the landward movement of marine conditions into estuaries, coastal wetlands, and fringing uplands (Day and Templet 1989; Reid and Trexler 1992).

4.1.2 Hurricanes and Storms

The Gulf Coast region is affected by tropical and extra-tropical storms. These atmospherically driven storm events can directly and indirectly contribute to coastal land loss through: 1) erosion and breaches from increased wave energies; 2) removal and/or scouring of vegetation from storm surges; and 3) storm induced saltwater intrusion into interior wetlands. These destructive processes can result in the loss and degradation of large areas of coastal habitats in relatively short periods of time (days and weeks versus years). Since 1893, over 130 tropical storms and hurricanes have struck or indirectly impacted Louisiana's coastline. On average, a tropical storm or hurricane affects Louisiana every 1.2 years. The most recent tropical cyclones to affect the study area were Hurricanes Katrina and Rita, which occurred in August 2005 and September 2005, respectively, and Hurricanes Gustav and Ike, which occurred in September 2008. Storm surge and wave field associated with the 2005 storms eroded 527 km^2 of wetlands within the Louisiana coastal plain (Barras et al 2008).

Hurricane Rita was the fourth-most intense Atlantic hurricane ever recorded and the most intense tropical ever observed in the Gulf of Mexico. The storm generated a surge of up to 5 meters in some areas, driving saltwater tens of kilometers inland killing wetlands in artificially impounded areas. Rita made landfall between Sabine Pass, Texas and Johnson's Bayou, Louisiana causing extensive damage to Louisiana's southwest coastal parishes. Coastal communities in Cameron Parish were destroyed; the communities of Holly Beach, Hackberry, Creole, Grand Chenier, and Cameron were severely impacted. The Calcasieu Parish communities of Sulphur, Westlake, and Vinton also suffered significant damage and parts of the City of Lake Charles experienced 2 to 3 meter deep flooding associated with surge propagating up a ship channel.. Six people lost their lives and 10,000 structures were flooded. Rita caused $9.4 billion in damage along the Louisiana and southeastern Texas coasts.

Additionally, hurricane impacts to coastal environments can include sediment overwash, ripped and torn marsh, erosion of pond and lake margins, wrack (large amounts of plant debris) deposition, and lateral compression of marshes. Substantial sediment deposition associated with the passage of the storm can result in the burial of the pre-storm surface and the smothering of vegetation (Dunbar et al1992, Jackson et al 1992). This same effect may occur as a result of burial by wrack. Extensive areas of marsh can be pushed against firm barriers (for example, levees and firmly grounded marsh) and can result in a ridge and trough. Freshwater marsh species can experience a "burning" effect (aboveground portions of the plants are killed) if exposed to saline waters (Dunbar et al 1992, Jackson et al 1992, Stone et al 1993, Stone et al 1997). In some marsh zones, unconsolidated or weakly rooted marsh has been eroded. Storms and hurricanes, depending on strength and intensity, can also blow over, defoliate, and/or cause major structural damage to trees well beyond the coastal zone (Lovelace 1998).

4.1.3 Hydrologic Alterations

Hydrologic alterations, including navigation channels and water control structures, are predominant sources of stress on the southwest Louisiana coastal system. These alterations cause disruptions in the natural coastal hydrological processes causing changes in circulation and tidal prism, and by increasing saltwater intrusion into the freshwater interior.

Altered hydrology is exacerbated by additional physical changes made in the watershed, which include canal, roads, and levees. Canals and associated spoil banks, constructed for navigation and/or oil and gas development, can be found throughout the project area. Canals impact wetlands by changing the normal hydrologic pattern. Canals deprive existing natural channels of water and allow more rapid runoff of water than the slower shallower natural channels do. This allows for greater fluctuation in the marsh and a lowering of the minimum water level which dry the marsh (Mitsch and Gosslink 2000).

These hydrologic alterations (e.g. cutting channels and canals, and the artificial creation of spoil banks) have also led to increased coastal habitat fragmentation. Hydrologic connectivity in the Chenier Plain has been disrupted by several activities, most notably the creation of navigational channels, such as the Sabine/Neches Waterway, Calcasieu Ship Channel, GIWW, Mermentau Ship Channel, and Freshwater Bayou Canal Navigational channel, and the creation of water control structures, such as the Calcasieu and Leland Bowman locks, the Freshwater Bayou Canal Lock, the Schooner Bayou Canal Structure, and the Catfish Point Control Structure. These channels have disrupted the hydrology of the region by facilitating saltwater intrusion into the historic freshwater interior. Water control structures were subsequently constructed in part to control the amount of saltwater intrusion into the interior, but further altered the hydrology by managing water flow. Together, these alterations have acted to change the hydrologic pattern of the Chenier Plain.

Through the creation of dredge material banks, roads and highways, and flood protection levees, some wetland habitats within the Chenier Plain have also become hydrologically isolated. During extreme water events, such as tropical storms, these habitats are particularly vulnerable due to their slow drainage patterns and the often resultant ponding of salt water throughout the wetlands. In such cases, the typical result has been ponding of water over the wetlands, often with high salinity content. This excessive ponding over an extended period of time in certain types of wetland habitats can kill the vegetative communities and result in wetland loss and eventual conversion to open water. Near 100percent mortality of marsh vegetation in many areas has been documented as a result of high salinity water brought in by storm surge.

The spoil banks associated with these channels and canals reduce sheetflow of water across the wetlands (Swenson and Turner 1987) and prevent the exchange of sediment and nutrients and cause artificially prolonged flooding. These effects combine to eliminate soil-building processes necessary to counteract subsidence (USACE 2004, USACE 2010). In addition canal constructions can cause secondary indirect impacts such as accelerating erosion rates along the channel and canal banks.

Channels and canals provide avenues for higher salinity water to move into previously freshwater marshes, which ultimately leads to habitat degradation and land loss. By altering salinity gradients and patterns of water and sediment flow through marshes, channel and canal dredging indirectly changed the processes essential to a healthy coastal ecosystem and led to habitat conversion. Channels and canals that stretch from the Gulf of Mexico inland to freshwater areas allow saltwater to penetrate much farther inland, particularly during droughts and storms, which has had severe effects on freshwater wetlands (Wang 1987). Extreme salinity changes can stress fresh and intermediate marshes to the point where vegetation dies and the wetlands convert to open water (Flynn et al 1995).

4.1.4 Sediment Supply

The Chenier Plain was developed as the result of the interplay of three coastal plain rivers (Sabine, Calcasieu, and Mermentau Rivers), cycles of Mississippi River Delta development, and the Gulf of Mexico. During periods of active Mississippi River delta building, Gulf of Mexico currents transported fine-grained sediments (clay and silt) in an East to West direction along the Louisiana coast. When delta formation occurred in shallow waters of bays or the inner continental shelf along the western reaches of the Deltaic Plain, longshore currents carried the fine-grained sediment west in a mudstream towards the Chenier Plain. These sediments were then brought into coastal estuaries and marshes along the gulf shoreline by tidal processes and storms which were deposited along the shore to form mudflats (Gagliano and van Beek 1970). This newly formed land was colonized by wetland vegetation, which further promoted the land-building process. Wave action and occasional storm events also deposited sand and shells onto the newly built land.

Alteration of the Mississippi River for navigation and flood control now limits the delivery of sediments onto the continental shelf and, thus, the redistribution of those sediments westward through littoral processes., with wide-ranging secondary effects. However, since 1973, delta-building processes at the mouth of the Atchafalaya River have initiated a new interval of land building via the formation of extensive mudflats along the eastern part of the Chenier Plain.

4.1.5 Mineral and Sediment Extraction

The production, refinement, and transport of oil and gas have resulted in both short- and long-term negative environmental impacts to coastal Louisiana. Recent findings have indicated that oil and gas fluid withdrawal has resulted in regional subsidence and fault reactivation causing wetland losses in coastal Louisiana (Morton et al 2005). This induced subsidence coupled with sea level rise can lead to elevation changes, increased flooding, and eventual habitat switching and loss.

Secondary impacts result from canal construction for oil and gas extraction and the subsequent associated spoil banks which have altered the hydrology of the area (Jones et al 2002). These barriers limit the exchange of water sediment, nutrients between the water pathways and the marsh. Hydrologic barriers such as roads, levee, and culverts obstruct the flow of water and can modify inundation patterns on either side of the barrier (Harvey et al 2010).

4.2 Ecological Stressors

ES1: Increased Flood Duration

ES2: Storm Surge

ES3: Saltwater/Salinity

ES4: Shoreline Erosion

ES5: Marsh fragmentation.

ES6: Increased Tidal Prism or Amplitude.

ES7: Altered Circulation

4.2.1 Increased Flood Duration

Hydrologic modifications in the project area, especially the construction of roads, levees, and other similar features has altered normal drainage patterns. This had led to a condition whereby flood durations are increased in many wetland areas. This is especially problematic in the wake of a hurricane, when highly saline storm surge waters are impounded for long periods, causing stress and eventual loss of the affected wetland communities.

4.2.2 Storm Surge

Tropical cyclone events exert a stochastic but severe stress upon the swamp habitat through salinity spikes associated with saline storm surge events. The introduction of saline storm surge water into impounded areas results in reduced biomass production and impaired health, which in turn causes increased vegetation mortality, decreased soil production and integrity, and a consequent increase in relative subsidence. Saline storm surge waters become impounded by the spoil banks, roads and levees in the area. Consequently, these periodic influxes of saline storm surge waters result in cumulative increases in salinity in impounded waters and soils in the study area. Saltwater introduction into freshwater wetlands has been demonstrated to reduce productivity for short-term periods and cause the loss of wetland vegetation altogether for longer periods of inundation.

The elevation of the storm surge within a coastal basin depends upon the meteorological parameters of the hurricane as well as the physical characteristics existing within the basin. The physical factors include the basin bathymetry, roughness of the continental shelf, configuration of the coastline, and the existence of significant natural or man-made barriers. With the loss of marsh and chenier features, storm surge can become larger at points further inland, including areas of dense development.

While the study area has periodically experienced localized flooding from excessive rainfall events, the primary cause of the flooding events has been the tidal surges from hurricanes and tropical storms. During the past eight years, the planning area has been greatly impacted by storm surges associated with three Category 2 or higher hurricanes—Lili, Rita, and Ike, which inundated structures and resulted in billions of dollars in damages to southwest coastal Louisiana.

Hurricane surge also causes significant damage to wetlands. Hurricane surge has formed ponds in stable, contiguous marsh areas and expanded existing, small ponds, as well as removed material in degrading marshes (Barras 2009). Fresh and intermediate marshes appear to be more susceptible to surge impacts (Barras 2006, Howes et al 2010).

4.2.3 Saltwater/Salinity Intrusion

Salinity levels exist along a gradient, which declines as the saltwater moves inland from the Gulf of Mexico. Distinct zones of plant communities, or vegetative habitat types, differing in salinity tolerance, exist along that gradient, with the species diversity of those zones increasing from salt to fresh environments. Saltwater intrusion changes the salinity gradient, which results in habitat changes.

The combined effects of hydrologic alterations and hurricanes in the near term as well as sea level rise and subsidence over the long term lead to saltwater intrusion into areas that would otherwise remain fresh or intermediate.

Decreased freshwater inputs and increase channelization allows tidal water to intrude farther upstream, causing significant damage to freshwater wetland systems and changing freshwater wetlands to brackish or saline marshes. This is the principle factor in the conversion of freshwater systems and in extreme cases salt intolerant vegetation cannot replaced the freshwater species before the marsh converts to open water (Mitsch and Gosslink 2000, Flynn et al 1995).

Changes to the salinity gradient are caused by a number of factors, including: the construction of levees, man-made channels, and canals, and degraded wetland areas. Tropical storm events can introduce saltwater into fresher areas, damaging large amounts of habitat in a short period of time.

4.2.4 Shoreline Erosion

Shoreline erosion is a normal consequence of natural tidal processes, wind generated waves, and surge from storm events, but can be accelerated by marsh breakdown and stress from other factors such as saltwater intrusion, flooding, and relative sea level rise. When these natural causes are combined with man-made activities (navigation/access channels) inland areas are subjected to more dramatic tidal forces and wave action, increasing erosion.
In the past 100 years, the total barrier island area in Louisiana has declined 55percent at a rate of 155 acres per year (Williams et al 1992), largely due to storm overwash and wave erosion. In many ways the bays and lakes and the banks of canals and streams are even more vulnerable to erosion than the barrier islands. The Louisiana coast has approximately 350 miles of sandy shoreline along its barrier islands and gulf beaches; however, there are about 30,000 miles of land-water interface along bays, lakes, canals, and streams. Most of these consist of muddy shorelines and bank lines, and virtually all are eroding. In many instances, rims of firmer soil around lakes and bays, and natural levees along streams have eroded away leaving highly organic marsh soils directly exposed to open water wave attack.

4.2.5 Increased Tidal Prism or Amplitude

Tidal currents in Louisiana are relatively small, due to the small tidal amplitude. In the absence of wind, density effects and barometric pressure gradients, these currents reach magnitudes of approximately 10 – 15 cm/s (0.3 - 0.5 ft/s). Although small in magnitude in open coastal waters, tidal currents can reach speeds of approximately 50 cm/s (1.7 ft/s) at estuary and barrier island inlets, depending on the inlet dimensions. Generally, tidal exchange between back-barrier bays and the Gulf of Mexico has increased along the delta plain since at least the 1880s due to widespread conversion of wetlands and salt marsh to open water areas.

4.2.6 Altered Circulation Patterns

Circulation of coastal waters depends on driving forces such as tides, wind, and atmospheric pressure. Along the complex Louisiana coast, circulation mechanisms go beyond these driving forces to include high rainfall; the large volume of fresh water introduced by the Mississippi and Atchafalaya Rivers; currents induced by density differences and mixing processes of these two masses of water; local shoreline and bathymetric features such as the Mississippi River mouth, barrier islands, marshes, inlets, bays, and so forth. More locally, the loss of wetlands coupled with the effects of canals, ridge gapping, and other landscape alterations can significantly alter circulatory patterns.

4.2.7 Marsh Habitat Fragmentation

Habitat fragmentation is the disruption of continuous blocks of habitat into less continuous habitat as a result of human disturbances and conversion of vegetation from one type to another. Climate change, hydrologic alterations, and diminishing sediment supply individually or combined are causes of coastal degradation and habitat fragmentation in Louisiana. These impacts are worsened by human intervention at various scales

Two components of climate change that will continue to effect ecosystem connectivity are sea level rise and the increased frequency and intensity of wind-driven storm events (Hitch and Leberg 2008). Impacts are and will continue to be exasperated by human activities that have modified water and sediment delivery from watersheds to the coastal systems. Relative sea level rise is key factor contributing to the fragmentation of coastal marshes. Inundation, resulting from seal level rise and subsidence, cause conversion of vegetated surfaces to open water thus decreasing the amount of available wetland habitat.

Marshes of the project area provide habitat and a food source for fish and wildlife species. Marsh loss implies an imbalance between sea level and marsh accretion rates – a primary factor is a decrease in or lack of sediment supply (Blum and Roberts 2009). Additionally, dredging of channels has increased water depths thereby strengthening tidal currents, enhancing erosion, and trapping sediments that would otherwise be deposited on the marsh surfaces in deeper areas.

4.3 Ecological Effects

EE1 Wetland Loss

EE2 Decreased Primary Productivity

EE3 Habitat Conversion and Changes in Biological Community Composition

EE4 Loss of Ridges and Cheniers.

4.3.1 Wetland Loss

Wetland loss in the project area can be the result of gradual decline of marsh vegetation due to inundation and saltwater intrusion eventually leading to complete loss of marsh vegetation or the result of storm surge events. As marsh vegetation is lost, underlying soils are more susceptible to erosion and are typically lost as well, leading to deeper water and precluding marsh regeneration. Significant accretion of sediments is then required in order for marsh habitat to reestablish.

The accelerated loss of Louisiana’s wetlands has been ongoing since at least the early 1900s with equal harmful effects on the ecosystem and possible future negative impacts to the economy of the region and the Nation (LCA 2004).

The LCA Study (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 is almost 10 percent of Louisiana's remaining coastal wetlands.

Wetland degradation and loss are the result of both natural factors and anthropogenic activities, producing conditions where wetland vegetation can no longer survive and wetlands are lost (Barras et al 2003, Barras et al 1994; Dunbar et al 1992). Natural causes contributing to coastal land loss include: wave erosion, sea level rise, subsidence resulting from compaction of muddy and organic sediment, geologic faulting, river floods, and tropical storm events. Human activities that have impacting coastal wetland loss include: flood control modifications including the Mississippi River levee system, navigation channels and structures, oil and gas infrastructure, and direct water quality impacts.

In the project area, the process for wetland loss can start with the be the result of gradual decline of marsh vegetation due to inundation and saltwater intrusion eventually leading to complete loss of marsh vegetation or the result of storm surge events. As marsh vegetation is lost, underlying soils are more susceptible to erosion and are typically lost as well, leading to deeper water and precluding marsh regeneration. Significant accretion of sediments is then required in order for marsh habitat to reestablish.

Perhaps the most serious and complex problem in the study area is the rate of land and habitat loss. The Louisiana coastal plain contains one of the largest expanses of coastal wetlands in the contiguous United States and accounts for 90 percent of the total coastal marsh loss in the nation (USACE 2004). Across much of the Louisiana coast, wetland loss and shoreline erosion continue largely unabated, resulting in accelerated coastal land loss and ecosystem degradation.

4.3.2 Reduced Primary Productivity

Decreased productivity in vegetative communities in the study area is thought to be a biological response to the lack of nutrients and sediment inputs, and saline stress from flooding following storm surge.

There has been a reduction in frequency of nutrient and sediment rich waters into and across the wetlands as a result of flood protection and water control structures, and channelization for navigation and oil and gas infrastructure. Instead, the nutrient rich water is delivered directly into the coastal bays or into the Gulf of Mexico, and often as a result, coastal wetlands lack the required nutrients necessary to maximize productivity. Increased productivity results in higher organic soil formation, which then leads to increased deposition and vertical accretion.

Salinity induced stress decreases primary production and biomass in freshwater marshes (Smart and Barko 1980, Linthurst and Seneca 1981, Pezeshki et al 1987, McKee and Mendelssohn 1989, Spalding and Hester 2007) and therefore organic matter and vertical accretion rates are compromised following saltwater intrusion. Maintaining a balanced position in the coastal landscape requires that marshes accrete vertically as sea level rises and the marsh surface sinks because of subsidence. In coastal Louisiana, the amount of sedimentation required to keep pace with sea level rise is high compared to regions of the United States (Stevenson et al 1986).

4.3.3 Habitat Conversion and Changes in Biological Community Composition

Habitat conversion can be the result of several drivers acting independently or collectively. The conversion of habitat can make an area more susceptible to storms and erosion as well as altering the type of fauna expected to occur in the area. Freshwater marsh can be susceptible to saltwater intrusion. The effects of invasive species can damage or displace native vegetation.

Coastal marshes also provide habitat for a variety of vertebrate wildlife including fish, birds, mammals, and reptiles. Teal (1986) stated that one of the most important functions of coastal marshes was to provide habitat for migrant and resident bird populations. Some wildlife species inhabiting tidal marshes are also important game animals, valuable furbearers, and provide recreational opportunities for birdwatchers, nature enthusiasts, and wildlife photographers (USACE 2010).

The majority of species that utilize the wetlands have neither commercial nor recreational value, but simply are ecologically important members of the ecosystem. Many of the organisms that use the marsh ecosystem are highly mobile and serve as a transfer mechanism for nutrients and energy to adjacent terrestrial or aquatic ecosystems. Some of the larger vertebrates, including the muskrat and nutria, consume large amounts of forage and, at high densities, can have significant impacts on marsh vegetation structure (USACE 2008).
Tidal marshes provide forage habitat, spawning sites, a predation refuge, and a nursery for resident and nonresident fishes and macrocrustaceans. These organisms use tidal marshes or adjacent subtidal shallows either year round or during a portion of their life history. These organisms are consumed by nektonic and avian predators and are considered to represent an important link in the marsh-estuarine trophic dynamics (USACE 2008).

4.3.5 Loss of Ridges and Cheniers

The Chenier Plain of SW Louisiana consists of multiple shore-parallel, sand rich ridges that are balanced on and physically separated from one another by relatively finer grain, clay-rish sediments. Cheniers are unique and critical components of the local environment. They support a diversity of wildlife and, because of their location along important migration pathways, are especially significant for migrating birds, as well as providing natural protection against salt water intrusion, storm surge, and flooding (Providence Engineering Group Cheniers and Natural Ridges Study 2009).

Formed over thousands of years by the deltaic processes of the Mississippi River and other streams, the chenier ridges of southwest Louisiana run laterally to the modern shoreline and rise above the surrounding marshes by as little as a few inches or as much as 10 ft (Gould and McFarlan 1959, Byrne et al 1959). These ridges range from 2 to 15 ft thick and from 100 to 1,500 ft wide, with some ridges extending along the coast for a distance of up to 30 miles. Live oak and hackberry are dominate canopy species, and others common species are red maple, sweet gum, water oak, green ash, and American elm.
Cheniers have been severely impacted by human activities such as deforestation for conversion to cattle pasture or development. They have also been threaten by coastal erosion and wetland loss resulting from salt water intrusion, subsidence, hurricanes, debris from oil and gas infrastructure by storms, navigation channels, and invasive species.

4.4 Attributes and Performance Measures

A1 Land Cover/ Land Change

Performance Measures: Relative Change in Land Cover

A2 Vegetation Distribution and Diversity

Performance Measures: Community Composition and Relative Abundance

A3 Elevation

Performance Measures: Surface Elevation and Vertical Sediment Accretion

4.4.1 Land Cover

Land cover has been identified as a key indicator of project success with respect to preventing habitat conversion and future land loss. Comparison of pre-project land cover characteristics with post-project land cover characteristics would serve to determine if the current trend in habitat conversion and land loss within the study area experiences a post-project decline or ceases altogether. Additionally, post-project land cover analysis would determine if areas within the study area that had previously gone through a conversion, undergo a post-project reversion. Spatial analysis has been identified as an assessment performance measure for the determination of the response of land cover to the proposed project. Spatial analysis may involve comparative analysis of pre-project and post-project aerial or satellite imagery and may utilize Landsat Thematic Mapper analysis to determine relative changes in land cover within the study area.

4.4.2 Vegetation Distribution and Diversity

Plant distribution and diversity has been identified as a key indicator of project success with respect to preventing, reducing, or reversing wetland loss in the study area. Comparison of pre-project vegetation monitoring data with post-project vegetation monitoring data would serve to determine if plant communities within the study area change in response to project features.

Relative abundance is a measure of the abundance or dominance of each species present in a sample. Relative abundance can be used to document the degree of impact in an area by measuring both species dominance and evenness. Relative abundance can be used to assess ecosystem health by comparing plant density before and after project implementation. The Braun-Blanquet method (Mueller-Dombois and Ellenberg 1974) as described in Steyer et al (1995) will be utilized to measure relative abundance.

A post-project stabilization of relative abundance within the study area would be an indication of significant project success, while a post-project reduction in the rate of decline of relative abundance would be an indication of moderate project success. Conversely, no change in the rate of decline of relative abundance post-project would indicate that the project did not succeed in increasing vegetation productivity.

4.4.3 Elevation

Ground surface elevation has been identified as a key indicator of project success with respect to increasing sediment and nutrient load within the study area. Comparison of pre-project elevations with post-project elevations would serve to determine if sediment input and soil accretion is occurring within the study area in response to project features. A post-project decrease in the rate of elevation decline would implicitly indicate the introduction of nutrients and sediment into the marshes as a result of the project. Two performance measures have been identified for this attribute, including surface elevation table (SET) measurements and feldspar marker horizon measurements.

Surface Elevation Table (SET) measurements provide a constant reference plane in space from which the distance to the sediment surface can be measured by means of pins lowered to the sediment surface. Repeated measurements of elevation can be made with high precision because the orientation of the table in space remains fixed for each sampling. Elevation change measured by the SET is influenced by both surface and subsurface processes occurring within the soil profile.

Feldspar marker horizon measurements involve the placement of a cohesive layer of feldspar clay on the ground surface. Soil borings are extracted at the marker horizon location periodically to measure the amount of soil deposition and/or accretion that has occurred above the horizon since placement. Significant quantities of soil atop marker horizons are indicative of soil building within the area, which in turn indicates an increase in relative elevation. A post-project stabilization of elevation as evidenced by SET measurements or documented soil accretion atop a marker horizon within the study area would be an indication of significant project success, while a post-project decrease in the rate of decline in elevation would be an indication of moderate project success. Conversely, no change in the rate of elevation decline post-project within the study area would indicate that the project did not succeed in offsetting subsidence and, by extension, habitat conversion and future land loss.

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SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex M

Water Quality Analysis

(Available in final)

SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex N

Recreational Resources

1. RECREATION RESOURCES

Historic and Existing Conditions
Recreational features and opportunities vary throughout the coastal zone, habitat and culture playing significant roles in the diversity of activities. From the games and competitions of Native Americans, to the influence of diverse immigrant cultures, traditional recreation in Louisiana has been a product of its people. Nearly 10,000 years ago, people began living off the ample resources of Louisiana. The means by which Louisiana's early residents lived, hunting and fishing for food, utilizing high ground for camps, and building vessels for transportation, shaped what is now recognized as traditional recreation in southern Louisiana.

State parks *within the Gulf Coast Prairie and Forested Terraced Uplands* physiographic regions include Palmetto Island and Sam Houston Jones parks. There are no Federal National Wildlife Refuges (NWR) or Wildlife Refuges (WR) within the regions. Sixteen boat launches are located within these regions.

Federal NWRs or State WRs within or adjacent to the Gulf Coast Marsh physiographic region include Sabine, Cameron Prairie, and Lacassine NWR and White Lake Wetlands Conservation Area. Public and private boat launches are located throughout the study area.

Recreation areas within or adjacent to the Gulf Coast Marsh physiographic region that provide access to high quality recreational resources include three National Wildlife Refuges, one Wildlife Management Area, one State Wildlife Refuge, and one State Park. See Map N1. From east to west, the region includes the 13,000-acre State Wildlife Refuge, the 71,544-acre White Lake Wetlands Conservation Area, the 76,000-acre Rockefeller WR, the Lacassine National Wildlife Refuge NWR, Cameron Prairie NWR, and the 124,511-acre Sabine NWR. Outside but adjacent to the area is Cypremont State Park, Shell Keys NWR and Marsh Island WR. These areas represent more than 329,000 acres that are visited more than 460,000 times annually. Recreation areas include trails for hiking and biking, five boat ramps (within recreation parks), three visitor centers, picnic shelters, one classroom, and one campground that is rented more than 36,700 times annually. Recreation areas also provide opportunities for hunting, boating, bird watching, fishing, crabbing, crawfishing, education, picnicking, education, camping, and playing.

Access into the WMAs and Refuges is generally by car or boat. Consumptive recreation includes hunting, fishing for freshwater and saltwater species and trapping alligators and nutria. Non-consumptive recreation includes bird watching, sightseeing, boating and environmental education/interpretation. Many of the parks offer hiking trails, camping and picnic shelters.
In addition to the high quality recreational fishing and hunting in the parks in the region, several lakes and inland marshes offer opportunities for hunting and catching both freshwater and saltwater species. Grand, White, Sabine and Calcasieu Lakes, Freshwater Bayou and Vermillion Bay are prime fishing spots for recreational species such as redfish and speckled trout as well as flounder and brown and white shrimp. White Lake is a remote open lake and can only be accessed by the Schooner Bayou Canal, the old Intracoastal Canal north of Pecan

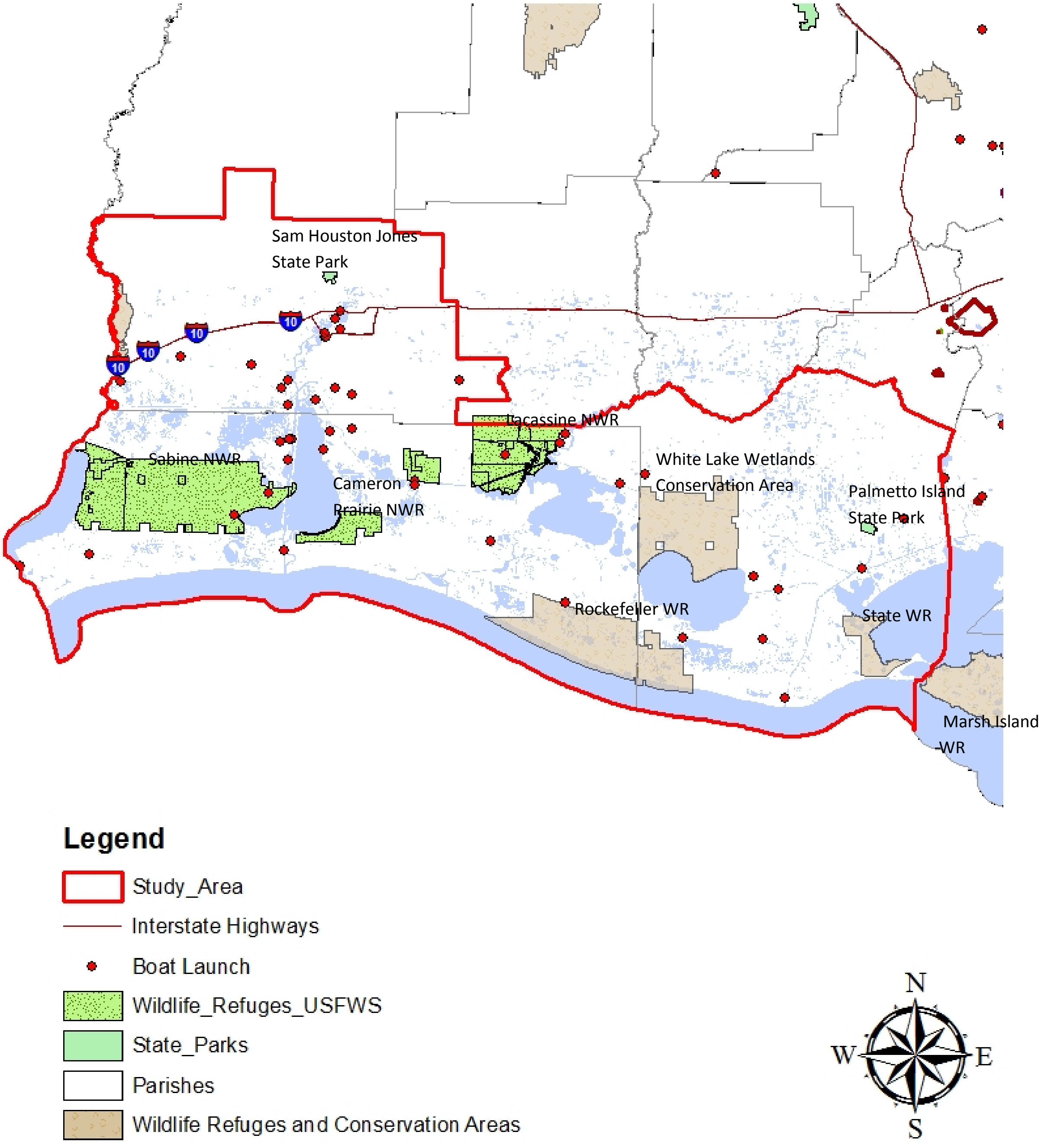
Island or via the Superior Canal west of Pecan Island. The Calcasieu Lake area offers 10 of the 35 public or private boat launches in the area.

Bird watching is also an important recreational resource in southern Louisiana. A global initiative of BirdLife International, implemented by Audubon and local partners in the United States, the Important Bird Areas Program (IBAs) is an effort to identify and conserve areas that are vital to birds and other biodiversity. In the NER area, Audubon lists the entire Chenier Plain as a globally IBA (source: http://netapp.audubon.org/iba, accessed 25 September 2013). Many of the IBAs recognized are located within state or federally operated areas. Federal parks within the Chenier Plain that are globally IBAs include Lacassine NWR, Cameron Prairie NWR and Sabine NWR. The sanctuary provided at Lacassine Pool, a very popular birding site, is critical to the long-term viability of continental pintail populations and is one of the key pintail wintering areas in the continent, with a wintering pintail population that has reached almost 400,000 (source: http://www.fws.gov/ swlarefugecomplex/lacassine/, accessed 25 September 2013). Also in the area is the Baton Rouge Audubon Society 40-acre Peveto Woods Sanctuary located along the Louisiana coast in Cameron Parish. The Peveto Woods Bird & Butterfly Sanctuary site is the most heavily birded locale in Louisiana and was the first Chenier sanctuary for migratory birds established in Louisiana. Each spring and fall, Peveto Woods hosts most migratory songbirds native to eastern North America (source: http://www.braudubon.org/peveto-woods-sanctuary.php, accessed 25 September 2013). The sanctuary is a favorite birding spot in southwest Louisiana, as well as a location for viewing the many butterfly species that migrate to the region.

The State of Louisiana owns and operates the White Lakes Conservation Area, Rockefeller WR and the State Wildlife Refuge (SWR), all located in the Chenier Plain and all globally IBAs. Rockefeller Wildlife Refuge is one of the most biologically diverse wildlife areas in the nation. Historically, Rockefeller wintered as many as 400,000-plus waterfowl annually, but severe declines in the continental duck population due to poor habitat quality on the breeding grounds have altered Louisiana's wintering population (source: http://www.wlf.louisiana.gov/refuge/ rockefeller-wildlife-refuge, accessed 25 September 2013). The Audubon/Paul J. Rainey Wildlife Sanctuary is located to the west and the Marsh Island Wildlife Refuge to the east of the SWR. The Little Pecan Island Preserve, located between Lacassine and Rockefeller WRs near White Lake is managed by The Nature Conservancy and contains 1,810 acres of gulf coast prairies and marshes in Cameron Parish. Palmetto Island State Park is an IBA.

Designated within the area is the Creole Nature Trail National Scenic Byway, a 105- mile driving and walking tour touching four state and national wildlife refuges and a bird sanctuary. Finally, public and private boat launches are located throughout the entire NER area.

Map N1: National and State Parks in the SWCL Area


Sam Houston Jones
State Park
10
10
10
10
Sabine NWR
Cameron
Prairie NWR
Lacassine NWR
White Lake Wetlands
Conservation Area
Palmetto Island
State Park
Rockefeller WR
State WR
Marsh Island
WR
Legend
Study_Area
Interstate Highways
Boat Launch
Wildlife_Refuges_USFWS
State_Parks
Parishes
Wildlife Refuges and Conservation Areas
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W
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S

1.1.1.1 HURRICANE AND STORM DAMAGE RISK REDUCTION (NED) PLAN
2.1.1.1 Alternative —Nonstructural Plan (TSP)

Nonstructural measures under consideration include elevation or acquisition of residential structures and floodproofing of non-residential structures. There would be no direct impacts on recreational resources from structure elevation that results in flood waters and storm surge passing safely below a structure. By elevating residential recreational structures, such as camps, damage from storm surge and flooding is less likely to occur. Additionally, elevated structures should create less debris that must be removed following a flood. Elevation requirements may lead to fewer camps and hunting clubs in the region because elevated structures would most likely be more costly to erect. This may negatively affect recreation opportunities because people would have to travel further to access locations for activities such as hunting, fishing, boating, and birding. Potential direct impacts of structure acquisition include the removal of recreational camps that are likely to be damaged by flooding or storm surge. The acquired property may become open space in perpetuity which could lend the site to recreational use.

A direct impact from floodproofing park buildings is the recreational use may be temporarily unavailable during floodproofing activities. Floodproofing at parks could affect recreational structures at the White Lake Wetlands Conservation Area, the Lacassine, Cameron Prairie, and Sabine National Wildlife Refuges and Sam Houston Jones State Park. Once floodproofing is complete, park structures would reopen more quickly following storm surge or floods.

Cumulative Impacts: Depending on the number of structures affected, recreational resources impacts could include fewer camps and features at parks as cost associated with elevation or floodproofing may result in fewer recreational opportunities, outside of fishing and hunting.

<u>ECOSYSTEM RESTORATION (NER) PLANS</u>
Alternative C4+M4 — Entry Salinity Control Plan (TSP)
Direct and Indirect Impacts:

Hydro/Salinity: Hydrologic salinity control structures are designed to reduce saltwater intrusion and tidal influx from various bodies of water at two locations, Little Pecan Bayou and East Calcasieu Lake, in the coastal area. Once completed, the structures should not have direct impacts on recreational resources. Temporary direct impacts include disruption to recreational fishing and hunting in the vicinity of construction activities.

The proposed freshwater introduction/retention structure or sill on Little Pecan Bayou should have minimal, positive indirect impacts on recreational opportunities. Wetlands surrounding the bayou may not be as susceptible to degradation from saltwater intrusion and therefore are more likely to provide a productive nursery habitat for fish and wildlife. By reducing saltwater intrusion and tidal flux from the lower Mermentau River into the wetlands adjacent to Little Pecan Bayou south of Grand Lake, levels of recreational fishing and hunting should be maintained and even improved as wetland acreages increase. The spillway structure proposed at East Calcasieu Lake will evacuate wetland-damaging storm surge from the wetlands behind the Cameron-Creole levee in the Cameron Prairie NWR East Cove Unit while not influencing the daily tidal exchange from Calcasieu Lake. The detrimental effects of salt laden storm surge on interior marshes should be reduced and minimize the negative impacts on recreational fishing and hunting by reducing impacts to wetland habitat needed to support fish and wildlife.

See Map N2 for National and State Parks in SWCL Area and TSP NED and NER Measures.

Marsh Creation: Any direct impacts to recreational fishing, hunting and other recreational resources would be temporary and occur during construction activities. However, since there are many other areas for recreational fishing and hunting in the coastal region, impacts are expected to be minimal.

An indirect effect of marsh restoration and nourishment is the potential for limiting access to fishing areas as boaters would have to navigate around newly created land area. Recreationalists may have to circumvent the marsh creation project area when traveling to a destination due to construction activities limiting or delaying access. It is assumed floating pipelines would convey dredge material from borrow areas to sites being restored. These pipelines may, in some cases, block access to fishing areas and fisherman may have to travel longer distances to arrive at their preferred destination. However, canals that are frequently used by fisherman should not be blocked as the pipeline crossing these locations may be submerged.

Marsh creation projects proposed for Cameron Prairie NWR East Cove Unit and to a lesser extent in Sabine NWR may improve fishing and hunting opportunities once the projects have a chance to mature into productive fishery and wildlife habitats. Marsh creation measures proposed along Freshwater Bayou should provide additional habitat to birds and other wildlife in the Paul J. Rainey Wildlife Sanctuary. In general, measures that create marsh habitat and improve hydrology of wetlands are more likely to improve recreational fishing opportunities by enhancing the sustainability of productive nursery habitats. Marsh creation, while improving nursery habitat for juveniles in the interior marshes, could improve recreational fishing opportunities in off-shore waters as adults move to deeper depths. Development of additional marsh habitat is potentially beneficial to bird watching as it would support more birds and increase the diversity of species in the area. Potential negative effects include temporary turbidity associated with construction of marsh projects and excavation of borrow material in the Calcasieu Ship Channel, Calcasieu Lake, Freshwater Bayou and the Gulf of Mexico.

Shoreline Protection: Any direct impacts to recreational fishing and hunting would be temporary and occur during construction activities. Bank fishing in areas proposed for shoreline protection or spoil bank fortification measures could be affected. Holly Beach shoreline stabilization offshore breakwater along the Gulf of Mexico shoreline from the western jetty of the Calcasieu Ship Channel to just west of the town of Holly Beach may temporarily disrupt recreational use on the beach during construction activities as will the reef breakwater along the Gulf of Mexico shoreline of the Rockefeller Wildlife Management Area and Game Preserve. The breakwaters would help reduce the risk of storm surge and saltwater damage to recreational opportunities within the preserve thereby helping preserve recreational resources of the park.

Indirect impacts of the spoil bank fortification projects for the GIWW and Freshwater Bayou Canal, designed to reduce erosion of canal banks, could help protect recreational resource lands from effects of coastal storm surge and minimize the loss of valuable fishery habitat. Potential effects of shoreline protection measures would include the temporary displacement of fish populations due to increased turbidity both near the shorelines and near borrow areas during project implementation. Spoil bank fortification with rock dikes along the Freshwater Bayou Canal may cause temporary disruption to recreational use in the project vicinity. Not sure what rock dikes look like.

Cheniers: Chenier reforestation measures support wildlife and system structure. Restoration of natural ridges would improve bank stabilization and potentially provide additional habitat for deer, small game and birds, which could be beneficial for hunting and bird watching. Restored ridges would also enhance protection available to adjacent swamps and marshes during coastal storms, which could also potentially benefit recreational resources and infrastructure such as boat launches.

Oyster Reefs: The preservation of the historic Sabine Oyster Reef located in the southern end of Sabine Lake near Sabine Pass should not have a direct impact on recreational resources. Public oyster grounds are located within the oyster reef restoration area. However, oyster seasons in Sabine Lake haven't occurred since the early 1960's based on anecdotal information; neither Texas nor Louisiana can document harvest beyond that time and no concrete harvest data has been located (LDWF 2012 Oyster Stock Assessment Report of the Public Oyster Areas in Louisiana). Since oyster reef restoration measures improve the hydrology of wetlands, there could be an indirect impact on fishing and hunting recreational resources from improved wetland habitat.

Cumulative Impacts:
The cumulative impacts of other ongoing and planned ecosystem restoration measures are expected to be generally beneficial to recreation as the risk of destruction of recreation resources by storm surge is reduced and habitat areas supporting fish and wildlife resources are enhanced. Temporary negative impacts of marsh restoration activities due to increased turbidity and possible boating access issues are mediated by the presence of other productive and popular recreation areas throughout the coastal region of Louisiana. Long-term positive cumulative impacts are expected to occur as restoration enhances the sustainability of valuable nursery habitats.

Alternative M4 Entry Salinity Control for Mermentau Basin
Direct and Indirect Impacts:

Hydro/Salinity: Alternative M4 Entry Salinity Control for Mermentau Basin includes one structure at Little Pecan Bayou. Direct and indirect impacts to recreational resources from the hydrology/salinity measure at Little Pecan Bayou would be the same as described for the TSP.

Marsh Creation: Direct and indirect impacts to recreational resources from marsh creation measures for Alternative M4 would be similar to and less than impacts described for the TSP. Alternative M4 consists of a few less marsh creation projects compared to Alternative C4+M4. Potential positive indirect impacts could accrue to recreational resources by improving opportunities for fishing, hunting and wildlife viewing in the vicinity of MC projects South of Highway 82 near Grand Chenier and along both the west and east side of Freshwater Bayou including the Paul J. Rainey Wildlife Sanctuary.

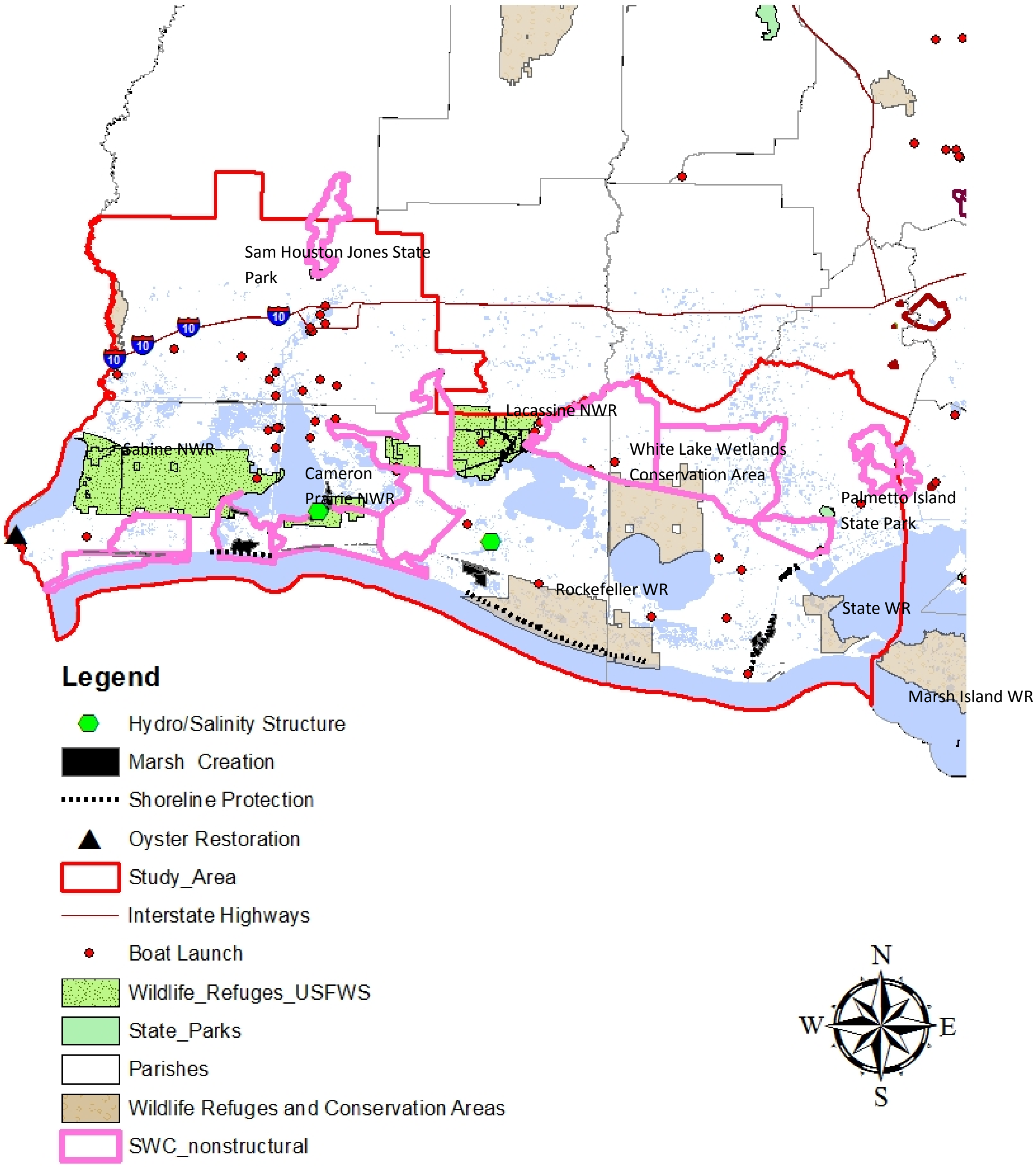
Shoreline Protection: Direct and indirect impacts to recreational resources from shoreline protection measures for Alternative M4 would be similar to and less than impacts described for the TSP. Alternative M4 includes SP measures along the Rockefeller Wildlife Management Area and Game Preserve and Freshwater Bayou.

Cheniers: Direct and indirect impacts to recreational resources from the Cheniers measures for Alternative M4 would be similar to and less than impacts described for the TSP.

Oyster Reefs: Direct and indirect impacts to recreational resources from Oyster Reefs measures for Alternative M4 would be similar to impacts described for the TSP.

Cumulative Impacts: Cumulative impacts to recreational resources from Alternative M4 would be similar to impacts described for the TSP.

Map N2: National and State Parks in SWCL Area and TSP NED/NER Measures



SOUTHWEST COASTAL LOUISIANA
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APPENDIX A

Annex O

Environmental Justice

CONTENTS

1. INTRODUCTION

An environmental justice (EJ) analysis was conducted which focused on the potential for disproportionately high and adverse impacts to minority and low-income populations during the construction and normal operation of the proposed risk-reduction system. While the assessment identified the occurrence of minority and low-income populations within the project area, both inside and outside of the proposed system, no disproportionately high and adverse effects to environmental or human resources are evident with any of the alternatives. Overall, at the Census Tract and block group level, the assessment found comparable impacts for communities inside and outside the system regardless of socioeconomic status or race/ethnicity.

A disproportionately high and adverse effect means the impact is appreciably more severe or greater in magnitude on minority or low-income populations than the adverse effect suffered by the non-minority or non-low-income populations after taking offsetting benefits into account.

This appendix will provide information on Census Tract and block group EJ analysis. If necessary additional details will be given in future supplemental NEPA documents for SWC on EJ analysis including:

- Outreach and public involvement details
- Details of buyout alternatives
- Relocation assistance for communities to preserve cultures/languages/traditions

2. METHODOLOGY

Environmental Justice 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, Pacific Islander, some other race, or a combination of two or more races. A minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population. Low-income populations as of 2000 are those whose income are $22,050 for a family of four and are identified using the Census Bureau's statistical poverty threshold. The Census Bureau defines a "poverty area" as a census tract or block group with 20 percent or more of its residents below the poverty threshold and an "extreme poverty area" as one with 40 percent or more below the poverty level. This resource is technically significant because the social and economic welfare of minority and low-income populations may be positively or disproportionately impacted by the proposed actions. This resource is publicly significant because of public concerns about the fair and equitable treatment (fair treatment and meaningful involvement) of all people with respect to environmental and human health consequences of Federal laws, regulations, policies, and actions.

The methodology, consistent with E.O. 12898, to accomplish this EJ analysis includes identifying low-income and minority populations within the project area using up-to-date economic statistics, aerial photographs, U.S. Census Bureau 2007-2011 American Community Survey (ACS) estimates, as well as conducting community outreach activities such as public meetings. The newly released ACS estimates provide the latest socioeconomic community characteristic data, including poverty level, released by the U.S. Census Bureau and are based on data collected between January 2007 and December 2011. Race and ethnicity data at the Census block level was compiled from the 2010 U.S. Census data. The 2010 U.S. Census dataset was chosen because it is more complete and based on actual counts. Income and poverty data was compiled from the 2007-2011 American Community Survey (ACS) 5-Year Estimates at the Census block group level.

A potential disproportionate impact may occur when a proposed project impacts a much higher percentage of minority and low income populations than other communities located within the project area. All Census Tracts and Census block groups located within the project area are identified as the EJ study area. Calcasieu, Cameron, and Vermilion Parishes are considered the reference communities of comparison.

2.1 Historic and Existing Conditions:

High poverty rates negatively impact the social welfare of residents and undermine the community's ability to provide assistance to residents in times of need. The 2007-2011 ACS data indicate that 17% of households in Calcasieu Parish, 9% in Cameron Parish, and 18% in Vermilion Parish fell below the poverty line. The 2007-2011 ACS data indicate that there are:

- 34 poverty areas and 15 extreme poverty areas (block groups) in Calcasieu Parish
- 0 poverty areas or extreme poverty areas (block groups) in Cameron Parish
- 18 poverty areas and 3 extreme poverty areas (block groups) in Vermilion Parish

Race and Ethnicity continue to play an important role in the everyday lives of Americans. Unequal access to social and political resources may affect preparing for and recovering from storm damage and flood events for certain groups. **Table 4** shows the racial characteristics of the three parishes according to the 2010 U.S. Census.

Table 4. Racial Characteristics of the 3 Affected Parishes

Racial Characteristics							
Parish	White	African American	American Indian/ Alaska Native	Asian	Hawaiian/ Pacific Islander	Total	Percent Minority
Calcasieu	136,514	47,782	898	2,073	93	192,768	29%
Cameron	6,546	119	36	6	0	6,839	4%
Vermilion	46,922	8,286	209	1,160	5	57,999	20%

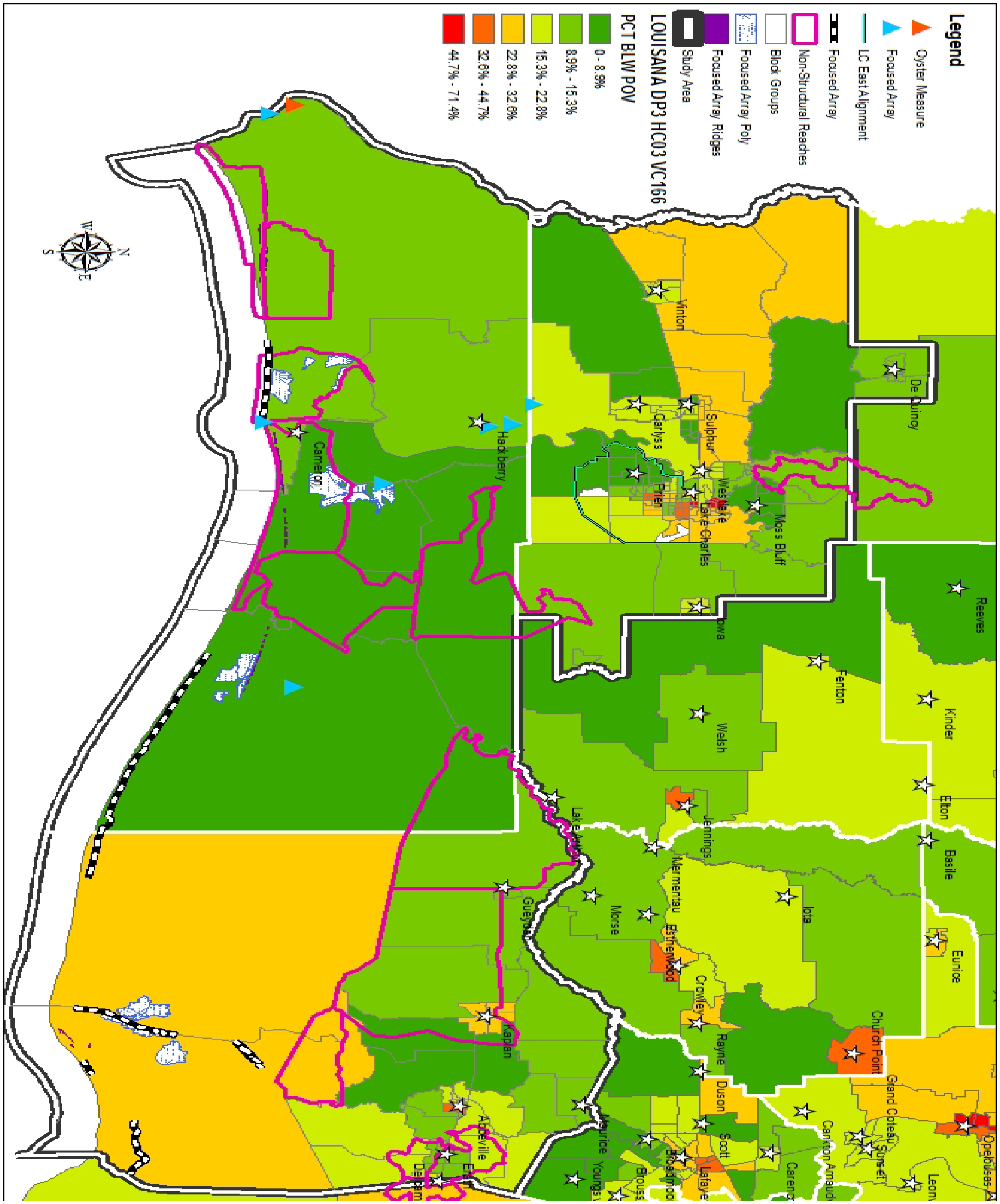

Figure 2-EJ Percent Below Poverty by Block Group

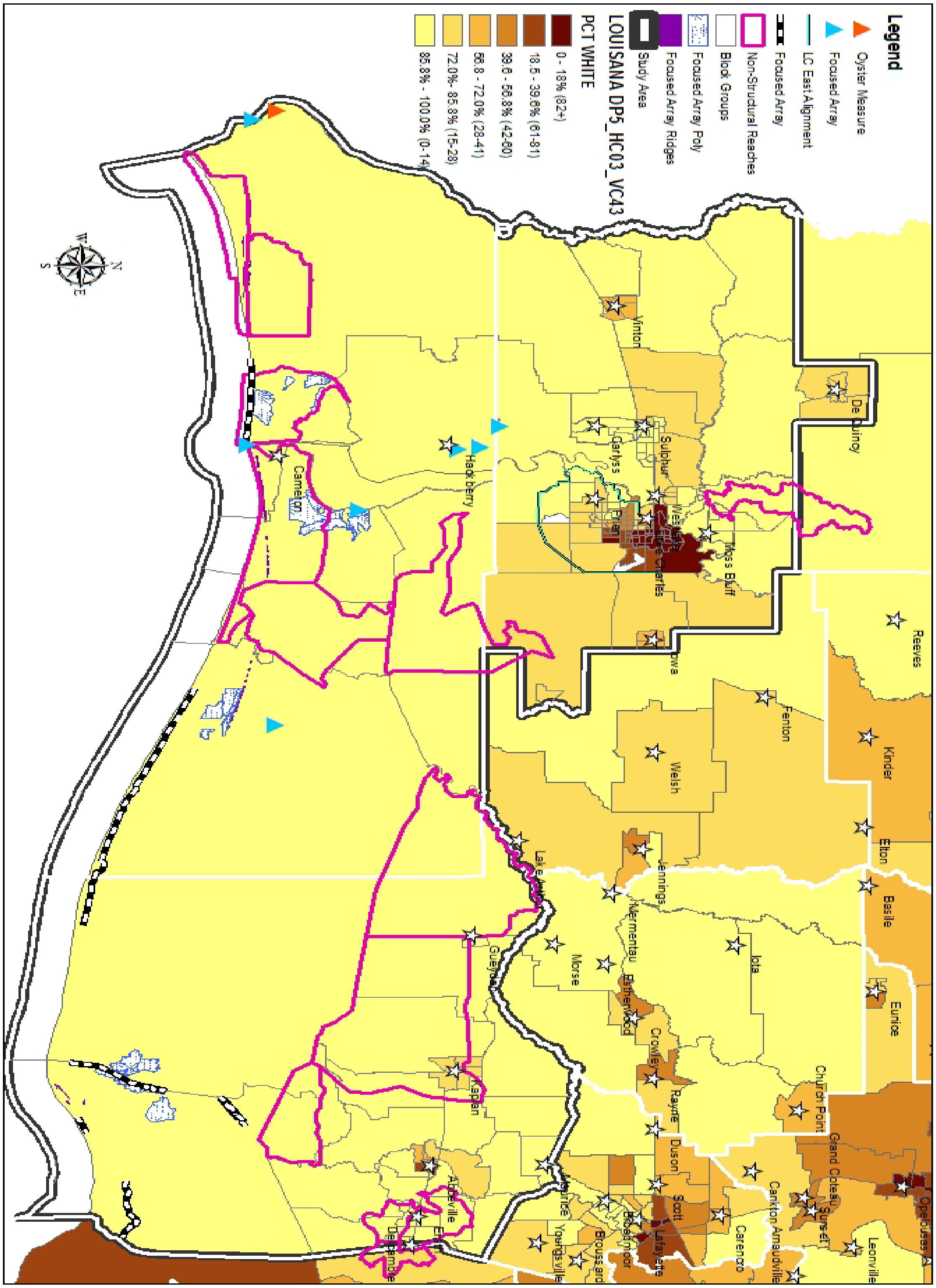

Figure 3- EJ Racial Majority by Block Group

According to the 2010 U.S. Census data there are 39 block groups in Calcasieu Parish where 50% or more of the population identify themselves as part of a minority group. There are no block groups in Cameron Parish where more than 1% of the population identify themselves as part of a minority group. There are 9 block groups in Vermilion Parish where 50% of the population identify themselves as part of a minority group.

2.2 Future Without-Project Conditions (No Action Alternative)

Direct, Indirect, and Cumulative Impacts: The No Action Alternative would not provide hurricane and storm damage risk reduction, or reduce flooding induced by storm surge, or provide ecosystem restoration that improves ecosystem sustainability. There would be no direct impact on minority and/or low-income populations under this alternative. Indirect impacts under the No Action Alterative include a higher potential for temporary displacement of minority and/or low-income populations because residents within the project area would remain vulnerable to flooding and may be forced to relocate to areas with risk reduction features in place. Storm surge increase due to subsidence and sea level rise will exacerbate their vulnerability to flooding. Low-income populations may also find it more difficult to bear the cost of evacuation. This alternative would not contribute to any additional EJ issues when combined with other Federal, state, local, and private risk reduction efforts.

3. ENVIRONMENTAL CONSEQUENCES

Since the no action alternative fails to provide risk reduction, impacts to minority and/or low-income populations under this alternative would be higher than under the proposed alternative.

Although multiple communities would be temporarily impacted by the project, the impacts would be temporary, lasting only as long as the construction and all residents are expected to be similarly impacted regardless of race, income, or ethnicity. Therefore, we have determined that there is no “disproportionate” impact to a minority or low-income community for any of the alternatives.

3.1 Alternative — Nonstructural Plan (TSP)

Direct, Indirect, and Cumulative Impacts: Indirect impacts would include a decrease in risk of damage from 1 percent (and more frequent) exceedance storm events for minority and/or low-income populations in the study area. Population groups residing or working near the construction site itself may experience direct impacts due to the added traffic congestion and construction noise and dust.

It is assumed that all structures within the 100-year flood zone in the economically justified 11 reaches of the nonstructural plan are either flood-proofed, elevated, or acquired; therefore all residents within the 11 reaches, irrespective of race, ethnicity, or income, would be expected to be similarly impacted. However, since the geographic unit of analysis may change during the feasibility phase, further evaluation will determine if the federal action causes a disproportionate impact to low-income or minority communities.

Positive cumulative impacts to minority and/or low-income populations associated with providing risk reduction are expected to occur as a result of the lower flood risk in the area under this alternative. If this alternative encourages regional economic growth, any additional jobs created may benefit minority and/or low-income groups living within the project area.

3.2 Alternative C4+M4 — Entry Salinity Control Plan (TSP)

Direct, Indirect, and Cumulative Impacts: Many of the areas in which these activities will occur are sparsely populated or devoid of permanent structures and/or population. Construction of control structures to reduce saltwater intrusion and tidal influx would temporarily impact leisure and recreation at any nearby camps or designated fishing and hunting spots. Access to some areas due to marsh creation and nourishment activities may be temporarily interrupted. Impacts due to shoreline protection construction would also be temporary. The long-term benefits of salinity control, marsh creation, shoreline protection, bank stabilization, chenier reforestation, and oyster reef restoration would improve wetland habitat which would subsequently improve leisure and recreation opportunities. If this alternative encourages regional economic growth, any additional jobs created may benefit minority and/or low-income groups living within the project area.

Temporary impacts from construction activities due to increased turbidity, noise, and access interruption are compensated for by the opportunity for long-term positive cumulative impacts as other restoration programs improve the habitat and sustainability of coastal Louisiana.

3.3 Alternative M4 — Entry Salinity Control for Mermentau Basin

Direct, Indirect, and Cumulative Impacts: The direct, indirect, and cumulative impacts would be the same as described for the M4 component of the TSP.

4. MITIGATION FOR ADVERSE IMPACTS

Regulations require that mitigation measures be developed to address environmental effects, including cumulative impacts, threatened by proposed actions (40 CFR 1502.14(f) and 1502.16(h)). In addition, mitigation measures should be developed specifically to address potential disproportionately high and adverse effects to minority and/or low-income communities. Potential mitigation measure for addressing adverse effects of construction of SWC could include:

- Providing assistance to the affected communities to ensure they receive a fair share of the anticipated benefits of the proposed action (infrastructure improvements)
- Providing uniform relocation assistance to the affected communities, with their concurrence
-

When identifying and developing potential mitigation measures to address environmental justice concerns, members of the affected communities would be consulted. Enhanced public participation efforts would also be conducted to ensure that effective mitigation measures are identified and that the effects of any potential mitigation measures are fully analyzed and compared. Mitigation measures may include a variety of approaches for addressing potential effects and balancing the needs and concerns of the affected community with the requirements of the action or activity. These details would be provided in the appropriate NEPA document.

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Annex P

Other Social Effects

CONTENTS

1. INTRODUCTION

This appendix presents a socioeconomic evaluation of the alternatives being considered for coastal storm damage risk reduction for the Southwest Coastal Louisiana evaluation area, which includes portions of three parishes in the state of Louisiana. It was prepared in accordance with Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, ER 1105-2-101, Planning Guidance, Risk Analysis for Flood Damage Reduction Studies, and Engineering Circular (EC) 1105-2-409.

Given the area's low elevation, flat terrain, and proximity to the Gulf of Mexico, the people, economy, unique environment and cultural heritage of Southwest Louisiana are at risk of storm surge flooding and wave impacts from tropical storms. Land subsidence, combined with rising sea level, is expected to increase the potential for coastal flooding, shoreline erosion, saltwater intrusion, and loss of wetland and chenier habitats in the future.

Because of that risk, alternatives to provide hurricane and storm damage risk reduction and reduce flooding induced by storm surge are being evaluated for Southwest Louisiana. Opportunities to incorporate non-structural solutions to reduce vulnerability, damages, and economic losses are being studied through the Southwest Coastal Louisiana Feasibility Study being conducted by the U.S. Army Corps of Engineers (USACE) New Orleans District (MVN) and Regional Planning and Environmental District South (RPEDS).

1.1 Purpose

The purpose of this appendix is to describe the Other Social Effects (OSE) account of the SWCL project. The OSE account considers the potential social ramifications of Corps actions so that decision makers and stakeholders are able to evaluate the social implications of each alternative and choose an alternative that will be judged as complete, effective, and fair.

1.1.1 Study Area

The area covers over 4,700 square miles in Louisiana's Chenier Plain. It lies in the southwest corner of the state in Calcasieu, Cameron and Vermilion parishes. The Gulf Intracoastal Waterway (GIWW) dissects the area horizontally, mostly coterminous with the existing coastal zone boundary.

The Gulf of Mexico coastline is another major water resource of the area. The major highways are LA Highway 82 and LA Highway 27. Population centers include many small towns, the largest of which are Lake Charles, Sulphur, Grand Lake, and Abbeville.

Communities located within the study area include the city of Lake Charles, the towns of Sulphur, Vinton, Iowa, and Bell City in Calcasieu Parish, the towns of Cameron, Creole, Grand Chenier, and Grand Lake in Cameron Parish, the city of Abbeville, and the towns of Erath, Delcambre, Kaplan, and Pecan Island in Vermilion Parish. All three parishes have historically suffered extensive hurricane and tropical storm damage due to insufficient flood control features. The impact of preparing for, mitigating, and recovering from these damages has placed a significant physical and emotional burden on individuals and has been devastating for communities. The goals of the proposed project are to provide protection to residents within the study area from the damaging effects of storm surges while also protecting and preserving the fragile and rapidly deteriorating coastal wetlands.

1.1.2 Overview of Other Social Effects

The USACE views “social well-being factors as constituents of life that influence personal and group definitions of satisfaction, well-being, and happiness. The distribution of resources; the character and richness of personal and community associations; the social vulnerability and resilience of individuals, groups, and communities; and the ability to participate in systems of governance are all elements that help define well-being and influence to what degree water resources solutions will be judged as complete, effective, acceptable, and fair.” (USACE, 2009) It is the OSE account that considers these elements and assures that they are properly weighted, balanced, and considered during the planning process under the USACE’s Four Accounts Planning Framework.

This appendix follows the guidance set forth by the USACE Institute for Water Resources (IWR) in *Applying Other Social Effects In Alternatives Analysis* (USACE, 2013). The handbook describes the procedures for analyzing and using OSE criteria in the planning process by identifying seven social factors that describe the social fabric of a community. The social factors are based on conventional psychological Human Needs Theory and Abraham Maslow’s Hierarchy of Needs. Table 1 lists and describes the social factors. These social factors are covered in the Socioeconomic and Other Social Effects sections of the report.

Table 1 Social Factors

Social Factor	**Description**
Health and Safety	Refers to perceptions of personal and group safety and freedom from risks
Economic Vitality	Refers to the personal and group definitions of quality of life, which is influenced by the local economy’s ability to provide a good standard of living
Social Connectedness	Refers to a community’s social networks within which individuals interact; these networks provide significant meaning and structure to life
Identity	Refers to a community member’s sense of self as a member of a group, in that they have a sense of definition and grounding
Social Vulnerability and Resiliency	Refers to the probability of a community being damaged or negatively affected by hazards, and its ability to recover from a traumatic event
Participation	Refers to the ability of community members to interact with others to influence social outcomes
Leisure and Recreation	Refers to the amount of personal leisure time available and whether

	community members are able to spend it in preferred recreational pursuits

Source: Applying Other Social Effects In Alternatives Analysis (USACE, 2013)

1.1.3 Organization of Appendix

The OSE appendix is organized as follows:

- Section 1 provides an introduction to OSE.
- Section 2 provides a description of the existing socioeconomic characteristics, and the existing and future without-project social factors of the study area.
- Section 3 provides an OSE analysis of the project alternatives.

2. OTHER SOCIAL EFFECTS STUDY AREA CHARACTERISTICS

This section provides a description of the existing and future without-project socioeconomic characteristics and other social factors of the study area.

2.1 Socioeconomic Characteristics of the Study Area

In this section, socioeconomic data for Calcasieu, Cameron, and Vermilion Parishes are presented in order to provide a context from which to evaluate the potential social impacts of the proposed project. A more detailed explanation of socioeconomic characteristics is available in the main report socioeconomic section.

2.1.1 Population and Households

Population increases in the three parish area between 2000 and 2010 are likely the result of population influx under normal growth conditions. The three parish total population in 2012 was 259,918 residents, although there has been a decline of population in Cameron Parish since 2000.

The 2012 study area population total 257,606. Most households are located in the metropolitan areas. Major communities include: Lake Charles, the largest urban area in the study, in Calcasieu Parish; Cameron (which serves as the parish seat) in Cameron Parish; and Abbeville in Vermilion Parish.

2.1.2 Employment Opportunities

Leading employment sectors include education, healthcare, petroleum and petrochemical and service industries. Industries providing employment include education, health and social services (20%), manufacturing (15%), arts, entertainment, accommodations and food services (12%), and retail trade (12%).

2.1.3 Social Profile of Communities

This section provides a baseline profile of existing and future without project conditions for the social communities in the study area. Data for the social profile were obtained from a variety of sources including 2010 U.S. Census records, the 2007-2011 U.S. Census Bureau's American Community Survey (ACS) estimates, ESRI data, public meetings, interviews with local representatives, and aerial photography. The baseline characteristics are considered the existing and future-without project conditions.

2.1.4 Health and Safety (Stress, Loss-of-Life, Health Care and Emergency Facilities)

Severe flood events threaten the health and safety of residents living within the study area. Loss of life, injury, and post flood health hazards may occur in the event of catastrophic flooding. For example, the study area was severely impacted by Hurricane Rita in 2006 and Hurricane Ike in 2008. The Louisiana Recovery Authority estimated that 120 fatalities occurred associated with Hurricane Rita with 1 in Louisiana. Hurricane Ike was more costly in terms of lives lost and damages incurred, claiming 195 deaths in four countries and ranking as the third costliest storm in US history according to the National Hurricane Center. When facilities that provide critical care or emergency services are impacted by flood events, residents are at an even greater risk for experiencing negative health outcomes. Hurricanes Rita and Ike reduced the accessibility and availability of health facilities and services and required additional first-responder (fire and police) protection. During Rita and Ike, police stations were destroyed by storm surge and/or required to relocate because of flood risk. In addition to the damages of Rita and Ike to hospitals, police stations, and fire stations, many employees providing related services lost their homes reducing the staff needed to operate health and safety services.

The number of medical facilities, police stations, and fire stations located within the study area were obtained using 2010 ESRI data (latest year available).

Medical Care Facilities: There are 8 medical care facilities within Calcasieu Parish, 4 medical care facilities in Cameron Parish, and 6 medical care facilities in Vermilion Parish.

Police Stations: Calcasieu Parish has 8 police stations/sheriff's offices located within the study area, Cameron Parish has 5 police stations/sheriff's offices, and Vermilion Parish has 6 police stations/sheriff's offices, according to ESRI data.

Fire Stations: There are 29 fire stations (parish and volunteer) located within the study area—9 in Calcasieu Parish, 8 in Cameron Parish, and 12 in Vermilion Parish.

2.1.5 Economic Vitality

Growth in employment, business and industrial activity is expected to follow economic trends in the local, regional, and national economies. An additional 11,940 jobs are projected by the year 2038. However, without flood risk management alternatives, the stability of employment, business and industrial activity could be adversely affected.

2.1.6 Social Connectedness

The degree to which communities are able to instill a shared sense of belonging and purpose among residents is in large part determined by the communities' civic infrastructure. The presence of social institutions such as libraries, places of worship, and schools provide residents an opportunity for civic participation and engagement which allows residents to come together and work toward a common goal. The number of libraries and schools located within the study area were obtained using 2010 ESRI data (latest year available).

Civic Infrastructure: According to ESRI data, Calcasieu Parish has 7 libraries and 34 schools. There are 2 libraries and 2 schools located within the study area in Cameron Parish. ESRI data also show that there are 9 libraries and 9 schools located within the study area in Vermilion Parish.

2.1.7 Social Vulnerability/Resiliency

The devastation left behind after Hurricanes Rita and Ike brought attention to the salience of the related concepts of social vulnerability and resiliency when evaluating water resources projects (USACE, 2008). Social vulnerability is a characteristic of groups or communities that limits or prevents their ability to withstand adverse impacts from hazards to which they are exposed.

Resiliency, in turn, refers to the ability of groups or communities to cope with and recover from adverse events. The factors that contribute to vulnerability often reduce the ability of groups or communities to recover from a disaster; therefore, more socially vulnerable groups or communities are typically less resilient.

Several factors have been shown to contribute to an area's vulnerability/resiliency, including poverty, racial/ethnic composition, educational attainment, and proportion of the population over the age of 65.

Poverty Rate: High poverty rates negatively impact the social welfare of residents and undermine the community's ability to assist residents in times of need. The 2007-2011 U.S. Census data indicate that 17 percent of the population of Calcasieu, 9 percent of the population in Cameron Parish, and 18 percent of the population in Vermilion Parish fell below the poverty line.

Racial / Ethnic Composition: Race/ethnicity continues to play an important role in the everyday lives of Americans. Unequal access to social resources and language barriers may affect preparing for and recovering from flood events for certain groups. In all parishes, according to the 2010 U.S. Census, the majority of the population is white (71% in Calcasieu Parish, 96% in Cameron Parish, and 80% in Vermilion Parish), followed by black (29% in Calcasieu Parish, 4% in Cameron Parish, and 20% in Vermilion Parish).

Social Vulnerability Index: The Hazards and Vulnerability Research Institute at the University of South Carolina created an index that compares the social vulnerability of U.S. counties/parishes to environmental hazards. The variables included in the index are based on previous research which has found that certain characteristics (e.g., poverty, racial/ethnic composition, educational attainment, and proportion over the age of 65) contribute to a community's vulnerability when exposed to hazards. According to the IWR OSE handbook (USACE, 2008), the Social Vulnerability Index (SoVI®)[3] is a valuable tool that can be used to identify areas that are socially vulnerable and whose residents may be less able to withstand adverse impacts from hazards.

The SoVI® was computed as a comparative measure of social vulnerability for all counties/parishes in the U.S., with higher scores indicating more social vulnerability than lower scores. Calcasieu Parish has a SoVI® 2006-10 score[4] of -1.21 (0.28 national percentile), Cameron Parish has a SoVI® 2006-10 score of -3.59 (.08 national percentile), and Vermilion Parish has a SoVI® 2006-10 score of -0.04 (0.49 national percentile). Calcasieu Parish is less socially vulnerable than roughly 28 percent of counties/parishes in the U.S., Cameron Parish is less socially vulnerable than about 8 percent of counties/parishes in the U.S., and Vermilion Parish is less socially vulnerable than roughly 49 percent of counties/parishes in the U.S. In comparison, Orleans Parish—notorious for its enduring levels of high poverty—has a SoVI®

[3] More information on the methodology and data used to calculate the SoVI® can be found here: http://webra.cas.sc.edu/hvri/products/sovi.aspx
[4] Data can be found here: http://webra.cas.sc.edu/hvri/products/sovi2010_data.aspx

2005-09 score of -0.92 with 67 percent of counties/parishes in the nation ranked more socially vulnerable.

Stated another way, Cameron Parish is the most socially vulnerable to coastal storm damage consequences, Calcasieu Parish is the next most socially vulnerable, and Vermilion Parish is the least socially vulnerable. In comparison, both Cameron and Calcasieu Parishes are more socially vulnerable to coastal storm damage consequences than Orleans Parish.
The study area's social vulnerability, however, is expected to increase over time if subsidence and sea level rise continue to occur, and the population in the study area increases as it is projected to do. The absolute number of socially vulnerable people (e.g., low-income, minority, less-educated, and over the age of 65) at risk for flood events will increase. This, in turn, may lead to an increased burden placed on local, state, and federal agencies to ensure that these socially vulnerable populations have access to resources before, during, and after flood events.

2.1.8 Leisure and Recreation

Having personal leisure time available and having access to recreational areas contributes to residents' quality of life and is therefore an important aspect of well-being. The number of recreational areas within the study area was obtained using 2011 ESRI data (latest year available).

The three parish study area is home to a State Wildlife Refuge, the 71,544-acre White Lake Wetlands Conservation Area, the 76,000-acre Rockefeller Wildlife Refuge (WR), the Lacassine National Wildlife Refuge (NWR), Cameron Prairie NWR, and the 124,511-acre Sabine NWR. State Parks in the study area include Palmetto Island and Sam Houston Jones parks.

Recreational fishing and hunting are very important to the area. In addition to the high quality recreational fishing and hunting in the wildlife refuges and parks in the study area, several lakes and inland marshes offer opportunities for hunting and catching both freshwater and saltwater species. Grand, White, and Calcasieu Lakes and Vermillion Bay are prime fishing spots. The high quality of the recreational fishery, especially an abundance of red fish and trout, has made this an important leisure time activity for residents. Inland saltwater fish species, crabs, and shrimp are also available in the more brackish water. Game species hunted in the area include waterfowl, deer, rabbit, squirrels, rail, gallinule, and snipe.

3. OTHER SOCIAL EFFECTS EVALUATION OF ALTERNATIVES

3.1 Social Implications of the Alternatives

This section provides an OSE analysis of the project alternatives. The evaluation is based on the differential impact that each alternative is expected to have on the socioeconomic characteristics and other social factors of the study area presented in the previous section.

The study area's social vulnerability is expected to increase over time if subsidence and sea level rise continue to occur, and the population in the study area increases as it is projected to do. The absolute number of socially vulnerable people (e.g., low-income, minority, less-educated, and over the age of 65) at risk for flood events will increase. This, in turn, may lead to an increased burden placed on local, state, and federal agencies to ensure that the most socially vulnerable populations have access to resources before, during, and after flood events.

Table 2 Other Social Effects (OSE) Account			
Social Factor	**No Action**	**Nonstructural**	**NER**
Health and Safety	High level of flood risk in entire region with associated stress and anxiety, risk to regional health care system, and impacts to emergency access during floods. High potential for loss of life during storm events.	Project would reduce risk to regional healthcare system and stress in Southwest Louisiana.	Project would contribute to a lower stress level due to perception of consideration.
Economic Vitality	Current regional economy is moderate. If a catastrophic flood occurs, economic impacts will be extensive and long-lasting.	Project would benefit the regional conomy.	The regional economy will benefit from improved habitat and storm resiliency.
Social Connectedne ss	High levels of instrumental social support will continue throughout the region. Population of coastal communities will continue to decline after storm events following historic trends, and social connectedness would be reduced.	Residents would experience social disruption during storm events or flooding, however social connectedness would likely improve population retention.	Residents would benefit socially and economically from improved habitat.
Social Vulnerability and Resiliency	Region is highly vulnerable to Storm damage, but residents would likely band together during recovery. Resilience of rural communities may be lower due to lack of temporary housing options. Low -income residents are more vulnerable to short-term impacts of flood fighting.	Project would significantly reduce the area's vulnerability to storm damage.	Project would increase the area's resiliency to storm damage.
Leisure and Recreation	Residents of the region are active. Recreational opportunities would continue to be provided in the communities as currently planned	Project measures would help protect existing recreational opportunities but could reduce long-term opportunities.	Project measures would increase long-term recreational opportunities.

4. SUMMARY OF ALTERNATIVE ANALYSIS

4.1 Alternative — NED Nonstructural Plan (TSP)

Direct, Indirect, and Cumulative Impacts: Under this alternative, the study area would experience flood risk reduction via nonstructural measures. This alternative would reduce the risks associated with damages to housing units, public facilities, and commercial structures during storm events as well as improve the health and safety of residents living within the study area. The area's social vulnerability would be reduced under this alternative, and thus, the potential for long-term growth and sustainability would be enhanced. Also, the area would be at a reduced risk of incurring the costs associated with clean-up, debris removal, and building and infrastructure repair as a result of flood events.

4.1.1 Alternative C4+M4 — Entry Salinity Control Plan (TSP)

Direct, Indirect, and Cumulative Impacts: This alternative would reduce the risks associated with habitat damage via saltwater intrusion, shoreline retreat, and loss of geomorphologic infrastructure. The area's social vulnerability would be reduced under this alternative via improved leisure and recreation opportunities, access to health and safety facilities, economic vitality, and reduced stress. Thus, the potential for long-term growth and sustainability would be enhanced.

4.1.2 Alternative M4 — Entry Salinity Control for Mermentau Basin

Direct, Indirect, and Cumulative Impacts: The direct, indirect, and cumulative impacts would be the same as described for the M4 component of the TSP

5. REFERENCES

Hazards and Vulnerability Research Institiute. SoVI® 2006-10 Index. http://webra.cas.sc.edu/hvri/products/sovi2010_data.aspx Accessed on 03 Oct 2013.

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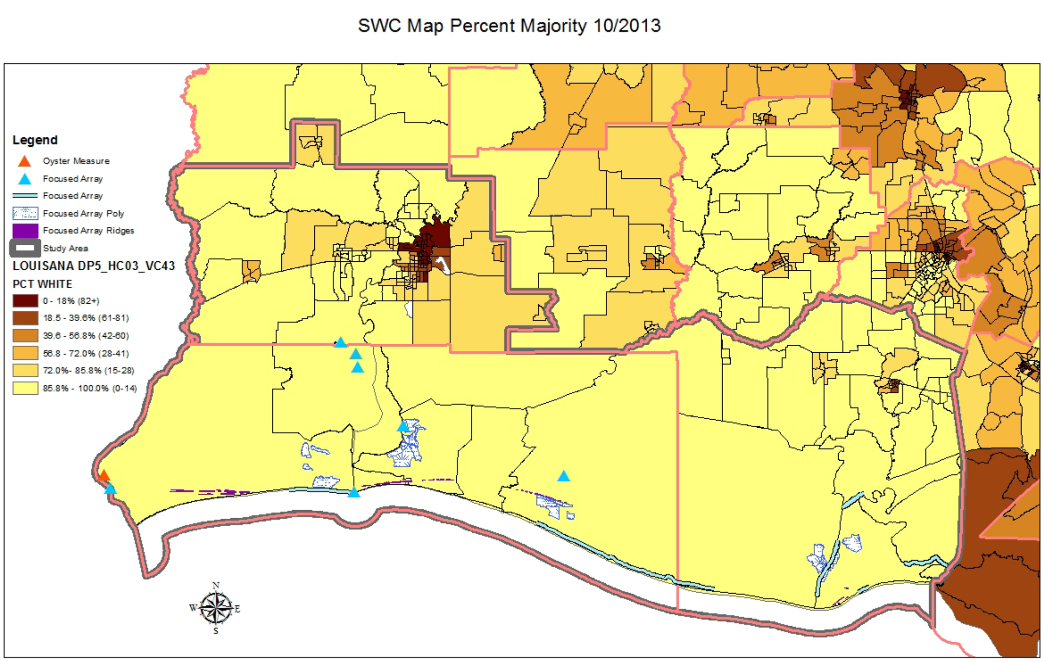


Figure 1. SWC Louisiana Study Area Racial Diversity 2013

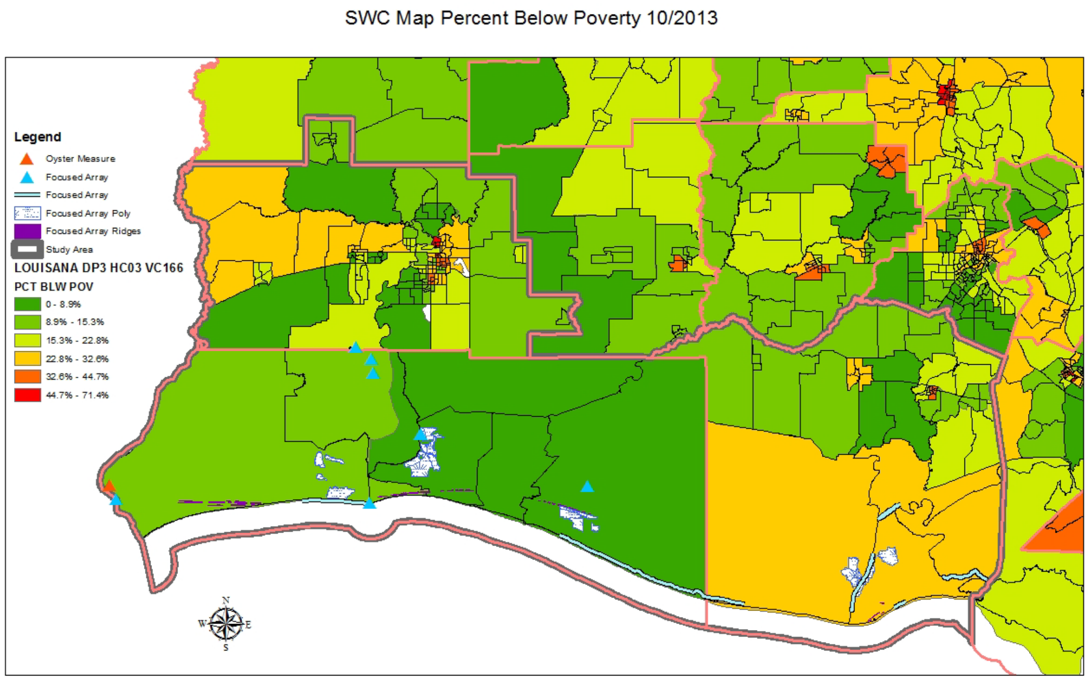


Figure 2. SWC Louisiana Study Area Percent Living Below Poverty 2013

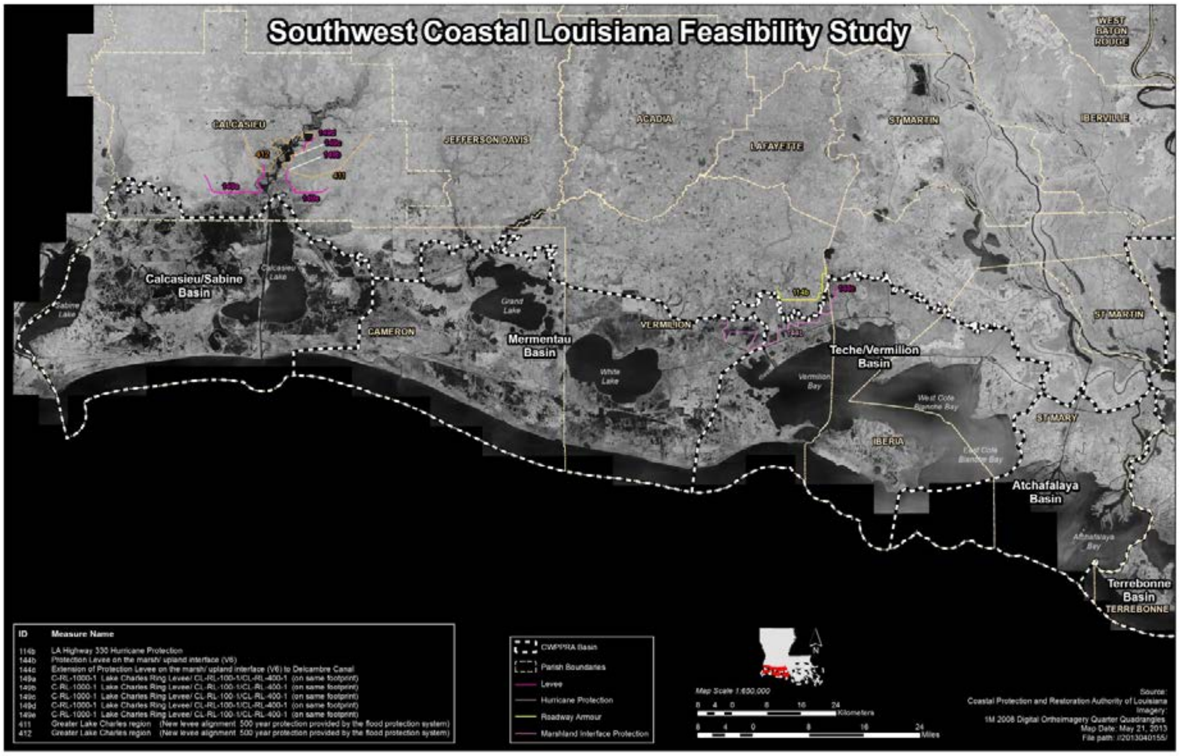


Figure 3. SWC Louisiana Study Area Non-Structural Alternatives 2013

SOUTHWEST COASTAL LOUISIANA INTEGRATED DRAFT FEASIBILITY REPORT AND PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex Q

Best Management Practices and Avoidance Procedures

MIGRATORY BIRD TREATY ACT and
BALD AND GOLDEN EAGLE PROTECTION ACT
BEST MANAGEMENT PRACTICES

Colonial nesting wading birds (including but not limited to, herons, egrets, and Ibis), seabirds/water-birds (including, but not limited to terns, gulls, Black Skimmers, and Brown Pelicans) and bald eagles are known to roost, forage and nest in the project area. The birds and their nests are protected by the Migratory Bird Treaty Act (MBTA) and must not be disturbed or destroyed. As such, in areas near known rookeries, nesting prevention measures may be necessary in order to insure the success of the nesting season. These measures would be developed by CEMVN in coordination with USFWS and LDWF and would be implemented by a trained biologist. The nesting activity period extends from 15 February through 1 September for colonial nesting wading and seabirds/water birds, and September to May for bald eagles. Therefore, the nesting prevention measures should begin well before February.

CEMVN and USFWS biologists will conduct surveys prior to construction to determine the presence and/or location of any eagle's nests, colonial nesting wading/water birds and/or rookeries and if nesting prevention measures would be necessary. Nest prevention measures shall be intended to deter birds from nesting within applicable the designated buffer zone of construction areas without physically harming birds or disturbing any existing nests. Nest prevention measures may be used in combination and/or adjusted to be most effective.
At minimum, nest prevention measures shall include, but not be limited to the following:

- Flagging/Streamers
- Vehicular/Pedestrian Traffic
- Clapping and Yelling
- Horn Blowing

Once work has commenced, the presence of nesting eagles, wading birds and/or seabirds/water-birds within the minimum distances from the work area, as specified in paragraph entitled "No Work Distances", shall be immediately reported to the Environmental Technical Manager, Ms. Tammy Gilmore, of the U.S. Army Corps of Engineers at (504) 862-1002 email address tammy.h.gilmore@usace.army.mil

No Work Distances

No-work distance restrictions are as follows:
o Terns, Gulls, and Black Skimmers -650 feet;
o Colonial nesting wading birds -1,000 feet; and,
o Brown Pelicans -2,000 feet; and,
o Bald Eagles -660 feet.

Coordination by the New Orleans District personnel with the U.S. Fish and Wildlife Service may result in a reduction or relaxing of these no-work distances depending on the species of birds found nesting at the work site and specific site conditions.
Manatee Protection Measures Coordinated with USFWS:

All contract personnel associated with the project would be informed of the potential presence of manatees and the need to avoid collisions with manatees. All construction personnel would be responsible for observing water-related activities for the presence of manatees. Temporary signs would be posted prior to and during all construction/dredging activities to remind personnel to be observant for manatees during active construction/dredging operations or within vessel movement zones (i.e., the work area), and at least one sign would be placed where it is visible to the vessel operator. Siltation barriers, if used, would be made of material in which manatees could not become entangled and would be properly secured and monitored. If a manatee is sighted within 100 yards of the active work zone, special operating conditions would be implemented, including: moving equipment would not operate within 50 ft of a manatee; all vessels would operate at no wake/idle speeds within 100 yards of the work area; and siltation barriers, if used, would be re-secured and monitored. Once the manatee has left the 100-yard buffer zone around the work area of its own accord, special operating conditions would no longer be necessary, but careful observations would be resumed. Any manatee sighting would be immediately reported to the U.S. Fish and Wildlife Service (337/291-3100) and the Louisiana Department of Wildlife and Fisheries (LDWF), Natural Heritage Program (225/765-2821).

SEA TURTLE PROTECTION MEASURES

1. Hopper dredging is being conducted under the "Gulf of Mexico Regional Biological Opinion" (RBO) which can be viewed at the following link: http://el.erdc.usace.army.mil/seaturtles/refs-bo.cfm.

It should be noted that incidental takes of sea turtle and gulf sturgeon are authorized on a Fiscal Year (FY) (October 1 – September 30) basis to be metered out by the Division Commander, South Atlantic Division, U.S. Army Corps of Engineers for the southeastern United States for Federal, military, and permitted projects. If care is not taken, the take limits could be reached by any of these parties and hopper dredging would cease for the remainder of that FY. The Permittee understands and agrees that, even where it is in full compliance with the terms and conditions of the RBO, incidental take by the Permittee may require suspension of the permit by the Corps of Engineers. The amount of incidental take that will trigger suspension, and the need for any such suspensions, shall be determined at the time in the sole discretion of the Corps of Engineers. The Permittee understands and agrees on behalf of itself, its agents, contractors, and other representatives, that no claim, legal action in equity or for damages, adjustment, or other entitlement against the Corps of Engineers shall arise as a result of such suspension or related action.

2. Prior to the commencement of hopper dredging, and throughout the dredging operations, a Corps of Engineers-approved Inspector shall inspect specific sea turtle protection requirements. The list of inspections the Inspector will perform is identified on a sea turtle inspection checklist entitled "USACE Sea Turtle Inspection Checklist for Hopper Dredges" that can be found at the following link: http://el.erdc.usace.army.mil/seaturtles/index.cfm. All identified deficiencies shall be corrected prior to the commencement of hopper dredging activities. An inspection shall also be performed following each sea turtle incidental take. Results of inspections shall be provided to Mr. Edward Creef (Edward.D.Creef@usace.army.mil) as soon as they are completed.

3. No dredging shall be performed by a hopper dredge without the inclusion of a rigid sea turtle deflector device. The Permittee shall electronically submit drawings showing the proposed device and its attachment to Mr. Edward Creef at Edward.D.Creef@usace.army.mil. Mr. Creef can be contacted by phone at (504) 862-2521. These drawings shall include the approach angle for any and all depths to be dredged during the dredging. A copy of the approved

drawings and calculations shall be available on the vessel during the dredging. No dredging work shall be allowed to commence until approval of the turtle deflector device has been granted by the New Orleans District U.S. Army Corps of Engineers. Sample turtle deflector design details may be viewed at the web site indicated in condition number 1.
The leading v-shaped portion of the deflector shall have an included angle of less than 90 degrees. Internal reinforcement shall be installed in the deflector to prevent structural failure of the device. The leading edge of the deflector shall be designed to have a plowing effect of at least 6" depth when the draghead is being operated. Appropriate instrumentation or indicator shall be used and kept in proper calibration to ensure the critical "approach angle". (Information only note: The design "approach angle" or the angle of lower draghead pipe relative to the average sediment plane is very important to the proper operation of the deflector. If the lower draghead pipe angle in actual dredging conditions varies tremendously from the design angle of approach used in the development of the deflector, the 6" plowing effect does not occur. Therefore, every effort should be made to insure this design "approach angle" is maintained with the lower drag pipe).

If adjustable depth deflectors are installed, they shall be rigidly attached to the draghead using either a hinged aft attachment point or an aft trunnion attachment point in association with an adjustable pin front attachment point or cable front attachment point with a stop set to obtain the 6" plowing effect. This arrangement allows fine-tuning the 6" plowing effect for varying depths. After the deflector is properly adjusted there shall be NO openings between the deflector and draghead that are more than 4" X 4".

4. The Permittee shall install baskets or screening over the hopper inflow(s) with no greater than 4" X 4" openings. The method selected shall depend on the construction of the dredge used and shall be approved by the Corps of Engineers-approved Inspector prior to commencement of dredging. The screening shall provide 100% screening of the hopper inflow(s). The screens and/or baskets shall remain in place throughout the performance of the work. The turtle deflector device and inflow screens shall be maintained in operational condition for the entire dredging operation.

5. When initiating dredging, suction through the dragheads shall be allowed just long enough to prime the pumps, and then the dragheads must be placed firmly on the bottom. When lifting the dragheads from the bottom, suction through the dragheads shall be allowed just long enough to clear the lines, and then must cease. Pumping water through the dragheads shall cease while maneuvering or during travel to / from the disposal area. (Information Only Note: optimal suction pipe densities and velocities occur when the deflector is operated properly. If the required dredging section includes compacted fine sands or stiff clays, a properly configured arrangement of teeth may enhance dredge efficiency, which reduces total dredging hours, and potential for "turtle takes". The operation of a draghead with teeth must be monitored for each dredged section to insure that excessive material is not forced into the suction line. When excess high-density material enters the suction line, suction velocities drop to extremely low levels causing conditions for plugging of the suction pipe. Dredge operators should configure and operate their equipment to eliminate all low-level suction velocities. Pipe plugging in the past was easily corrected, when low suction velocities occurred, by raising the draghead off the bottom until the suction velocities increased to an appropriate level. Pipe plugging cannot be corrected by raising the draghead off the bottom. Arrangements of teeth and / or the reconfiguration of teeth should be made during the dredging process to optimize suction velocities.

6. Raising the draghead off the bottom to increase suction velocities is not acceptable. The primary adjustment for providing additional mixing water to the suction line should be through water ports. To insure suction velocities do not drop below appropriate levels, production meters shall be monitored throughout the job and adjustments primarily made to the number and opening sizes of water ports. Water port openings on top of the draghead or on raised standpipes above the draghead shall be screened before they are utilized on the dredging project. If a dredge section includes sandy shoals on one end of a tract line and mud sediments on the other end of the tract line, the equipment shall be adjusted to eliminate draghead pick-ups to clear the suction line.

7. During turning operations, the pumps must either be shut off or reduced in speed to the point where no suction velocity or vacuum exists. These operational procedures are intended to stress the importance of balancing the suction pipe densities and velocities in order to keep from taking sea turtles.

8. All hopper dredges shall be equipped with the National Dredging Quality Management Program (DQM) system, formerly known as Silent Inspector, for hopper dredge monitoring. The DQM system must have been certified by the Engineer Research and Development Center (ERDC) within the last year. Questions regarding certification should be addressed to the DQM support team at 877-840-8024. The DQM is an automated dredge monitoring system comprised of both hardware and software developed by the U.S. Army Corps of Engineers (Corps). The Corps developed the DQM as a low cost, repeatable, impartial system for automated dredge monitoring. The DQM consists of three major components: The Dredge Specific System (DSS), the Ship Server, and the Shore Server. The DSS collects and displays various dredge sensor data for the dredge crew to monitor dredge progress and quality control. The other major task of the DSS is to send data to the Ship Server. Most dredging contractors already have a computer system and sensors onboard for control or positioning that can be used as the DSS. The dredging contractor supplies and owns the DSS and all associated sensors. The Ship Server acts as the dredged-based data archive and report creation center by storing the data from the DSS and performing automated review of the data. The Ship Server can produce many different reports including dredge location history, volume history, and an operational status. Additional information about DQM can be found at: http://dqm.usace.army.mil/. The data collected by the DQM system shall, upon request, be made available to the Operations Division Technical Support Branch of the New Orleans District U.S. Army Corps of Engineers.

All hopper dredge(s) shall be equipped with recording devices for each draghead that capture real time draghead elevation, slurry density, and at least two of the following: Pump(s) slurry velocity measured at the output side, pump(s) vacuum, and / or pump(s) RPM. The Permittee shall record continuous real time positioning of the dredge, by plot or electronic means, during the entire dredging cycle including dredging area and disposal area. Dredge location accuracy shall meet the requirements of the latest version of EM 1110-1-1003. A copy of the EM can be downloaded from the following website: http://www.hnd.usace.army.mil/techinfo/engpubs.htm. The recording system shall be capable of capturing data at variable intervals but with a frequency of not less than every 60 seconds. All data shall be time correlated to a 24-hour clock and the recording system shall include a method of daily evaluation of the data collected. This data shall be made available at the request of the New Orleans District U.S. Army Corps of Engineers.

9. **Dredging operations shall cease immediately upon the first incidental take, and thereafter as directed by the Corps, until the District Engineer, or his designee, notifies the Permittee to resume dredging.** The Permittee shall immediately notify Mr. Edward Creef by phone (504-862-2521) and e-mail (Edward.D.Creef@usace.army.mil) that an incidental take has occurred. The Sea Turtle Mortality Report, available on the web site indicated in condition number 1, will be filled out by the National Marine Fisheries (NMFS)-Approved Protected Species Observer immediately (within 6 hours) and sent to Edward Creef electronically at the e-mail address listed above.

10. During dredging operations, NMFS-Approved Protected Species Observers shall be aboard to monitor for the presence of sea turtles, sturgeon, and whales. Observer coverage shall be 100% (24 hr/day) and shall be conducted year round. During transit to and from the disposal area, the Observer shall monitor from the bridge during daylight hours for the presence of endangered species. During dredging operations, while dragheads are submerged, the Observer shall continuously monitor the inflow and / or outflow screening for turtles and / or turtle parts. Upon completion of each load cycle, dragheads should be monitored as the draghead is lifted from the sea surface and is placed on the saddle in order to assure that sea turtles that may be impinged within the draghead are not lost and unaccounted for. Observers shall physically inspect dragheads and inflow and overflow screening / boxes for threatened and endangered species takes.

11. Monitoring Reports: The results of the monitoring shall be recorded on the appropriate observation sheets. There is a sheet for each load, a daily summary sheet, and a weekly summary sheet. In addition, there will be a post dredging summary sheet. Observation sheets will be completed regardless of whether any takes of sturgeon, whales, or sea turtles occur. In the event of any sea turtle or sturgeon takes by the dredge, appropriate incident reporting forms shall be completed. Additionally, all specimens shall be photographed with a digital camera. These photographs shall be attached to the respective reports for documentation. Dredging of subsequent loads shall not commence until all appropriate reports are completed from the previous dredging load to ensure completeness and thoroughness of documentation associated with the incidental take. Reports shall be submitted to the Corps within 24-hours of the take. Copies of the form shall be legible. Observer forms may be accessed on the web site indicated in condition number 1.

a. NMFS-Approved Protected Species Observers: A list of protected species observer-biologists that have been NMFS-approved to monitor threatened / endangered species takes by hopper dredges can be obtained by contacting NOAA Fisheries Northeast Region, Protected Resources Division. The main contact is Ms, Julie Crocker; she can be reached at Julie.Crocker@noaa.gov or 978-281-9300 ext. 6530. A current list of NMFS-Approved Protected Species Observer companies is provided at the end of this document.

b. The Contractor shall provide a digital camera, with an image resolution capability of at least 300 dpi, in order to photographically report incidental takes, without regard to species, during dredging operations. Immediately following the incidental take of any threatened or endangered species, images shall be provided via e-mail, CD, or DVD to Mr. Edward Creef electronically at Edward.D.Creef@usace.army.mil in a .JPG or .TIF format and shall accompany incidental take forms. The nature of findings shall be fully described in the incidental take forms including references to photographs.

12. Manatee, Sea Turtle, and Whale Sighting Reports.

Any take concerning a manatee, sea turtle, sturgeon, or whale; or sightings of any injured or incapacitated manatees, sea turtles, or whales shall be reported immediately to the Corps Regulatory Section Chief, Pete Serio electronically at Pete.J.Serio@usace.army.mil, and to Mr. Edward Creef electronically at Edward.D.Creef@usace.army.mil.

13. Disposition of Sea Turtles or Turtle Parts

a. Turtle taken by hopper dredge

(1) Dead turtles – upon removal of sea turtle and / or parts from the draghead or screening, Observers shall take photographs as to sufficiently document major characteristics of the turtle or turtle parts including but not limited to dorsal, ventral, anterior, and posterior views. For all photographs taken, a backdrop shall be prepared to document the dredge name, observer company name, contract title, time, date, species, load number, location of dredging, and specific location taken (draghead, screening, etc.). Carcass / turtle parts shall also be scanned for flipper and Passive Integrated Transponder (PIT) tags. Any identified tags shall be recorded on the “Sea Turtle Incidental Take Form” that is included in the “Endangered Species Observer Program Forms” located on the web site indicated in condition number 1. Turtle parts which cannot be positively identified to species on board the dredge or barge(s) shall be preserved by the observer(s) for later identification. A tissue sample shall be collected from any lethally taken sea turtle and submitted under the process stated in the “Protocol for Collecting Tissue Samples from Turtles for Genetic Analysis” on the web site indicated in condition number 1. After all data collection is complete, the sea turtle / parts should be marked (spray paint works well), weighted down and disposed of in direction of the contracting officer.

(2) Live Turtles - Observer(s) shall measure, weigh, scan for PIT tags, tag (Inconel flipper and PIT tags - if PIT tag is not located during scan and only if observer is qualified to tag using PIT tags), and photograph any live turtle(s) incidentally taken by the dredge. Observer(s), or their authorized representative, shall coordinate with the contracting officer’s representative and environmental branch staff to transport as soon as possible the live turtle(s) taken by the dredge to an approved rehabilitation facility such as the Aquarium of the Americas in New Orleans, Louisiana.

14. Relocation Trawling of Sea Turtles

Sea turtle relocation trawling efforts to aid in the prevention of sea turtle takes during dredging operations would be performed by the Permittee as deemed necessary. An initial sea turtle relocation trawling effort would be performed 2 to 3 days prior to the start of hopper dredging activities to determine if sea turtles are present at the dredging site. Based on the results of this trawling effort, the Permittee may be required to implement sea turtle relocation trawling either at the start of hopper dredging activities, or following the first sea turtle take by the hopper dredge. Captured sea turtles either would be relocated approximately 5 miles away from the dredging site, or, if injured, transported to the Aquarium of the Americas located in New

Orleans, Louisiana. A NMFS-Approved Protected Species Observer shall supervise the relocation trawling efforts. If relocation trawling in Louisiana territorial waters occurs outside of the shrimping season, the approved sea turtle relocation trawling supervisor must possess a Scientific Collecting Permit from the Louisiana Department of Wildlife and Fisheries (point of contact is Ms. Karen Foote at 225-765-2384).

Trawling operations shall be performed in front of the working hopper dredge, with trawlers operating a safe distance from the hopper dredge. Trawling efforts shall be performed with and against the tidal flow at a speed not to exceed 3.5 knots using repetitive trawls in the dredging area with each trawling effort not to exceed 42 minutes duration.

Methods and equipment shall be standardized including data sheets, nets, trawling direction to tide, length of station, length of tow, and number of tows per station. Data on each tow shall be recorded using the Sea Turtle Trawling Report found at the website (http://el.erdc.usace.army.mil/seaturtles/docs/trawlingforms.pdf). The trawler shall be equipped with 60-foot nets constructed from 8-inch mesh (stretch) fitted with mud rollers and flats as specified in the Turtle Trawl Nets Specifications appended to the end of this Section. Paired net tows shall be made for 24 hours per day. The tows shall be performed in shifts, and the trawler shall be available for operation 24 hours a day. Positions at the beginning and end of each tow shall be determined from GPS Positioning equipment.

At least one crewmember who is a NMFS-Approved Protected Species Observer shall be on board the trawler during the trawl. The Observer shall be responsible for handling of captured sea turtles. Each captured turtle shall be identified, scanned for PIT tags, measured, tagged, tissue sampled and released, and data recorded on the Sea Turtle Tagging and Relocation Report, which can be found at the following website: (http://el.erdc.usace.army.mil/seaturtles/docs/taggingforms.pdf). Presence of PIT tags shall be scanned for by using a multi-frequency scanner capable of reading multiple frequencies (including 125-, 128-, 134-, and 400-kHz tags) and reading tags deeply embedded in muscle tissue. Turtle measurements shall be recorded and shall include, at a minimum, weight, straight-line length, straight-line width, and tail length. Turtles shall be tagged with NMFS #681 Inconel tags in each of the front flippers according to NMFS protocol. Aseptic conditions shall be maintained for tags and tag attachment. The Contractor shall be responsible for obtaining any and all permits related to trawling from the appropriate state and Federal agencies. All aspects of the trawling shall be coordinated with Mr. Edward Creef (504-862-2521).

Anyone handling sea turtles infected with fibropapilloma tumors shall either: 1) clean all equipment that comes in contact with the turtle with mild bleach solution between the processing of each turtle, or 2) maintain a separate set of sampling equipment for handling turtles displaying fibropapilloma tumors or lesions.

Water temperature measurements shall be taken at the water surface each day using a laboratory thermometer. Weather conditions shall be recorded from visual observations and instruments on the trawler. Weather conditions, air temperature, wind velocity and direction, sea state-wave height, and precipitation shall be recorded on the Sea Turtle Trawling Report. High and low tides shall be recorded.

a. Repair and Replacement of Damaged Trawl Nets
The Contractor, at the time of mobilization, shall provide trawl nets that meet the requirements specified in the Turtle Trawl Net Specifications at the end of this section. Tools, supplies and materials for repairing nets shall be kept aboard the trawler. In the event of damage to trawl nets, one hour will be allowed to either repair or replace them. The Contractor shall have at least one set of replacement nets immediately available at all times, to insure that the dredging work is not adversely delayed due to trawler down-time for replacing damaged nets. It is recommended that a second set of replacement nets be available aboard the trawler.

b. Suspension of Dredging and Relocation Trawling
Should there be a tearing of nets, or breakdown of other equipment that would cause the trawler to leave the area where dredging is underway during any period of time where relocation trawling is required, the dredge may continue to operate for up to 48 hours, as long as no turtles are taken. Should there be dangerously high seas that would cause the trawler to leave the dredging area when relocation trawling is required the dredge may continue to operate, as long as no turtles are taken.

c. Turtle Excluder Devices
Approval for trawling for sea turtles without Turtle Excluder Devices (TEDs) must be obtained from NMFS (contact Eric Hawk at 727-551-5773). Any necessary State or Federal clearances for the capture and relocation of sea turtles must also be obtained. Approvals must be submitted to Mr. Edward Creef electronically at Edward.D.Creef@usace.army.mil prior to trawling.

d. Reporting
Immediately after completing each day of relocation trawling, if possible, the Contractor shall notify Mr. Edward Creef by telephone (504-862-2521) or email (Edward.D.Creef@usace.army.mil) conveying the results of the trawl. The results of each trawl shall be recorded on the Sea Turtle Trawling Report. The Sea Turtle Trawling Report also shall be furnished by the Contractor to Mr. Edward Creef within 24 hours after completing the relocation trawl. Following completion of the project, a copy of the Contractor's log regarding sea turtles shall be forwarded to Mr. Edward Creef within 10 working days.

15. Report Submission.

The Contractor shall maintain a log detailing all incidents, including sightings, collisions with, injuries, or killing of manatees, sea turtles, sturgeon, or whales occurring during the contract period. The data shall be recorded on forms provided at the web site indicated in condition number 1. All data in the original form shall be forwarded directly within 10 days of collection to Mr. Edward Creef at the address provided below. Following project completion, a report summarizing the above incidents and sightings shall be submitted to:

USACE - New Orleans District
Operations Division - Technical Support Branch
Attn Edward Creef
P.O. Box 60267
New Orleans, Louisiana, 70160-0267

Partial List of NMFS-Approved Protected Species Observer Companies

Dr. L. M. Ehrhart Dept. of Biological Science University of Central Florida P.O. Box 25000 Orlando, FL 32816 407-823-2970 Fax: 407-283-5769 lehrhart@pegasus.cc.ucf.edu	A.I.S. Inc. (P.O.C. Arv Poshkus) 19 Camden Street P.O. Box 421 Stoughton, MA 02072-0421 800-230-8032 Fax: 781-297-7669 ARVIDAS1@juno.com	Mary Jo Barkaszi ECOES, Inc. 7341 Glenwood Road Cocoa, FL 32927 321-635-8477 Fax: 321-635-8449 maryjo@ecoes.com www.ecoes.com
Jane Provancha Dynamac Corporation DYN-2 Kennedy Space Ctr., FL 32899 321-759-0935 Fax: 321-730-3455 jprovancha@dynamac.com	R. Eric Martin Ecological Associates, Inc. P.O. Box 405 Jensen Beach, FL 34958 772-334-3729 Fax: 772-334-4925 erikmartin@bellsouth.net	Roxanne Carter REMSA, Inc. * 124 W Queens Way Hampton, VA 23669 757-722-0113 ext. 25 Fax: 757-722-0638 roxy@remsameso.com
Christopher Slay, President ***** Coastwise Consulting (Environmental Consultants - Land, Sea, Air) 173 Virginia Avenue Athens, GA 30601 706-543-6859 904-261-8518 Fax/Tel cslay@att.net	Richard Alboth Tiny's Marine Environmental Services 7 Rogers Street Randolph, MA 02368 781-963-6308 Cellular: 321-863-6561 tinysvc@aol.com	Andrea Balla-Holden, Marine & Marine Life Consulting 5988 SE Kelsey Court Port Orchard, WA 98367 360-769-5934: Office 360-769-4195: Fax MarineMarineLife@aol.com
Trish Bargo, ***** East Coast Observers, Inc. P.O. Box 6192 Norfolk, VA 23508 757-227-5779 757-965-6766 Fax 757-880-7636 Cell tbargo@eastcoastobservers.com		Robert K. Metzger ***** Relocation Trawling Biologist 1327 N. Wheaton Dr. St. Charles, MO 63301-0881 636-946-6464 Tel/Fax 314-265-4806: Cell metzgerr@swbell.net

* Contractors that also provide sea turtle trawling and relocation services.

Turtle Trawl Net Specifications

DESIGN:	4 Seam, 4 Legged, 2 Bridal Trawl Net
WEBBING:	4 inch bar, 8 inch stretch Top – 36 Gauge Twisted Nylon Dipped Side – 36 Gauge Twisted Nylon Dipped Bottom – 84 Gauge Braided Nylon Dipped
NET LENGTH:	60 ft from cork line to cod end
BODY TAPER:	2 to 1
WING END HEIGHT:	6 feet
CENTER HEIGHT:	Dependent on depth of trawl – 14 to 18 ft
COD END:	Length 50 meshes x 4 in equals 16.7 ft Webbing 2 in bar, 4 in stretch, 84 gauge braid nylon Dipped, 80 meshes around, 40 rigged meshes with ¼ x 2 in choker rings, 1 each ½ x 4 in at end Cod End Cover – none Chaffing Gear – none
HEAD ROPE:	60 ft ½ in combination rope (braid nylon with stainless cable center)
FOOT ROPE:	65 ft ½ in combination rope
LEG LINE:	Top – 6 ft, Bottom – 6 ft
FLOATS:	Size – Tuna Floats (football style), Diameter – 7in; Length – 9 in; number 12 each; Spacing – center of top net 2 in apart
MUD ROLLERS:	Size – 5 in Diameter, 5.5 in length Number – 22 each; spacing – 3 ft attached with 3/8 in Polypropylene rope (replaced with snap on roller when broken)
TICKLER CHAINS:	NONE (Discontinued – but previously used ¼ in x 74 ft galvanized chain)
WEIGHT:	20 ft of ¼ in galvanized chain on each wing, 40 ft per net looped and tied
DOOR SIZE:	7 ft x 40 in (or 8 ft x 40 in); Shoe – 1 in X 6 in: bridles – 3/8 in high test chain
CABLE LENGTH:	(Bridle Length, Total): 7/16 in x 240-300 ft varies with bottom conditions
FLOAT BALL:	NONE
LAZY LINES:	1 in nylon
PICKUP LINES:	3/8 in polypropylene
WHIP LINES:	1 in nylon

SEA TURTLE/GULF STURGEON OBSERVER SPECIFICATIONS

As a result of consultation under Section 7 of the Endangered Species Act of 1973, as amended, the U.S. Army Corps of Engineers has agreed to report any sea turtle/gulf sturgeon activity to the National Marine Fisheries Service (NMFS). The points of contact (listed below) should be notified of any sightings, collisions with, injuries or killing of sea turtles/gulf sturgeons by telephone within 12 hours of the action. The notification should include the number and species of turtles (if known) impacted and the time the activity occurred.

New Orleans District, Operations Division,
Marine Management Section, Dredge Wheeler
Ms. Bethany Walker
(504) 862-2699 and fax (504) 862-1912
After hours number: 504-905-4573 (cell)

New Orleans District, Operations Division,
Operations Technical Support Branch,
Mr. Ed Creef
(504) 862-2521 and fax (504) 862-2317
After hours number: 504-818-0034 (home)

Observers will continuously monitor all of the hopper inflow and/or over-flow screens 24 hours per day during dredging mode, to detect turtles/sturgeons or turtle/sturgeon parts. Screen monitoring shall be conducted as required to effectively watch these screens, based on the design, configuration, and position thereof. The observers will be provided access and use of a facsimile and telephone 24 hours per day to insure, in the event of a take, the observers will be able to fulfill the requirements of the paragraph entitled "Sea Turtle/Gulf Sturgeon Reporting".

In addition to monitoring 24 hours per day during dredging mode, the observers will be responsible for assuring that:

1) temperatures in the waterway are taken, in degrees Fahrenheit, at the surface and at the mid-depth from the surface to the water bottom. The readings shall be made each eight hours for the duration of each dredging assignment. The waterway mileage and latitude/longitude shall be recorded corresponding to each temperature reading.

2) during transit of the dredge to/from the disposal site(s), after dredging has ceased, the screen observer shall assure that the hopper screens are cleaned of debris and correctly re-installed on the dredge for return to dredging mode. The observer shall report damage of the screens to the Dredge Wheeler representative immediately upon detection of such damage, and the screens shall be repaired or replaced before dredging is resumed.

3) complete turtle/sturgeon data reporting is made, as required in paragraph entitled "Sea Turtle/Gulf Sturgeon Reporting".

4) positively identified turtle/sturgeon parts are disposed of at the dredge material disposal site(s). Turtle/sturgeon parts which cannot be positively identified on board the dredge shall be color photographed by the observer(s) using instant developing film or a digital

camera. The photos shall be attached to respective reports for documentation and later identification. Observer(s) shall measure, weigh, tag, and release any uninjured turtles incidentally taken by the dredge. Turtle/sturgeon handling and tagging methods shall be performed in accordance with NMFS-approved procedures. Injured turtles shall be transported to a rehabilitation facility, the Aquarium of the Americas at New Orleans, Louisiana. Observer(s) or their authorized representative shall provide NMFS-approved containers for turtle/sturgeon transport.

5) Sea Turtle/Gulf Sturgeon Reporting
The observers shall maintain a log detailing all incidents, including sightings, collisions with, injuries, or killing of sea turtles/sturgeons occurring during the contract period. The results of the monitoring shall be recorded on copies of the observation sheets attached, entitled “Endangered Species Observer Program” or similar forms. For each load, screen watch data shall be consolidated on a single sheet prior to beginning a new sheet for the next load. An observation sheet shall be completed for each load whether or not turtles are sighted in the waterway or turtle/sturgeon parts are detected on the screens. Dredging shall not commence until the consolidated report is completed from the previous dredging load. The observer(s) should notify the District points of contact (listed above) of any sightings, collisions with, injuries or killing of sea turtles by telephone and facsimile within 12 hours of the action. The notification should include the number and species of turtles impacted and the time the activity occurred. Upon completion of the dredging project, all consolidated and completed data reports shall be forwarded to the District points of contact (listed above).

Endangered Species Observer Program – Load Data Form

ENDANGERED SPECIES OBSERVER PROGRAM

LOAD DATA FORM

USACE DISTRICT: ____________________________

CONTRACT #: ______________ Maintenance____/New Work _____ PROJECT start date ________

PROJECT NAME: __________________________ DREDGE NAME: _______________

DREDGE FIRM: _______________

LOAD #: ________ LOAD start date: ________ Times (24hrs): Start ________ End ______

Condition of screening : Port____________ Starboard ____________ Overflow ____________

Number of dragheads in use: _____ Type of dragheads used: __________Size of dragheads: __________

Draghead deflector? YES ____ NO ____ Condition of deflector: __________________________

Type of material dredged: ____

Weather conditions: ____

____

Tidal stage (CIRCLE ONE): Slack Rising High Falling Low Unknown

Beaufort Sea States (Winds/Wave Height) (CIRCLE ONE)

0 = <1 knot/ 0 ft	3 = 7-10 knot/ 2 ft	6 = 22-27 knot/10 ft	9 = 41-47 knot/23 ft	12 = >63 knot/45
1 = 1- 3 knot/ 0.25 ft	4 = 11-16 knot/ 4 ft	7 = 28-33 knot/14 ft	10 = 48-55 knot/29 ft	
2 = 4- 6 knot/ 0.5 ft	5 = 17-21 knot/ 6 ft	8 = 34-40 knot/18 ft	11 = 56-63 knot/37 ft	

Waves: _______ ft Wind (speed & direction): ________________

AIR TEMP: ________ °C/°F (°F = 9/5 (°C) + 32; °C = 5/9 (°F - 32))

WATER TEMP: Surface _______ °C /°F Column (mid-depth) _______ °C /°F Bottom _______ °C /°F

SCREEN TYPE						
________Inflow screening:	None	25%	50%	75%	100%
________Overflow screening:	None	25%	50%	75%	100%
________Other screening:	None	25%	50%	75%	100%

PORT SCREEN CONTENTS: ____

____

____

STARBOARD SCREEN CONTENTS: ____

____

____

Estimate number entrained on this load for the following:

Sturgeon (any species) ______________________________

Shark (any species) ______________________________

Horseshoe crab ______________________________

Blue crab ______________________________

TURTLE OR TURTLE PARTS PRESENT THIS LOAD: YES ______ NO _______

SPECIES OF TURTLE TAKE: Unknown Loggerhead Green Kemp's ridley Hawksbill Leatherback

Comments: ____

____

Number observers used/24hrs: _____ % Monitoring/24 hrs: None 25% 50% 75% 100%

Observer's name: ________________________ Observer firm________________

Observer signature ________________________

Endangered Species Observer Program – Daily Report

ENDANGERED SPECIES OBSERVER PROGRAM

DAILY REPORT

USACE DISTRICT: ______________________________________

PROJECT NAME: ___________________________________ DREDGE NAME: ________________

Date: ______________ Load #s: ______________ Areas dredge worked: ______________________

Beaufort Sea State: 0 1 2 3 4 5 6 7 8 9 10 11 12

AIR TEMP: _______ °C/°F (°F = 9/5 (°C) + 32; °C = 5/9 (°F - 32))

WATER TEMP: Surface ______ °C /°F Column (mid-depth) _______ °C /°F Bottom _______ °C /°F

Condition of deflector:________________________ Condition of screening: _______________________

Were there incidents involving endangered or protected species? YES ____ NO ____

Which species? (complete incident form(s))____

Comments (type of material, biological specimens, unusual circumstances, etc): ________________________

BRIDGE WATCH SUMMARY

Time	Species	# Sightings/# Animals	Location/Comments
		/	
		/	
		/	
		/	
		/	
		/	
		/	
		/	
		/	
		/	
		/	
		/	
		/	
		/	
		/	

Observer name ______________________________

USACE Sea Turtle/Dredging Database – Post Hopper Dredging Project Checklist

USACE Sea Turtle/Dredging Database
Post-Hopper Dredging Project Checklist

(1)______PROJECT SUMMARY

District name _____________________________ District POC _________________________________
Contract # ________________________ Maintenance ___ New Work___ Federal ___Regulatory ___

Project name _____________________________ Dates of project ______________________________

Dredge name _________________ Dredge firm ______________ Dates worked ______________________
Dredge name _________________ Dredge firm ______________ Dates worked ______________________
Dredge name _________________ Dredge firm ______________ Dates worked ______________________
Dredge name _________________ Dredge firm ______________ Dates worked ______________________

For total project:
days dredged: _____ # hours dredged:_______ # loads dredged: _____Total CY dredged___________

For dredge vessel___________________
days dredged: _____ # hours dredged:_______ # loads dredged: _____Total CY dredged___________
For dredge vessel___________________
days dredged: _____ # hours dredged:_______ # loads dredged: _____Total CY dredged___________
For dredge vessel___________________
days dredged: _____ # hours dredged:_______ # loads dredged: _____Total CY dredged___________
For dredge vessel___________________
days dredged: _____ # hours dredged:_______ # loads dredged: _____Total CY dredged___________

General project description/Disposal method(s):____
____
____

Type of material dredged: (circle) silt clay sand mud shell rock other
Type of draghead(s): _________________________ Silent inspector: YES _____ NO _____
Mitigation measures:

Dredging within designated environmental window	YES _____	NO _____	N/A ______
Draghead deflectors installed	YES _____	NO _____	N/A ______
Relocation trawling conducted	YES _____	NO _____	N/A ______
Pre-dredge assessment trawling conducted	YES _____	NO _____	N/A ______

Monitoring measures:
Screening type(s) : ______________ % material screened: None 25% 50% 75% 100%
observers/24hrs: ______________ % monitoring/24 hrs: None 25% 50% 75% 100%

For total project:
Incidental sea turtle takes Loggerhead ____ Green _____ Kemp's ridley _____ Other _____ Unknown _____
Incidental sturgeon takes Shortnose _____ Gulf _____ Other _____ Unknown _____
Description of other endangered/sensitive species incidents: ______________________________
____

(2)_______ Dredge summary logs associated with dates of incidental takes

(3)_______ Endangered Species Observer Final Report(s)
(Each incidental take reported should include: Incidental Take Form, Load Data Form, Dredge Load Log, Copies of photos)

(4)_______ Relocation and/or assessment trawling Final Report(s)
(Report should include: total #/species of turtles relocated during project; total #/species of turtles relocated on date of dredging incidental take, total #/species of sturgeon collected.)

(5)_______ Reports/descriptions of other related research/studies being done during/related to project.

Endangered Species Observer Program – Sturgeon Incidental Take Data Form

ENDANGERED SPECIES OBSERVER PROGRAM
STURGEON INCIDENTAL TAKE DATA FORM

USACE DISTRICT: ______________________________
PROJECT NAME: ______________________________ DREDGE NAME: ______________

DATE: ____________ Time sturgeon take recovered (24hr): _______ Sturgeon # for project: ____

LOAD #: _________ Times (24hrs): Start _______ End _______ Load start date _______

SPECIES OF STURGEON TAKE: Shortnose _____ Gulf _______ Other _______ Unknown ____

Channel location of take: Latitude ____________________ Longitude ____________________
Other location / Channel description (e.g. buoy markers, landmarks): ______________________________
____

Location take recovered on dredge: ____

Number of dragheads in use at time of incident: _____ Draghead deflector? YES ___ NO ___
Condition of deflector: ____________________ Condition of screening: ____________________

Beaufort Sea State: 0 1 2 3 4 5 6 7 8 9 10 11 12

AIR TEMP: ________ °C/°F (°F = 9/5 (°C) + 32; °C = 5/9 (°F - 32))
WATER TEMP: Surface _______ °C /°F Column (mid-depth) ________ °C /°F Bottom ________ °C /°F

Condition of specimen: ____
____
____
0 = Alive; 1 = Fresh dead; 2 = Moderately decomposed; 3 = Severely decomposed; 4 = skeleton/old bone; 5 = undetermined

Measurements/description of specimen: ____
____
____

Genetic samples taken: YES ___ NO ___ Photos taken: YES ___ NO ___
Sample frozen/preserved: YES ___ NO ___
Final disposition of specimen: ____

Comments: ____
____
____
____

Load data form attached: YES ___NO ___ Dredge load log attached: YES ___NO ___

Observer's name ______________________________

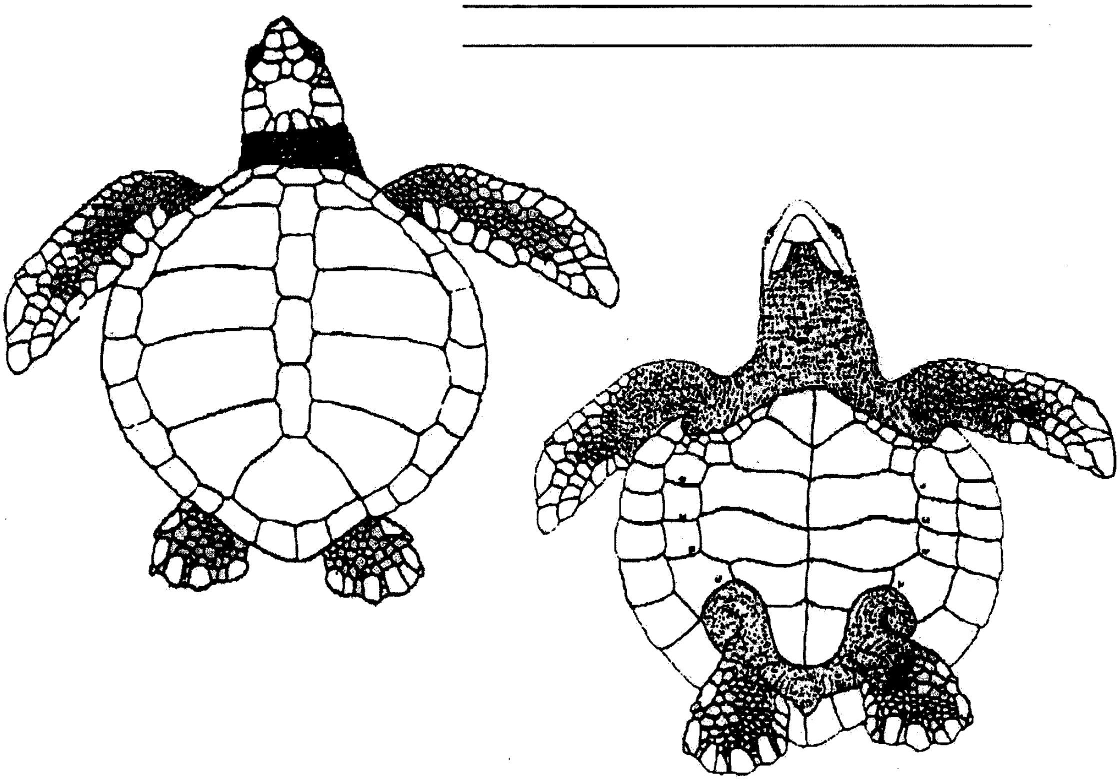
Use diagram below to illustrate specimen/part recovered:

Endangered Species Observer Program Sea Turtle Take Form - Kemp's Ridley

Kemp's Ridley (*Lepidochelys kempii)*

Shade areas of turtle that are missing; sketch cracks and lacerations

Comments: ______________________________



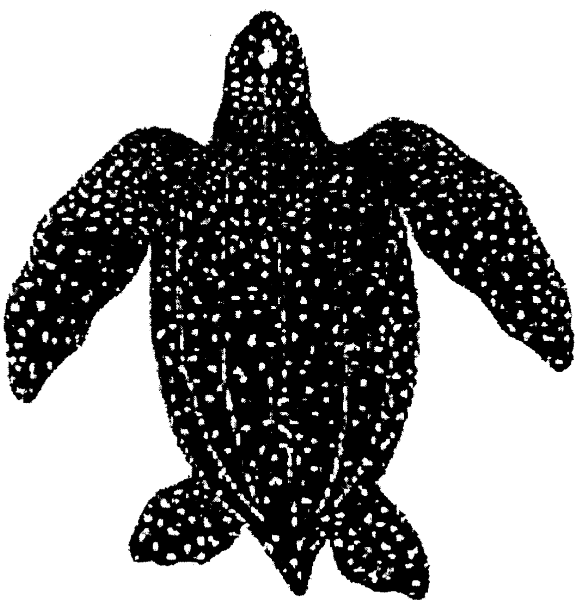
Diagrams by Tom McFarland

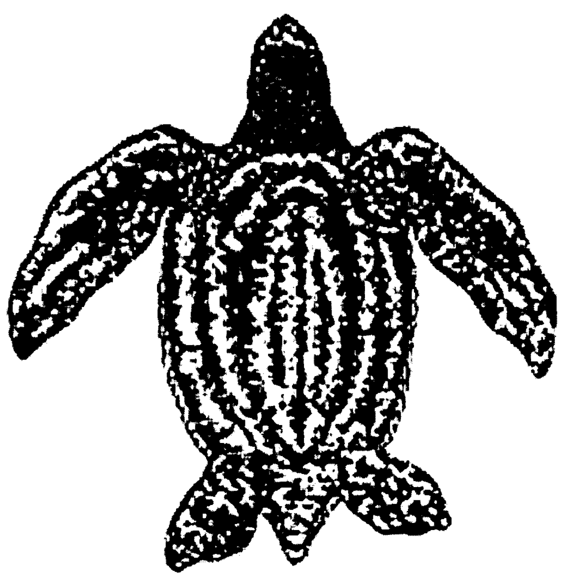
Endangered Species Observer Program Sea Turtle Take Form – Leatherback

Leatherback (*Dermochelys coriacea)*

Shade areas of turtle that are missing; sketch cracks and lacerations

Comments: ______________________________





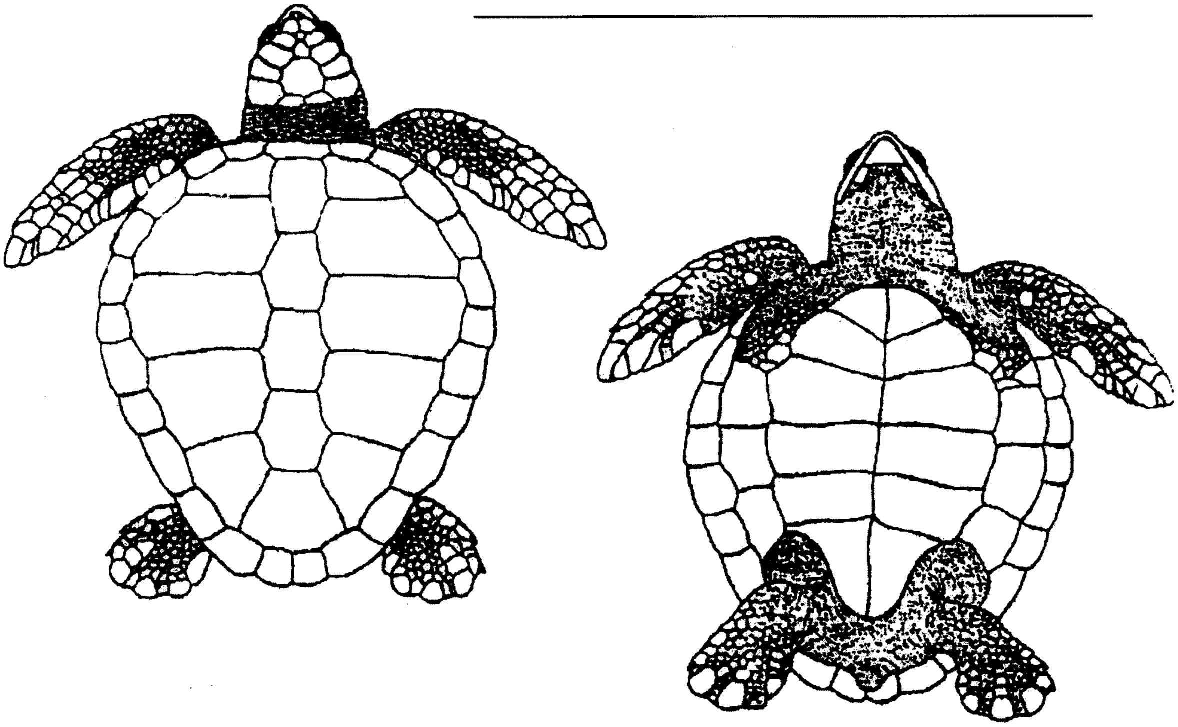
Diagrams by Tom McFarland

Endangered Species Observer Program Sea Turtle Take Form – Loggerhead

Loggerhead (*Caretta caretta*)

Shade areas of turtle that are missing; sketch cracks and lacerations

Comments: ______________________________



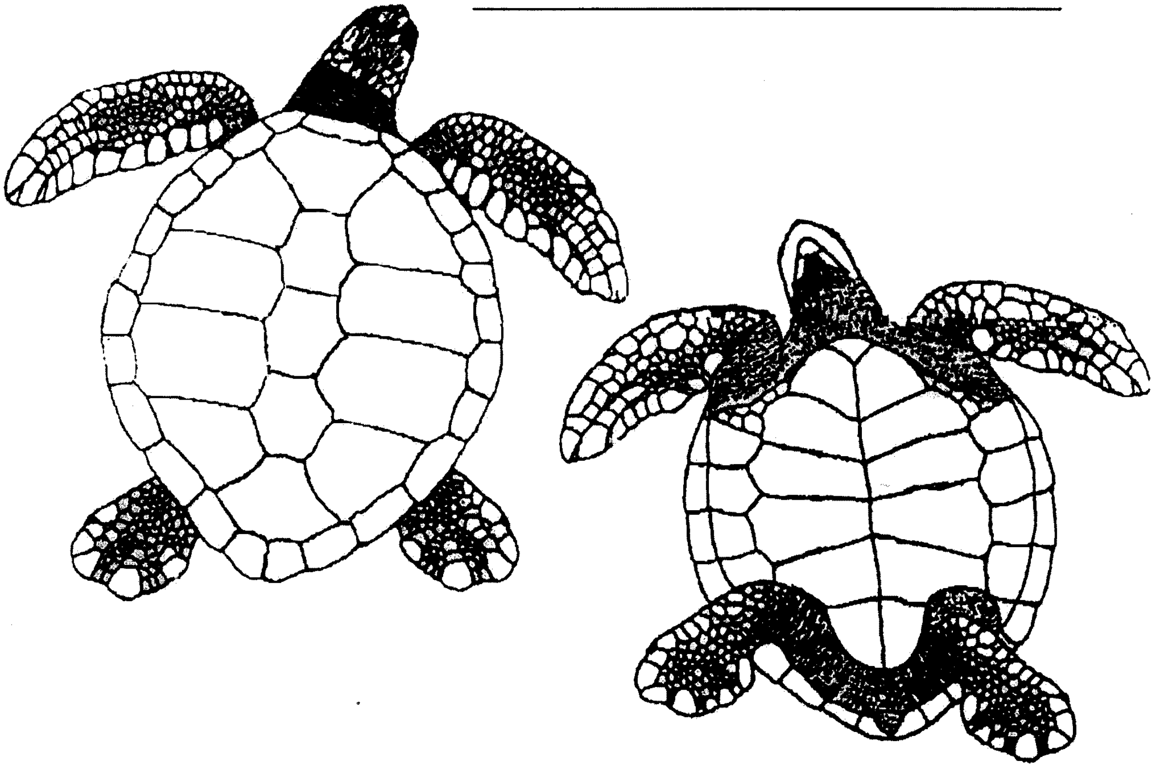
Diagrams by Tom McFarland

Endangered Species Observer Program Sea Turtle Take Form – Green turtle

Green turtle (*Chelonia mydas*)

Shade areas of turtle that are missing; sketch cracks and lacerations

Comments: ____



Diagrams by Tom McFarland

Endangered Species Protection for Sea Turtles & Gulf Sturgeon

I. Sea Turtle Trawling and Relocation

Sea Turtle Trawling and Relocation, as specified herein, will be at the option and in the discretion of the Government to aid in preventing the taking of sea turtles during dredging operations with the approved turtle deflector in place. Within 72 hours after receiving written directions from the Contracting Officer, the Contractor shall begin trawling for turtles to relocate them from the dredging project area. Relocation trawling shall be performed so as to not interfere with dredging operations in progress.

e. Approved Sea Turtle Trawling and Relocation Supervisor

A NMFS-Approved Protected Species Observer (supervisor) shall conduct sea turtle trawling. A letter of approval from NMFS shall be provided to the Contracting Officer or his/her authorized representative prior to commencement of trawling. If trawling in Louisiana territorial waters outside of the shrimping season, the approved sea turtle trawling and relocation supervisor must also possess a Scientific Collecting Permit from the Louisiana Department of Wildlife and Fisheries (point of contact is Ms. Karen Foote at 225-765-2384).

f. Sea Turtle Trawling Procedures

Any captured sea turtles either shall be transported to the Institute for Marine Mammal Studies located in Gulfport, Mississippi, or released into waters minimally impacted by presence of oil/dispersants (to be determined by the relocation trawling supervisor in coordination with Edward Creef and Dena Dickerson (601-831-0687). Any captured gulf sturgeons shall be released immediately after capture and handling for measurements away from the dredging site in waters minimally impacted by presence of oil/dispersants (to be determined at the time of capture by the trawling supervisor in coordination with Edward Creef and Dena Dickerson). Methods and equipment shall be standardized including data sheets, nets, trawling direction to tide, length of station, length of tow, and number of tows per station. Data on each tow shall be recorded using the Sea Turtle Trawling Report found at the website (http://el.erdc.usace.army.mil/seaturtles/docs/trawlingforms.pdf). The trawler shall be equipped with 60-foot nets constructed from 8-inch mesh (stretch) fitted with mud rollers and flats as specified in the Turtle Trawl Nets Specifications appended to the end of this Section. Paired net tows shall be made for 24 hours per day, as directed by the Contracting Officer or his/her authorized representative. The tows shall be performed in shifts, to be determined by the Contracting Officer or his/her authorized representative, and the trawler shall be available for operation 24 hours a day. Positions at the beginning and end of each tow shall be determined from GPS Positioning equipment. Refer to EM 1110-1-1003 "Navstar global positioning system surveying", paragraph 5.3 and Table 5-1, for acceptable GPS criteria.

g. Trawling Requirements

Trawling operations shall be conducted in the vicinity of dredge operations, but shall maintain a safe distance from that dredge. **NOTE: ALL TRAWLING ACTIVITIES, VESSELS AND EQUIPMENT SHALL COMPLY WITH THE CONTRACTOR'S ACCIDENT PREVENTION PLAN AND THE REQUIREMENTS OF EM 385-1-1, U.S. ARMY CORPS OF ENGINEERS**

SAFETY AND HEALTH REQUIREMENTS MANUAL. Trawling shall be conducted with and against the tidal flow at a speed not to exceed 3.5 knots using repetitive trawls in the channel or other work area not to exceed 42-minutes (total time). Trawls shall be made in the center, green, and red sides of the channel such that the total width of the channel bottom is trawled.

h. Sea Turtle/Gulf Sturgeon Handling and Measurements

At least one crewmember who is a NMFS-Approved Protected Species Observer shall be on board the trawler during the trawl. The observer shall be responsible for handling of captured sea turtles and Gulf sturgeons. Each captured turtle or gulf sturgeon shall be identified, scanned for PIT tags, measured, tagged, tissue sampled and released, and data recorded on the Sea Turtle Tagging and Relocation Report, which can be found at the following website: (http://el.erdc.usace.army.mil/seaturtles/docs/taggingforms.pdf). Presence of PIT tags shall be scanned for by using a multi-frequency scanner capable of reading multiple frequencies (including 125-, 128-, 134-, and 400-kHz tags) and reading tags deeply embedded in muscle tissue. Any captured sea turtles shall be transported to the Institute for Marine Mammal Studies located in Gulfport, Mississippi. Turtle measurements shall be recorded and shall include, at a minimum, weight, straight-line length, straight-line width, and tail length. Gulf sturgeon measurements shall be recorded and shall include, at a minimum, weight, total length, and fork length. Turtles shall be tagged with NMFS #681 Inconel tags in each of the front flippers according to NMFS protocol. Aseptic conditions shall be maintained for tags and tag attachment. The Contractor shall be responsible for obtaining any and all permits related to trawling from the appropriate state and Federal agencies. All aspects of the trawling shall be coordinated with Edward Creef (504-862-2521) and Dena Dickerson (601-831-0687).

i. Handling Fibropapillomatose Turtles

Anyone handling sea turtles infected with fibropapilloma tumors shall either: 1) clean all equipment that comes in contact with the turtle with mild bleach solution between the processing of each turtle, or 2) maintain a separate set of sampling equipment for handling turtles displaying fibropapilloma tumors or lesions.

j. Water Quality and Physical Measurements

Water temperature measurements shall be taken at the water surface each day using a laboratory thermometer. Weather conditions shall be recorded from visual observations and instruments on the trawler. Weather conditions, air temperature, wind velocity and direction, sea state-wave height, and precipitation shall be recorded on the Sea Turtle Trawling Report. High and low tides shall be recorded.

k. Repair and Replacement of Damaged Trawl Nets

The Contractor, at the time of mobilization, shall provide trawl nets that meet the requirements specified in the Turtle Trawl Net Specifications at the end of this section. Tools, supplies and materials for repairing nets shall be kept aboard the trawler. In the event of damage to trawl nets, one hour will be allowed to either repair or replace them. The Contractor shall have at least one set of replacement nets immediately available at all times, to insure that the dredging work is not adversely delayed due to trawler down-time for replacing damaged nets. It is recommended that a second set of replacement nets be available aboard the trawler.

l. Suspension of Dredging and Relocation Trawling

Should there be a tearing of nets, or breakdown of other equipment that would cause the trawler to leave the area where dredging is underway during any period of time where relocation trawling is required, the dredge may continue to operate for up to 48 hours, as long as no turtles are taken, and subject to the discretion of the Contracting Officer. Should there be dangerously high seas that would cause the trawler to leave the dredging area when relocation trawling is required, the dredge may continue to operate, as long as no turtles are taken and subject to the discretion of the Contracting Officer.

m. Turtle Excluder Devices

Approval for trawling for sea turtles without Turtle Excluder Devices (TEDs) must be obtained from NMFS (contact Eric Hawk at 727-551-5773). Any necessary State or Federal clearances for the capture and relocation of sea turtles must also be obtained. Approvals must be submitted to the Contracting Officer or his/her authorized representative prior to trawling.

n. Reporting

Immediately after completing each day of relocation trawling, if possible, the Contractor shall notify Dena Dickerson by telephone conveying the results of the trawl. The results of each trawl shall be recorded on the Sea Turtle Trawling Report. The Sea Turtle Trawling Report also shall be furnished by the Contractor to Mr. Edward Creef, U.S. Army Corps of Engineers, New Orleans District, within 24 hours after completing the relocation trawl (fax number 504-862-2317; email: edward.d.creef.@usace.army.mil). Following completion of the project, a copy of the Contractor's log regarding sea turtles shall be forwarded to Mr. Edward Creef within 10 working days.

Turtle Trawl Net Specifications

DESIGN:	4 Seam, 4 Legged, 2 Bridal Trawl Net
WEBBING:	4 in bar, 8 in stretch Top – 36 Gauge Twisted Nylon Dipped Side – 36 Gauge Twisted Nylon Dipped Bottom – 84 Gauge Braided Nylon Dipped
NET LENGTH:	60 ft from cork line to cod end
BODY TAPER:	2 to 1
WING END HEIGHT:	6 ft
CENTER HEIGHT:	Dependent on depth of trawl – 14 to 18 ft
COD END:	Length 50 meshes x 4 in equals 16.7 ft Webbing 2 in bar, 4 in stretch, 84 gauge braid nylon Dipped, 80 meshes around, 40 rigged meshes with ¼ x 2 in choker rings, 1 each ½ x 4 in at end Cod End Cover – none Chaffing Gear – none
HEAD ROPE:	60 ft ½ in combination rope (braid nylon with stainless cable center)
FOOT ROPE:	65 ft ½ in combination rope
LEG LINE:	Top – 6 ft, Bottom – 6 ft
FLOATS:	Size – Tuna Floats (football style), Diameter – 7 In; Length – 9 in; number 12 each; Spacing – center of top net 2 in apart
MUD ROLLERS:	Size – 5 in Diameter, 5.5 in length Number – 22 each; spacing – 3 ft attached with 3/8 in Polypropylene rope (replaced with snap on roller when broken)
TICKLER CHAINS:	NONE (Discontinued – but previously used ¼ in x 74 ft galvanized chain)
WEIGHT:	20 ft of ¼ in galvanized chain on each wing, 40 ft per net looped and tied
DOOR SIZE:	7 ft x 40 in (or 8 ft x 40 in); Shoe – 1 in X 6 in: bridles – 3/8 in high test chain
CABLE LENGTH:	(Bridle Length, Total): 7/16 in x 240-300 ft varies with bottom conditions
FLOAT BALL:	NONE
LAZY LINES:	1 in nylon
PICKUP LINES:	3/8 in polypropylene
WHIP LINES:	1 in nylon

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
(727) 824-5312; FAX (727) 824-5309
http://sero.nmfs.noaa.gov

Measures for Reducing Entrapment Risk to Protected Species

Bottlenose dolphins, sea turtles, and Gulf sturgeon (protected species) are known to inhabit coastal waters of the northern Gulf of Mexico. Bottlenose dolphins are protected under the Marine Mammal Protection Act (MMPA) and sea turtles and Gulf sturgeon are protected under the Endangered Species Act (ESA). Because of the potential for these protected species to become entrapped within coastal waters of construction sites along the northern Gulf coast, projects that enclose shallow open water areas for wetland creation or nourishment will use the following measures to minimize the potential for entrapment:

1. **Pre-construction planning.** During project design, the Federal Action Agency or project proponents must incorporate at least one escape route into the proposed retention structure(s) to allow any protected species to exit the area(s) to be enclosed. Escape routes must lead directly to open water outside the construction site and must have a minimum width of 100 feet. Escape routes should also have a depth as deep as the deepest natural entrance into the enclosure site and must remain open until a thorough survey of the area, conducted immediately prior to complete enclosure, determines no Protected Species are present within the confines of the structure (see item 5 below for details).

2. **Pre-construction compliance meeting.** Prior to construction, the Federal Action Agency, project proponents, the contracting officer representative, and construction personnel should conduct a site visit and meeting to develop a project-specific approach to implementing these preventative measures.

3. **Responsible parties.** The Federal Action Agency will instruct all personnel associated with the project of the potential presence of protected species in the area and the need to prevent entrapment of these animals. All construction personnel will be advised that there are civil and criminal penalties for harming, harassing, or killing protected species. Construction personnel will be held responsible for any protected species harassed or killed as a result of construction activities. All costs associated with monitoring and final clearance surveys are the responsibility of project proponents and must be incorporated in the construction plan.

4. **Monitoring during retention structure construction.** It is the responsibility of construction personnel to monitor the area for protected species during dike or levee construction. If protected species are regularly sighted over a 2 or 3 day period within the enclosure area during retention structure assembly, construction personnel must notify the Federal Action Agency. It is the responsibility of the Federal Action Agency

to then coordinate with the National Marine Fisheries Service (NMFS) Marine Mammal Health and Stranding Response team (1-877-WHALE HELP [1-877-942-5343]) or the appropriate State Coordinator for the Sea Turtle Stranding and Salvage Network (see http://www.sefsc.noaa.gov/species/turtles/stranding_coordinators.htm) to determine what further actions may be required. Construction personnel may not attempt to scare, herd, disturb, or harass the protected species to encourage them to leave the area.

5. **Pre-closure final clearance.** Prior to completing any retention structure by closing the escape route, the Federal Action Agency will insure that the area to be enclosed is observed for protected species. Surveys must be conducted by experienced marine observers during daylight hours beginning the day prior to closure and continuing during closure. This is best accomplished by small vessel or aerial surveys with 2-3 experienced marine observers per vehicle (vessel/helicopter) scanning for protected species. Large areas (e.g. >300 acres) will likely require the use of more than one vessel or aerial survey to insure full coverage of the area. These surveys will occur in a Beaufort sea state (BSS) of 3 feet or less, as protected species are difficult to sight in choppy water. Escape routes may not be closed until the final clearance determines the absence of protected species within the enclosure sight.

6. **Post closure sightings.** If protected species become entrapped in an enclosed area, the Federal Action Agency and NMFS must be immediately notified. If observers note entrapped animals are visually disturbed, stressed, or their health is compromised then the Action Agency may require any pumping activity to cease and the breaching of retention structures so that the animals can either leave on their own or be moved under the direction of NMFS.

   a. In coordination with the local stranding networks and other experts, NMFS will conduct an initial assessment to determine the number of animals, their size, age (in the case of dolphins), body condition, behavior, habitat, environmental parameters, prey availability and overall risk.
   b. If the animal(s) is/are not in imminent danger they will need to be monitored by the Stranding Network for any significant changes in the above variables.
   c. Construction personnel may not attempt to scare, herd, disturb, or harass the protected species to encourage them to leave the area. Coordination by the Federal Action Agency with the NMFS SER Stranding Coordinator may result in authorization for these actions.
   d. NMFS may intervene (catch and release and/or rehabilitate) if the protected species are in a situation that is life threatening and evidence suggests the animal is unlikely to survive in its immediate surroundings.
   e. Surveys will be conducted throughout the area at least twice or more in calm surface conditions (BSS 3 feet or less), with experienced marine observers, to determine whether protected species are no longer present in the area.

Revised: May 22, 2012

While NMFS recommends these best management practices to prevent the future takes of marine mammals by entrapment, use of these measures cannot guarantee a take will not occur. Following these measures does not constitute compliance with the MMPA's Incidental Take requirements and take is not authorized.

SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

ANNEX R

2050 Coastal Wildlife Tables

Table 7-2. Region 3 wildlife functions, status, trends, and projections.

Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo = Moderate Numbers; Hi = High Numbers
Functions of Particular Interest: Ne = Nesting; St = Stopover Habitat; W = Wintering Area; Mu = Multiple Functions
Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna																Furbeare												Game Mammals												Reptiles			
	Type	% of Unit	Other Marsh/ OW Residents				Other Wood- land Resid.				Other Marsh/ OW Migrants				Other Wood- land Migrants				Nutria				Muskrat				Mink, Otter, and Raccoon				Rabbits				Squirrels				Deer				American Alligator			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Atchafalaya Basin																																															
Atchafalaya Subdelta	OW	95	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Lo	I	I
	FM	3	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	I
	BB	1		NH				NH				NH				NH				NH				NH				NH				NH				NH				NH			Mu	Lo	Sy	Sy
West N. Wax Lake	FM	17	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy
	FS	16	Mu	Lo	Sy	Sy	Ne	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
	HF	55		NH			Ne	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
	AU	11		NH			Ne	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
East N. Wax Lake	FS	35	Mu	Lo	Sy	Sy	Ne	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	HF	56		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Wax Lake Wetlands	OW	18	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	I
	FM	38	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	I
	FS	8	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Hi	I	I
	HF	34		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	I	I
Wax Lk. Outlet Subdelta	OW	97	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Lo	I	I
	FM	2	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	I
	BB	1		NH				NH				NH				NH				NH				NH				NH				NH				NH				NH			Mu	Lo	Sy	Sy
Teche/Vermilion Basin																																															
Cote Blanche Wetlands	OW	10	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Hi	I	I
	FM	54	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Hi	I	I
	FS	15	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	I	I
	HF	17		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	I	I
East Cote Blanche Bay	OW	100	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH				NH				NH				NH				NH				NH				NH				NH		
West Cote Blanche Bay	OW	100	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH				NH				NH				NH				NH				NH				NH				NH		
Marsh Island	OW	20	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy		NH				NH				NH			Mu	Mo	Sy	I

Table 7-2. Region 3 wildlife functions, status, trends, and projections.

Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
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Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna																																							
	Type	% of Unit	Brown Pelican				Bald Eagle				Seabirds				Wading Birds				Shorebirds				Dabbling Ducks				Diving Ducks				Geese				Raptors				Rails, Coots, and Gallinules			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
	BM	70		NH				NH			Mu	Hi	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
	SM	10		NH				NH			Mu	Hi	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy
Vermilion Bay Marsh	OW	13		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Lo	Sy	Sy	W	Lo	Sy	Sy		NH				NH			Mu	Lo	Sy	Sy
	FM	5		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	IM	25		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	BM	30		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	FS	5		NH			Ne	Lo	Sy	Sy		NH			Mu	Hi	I	Sy		NH			Mu	Lo	Sy	Sy		NH				NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
	HF	18		NH				NH				NH				NH				NH			Mu	Lo	Sy	Sy		NH				NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy
Vermilion Bay	OW	99	W	Lo	I	I		NH			Mu	Hi	Sy	Sy		NH				NH			W	Lo	Sy	Sy	W	Lo	Sy	Sy		NH				NH				NH		
Big Woods	FM	8		NH				NH			St	Lo	Sy	Sy	Mu	Mo	I	Sy	Mu	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Lo	Mo	Sy	Sy
	HF	60		NH				NH				NH				NH				NH			Mu	Lo	Sy	Sy		NH				NH			Mu	Hi	Sy	D		NH		
	AU	25		NH				NH				NH			St	Lo	I	Sy	Mu	Mo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH		
Rainey Marsh	OW	12	W	Lo	I	I		NH			Mu	Hi	Sy	Sy		NH				NH			W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy		NH			W	Lo	Sy	Sy
	IM	11		NH				NH			Mu	Mo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	W	Lo	Sy	Sy
	BM	70		NH				NH			Mu	Mo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	W	Lo	Sy	Sy

Table 7-2. Region 3 wildlife functions, status, trends, and projections.
Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
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Trends (since 1985) / **Projections** (through 2050): Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna (cont.)																Furbearers												Game Mammals												Reptiles			
	Type	% of Unit	Other Marsh/ OW Residents				Other Wood-land Resid.				Other Marsh/ OW Migrants				Other Wood-land Migrants				Nutria				Muskrat				Mink, Otter, and Raccoon				Rabbits				Squirrels				Deer				American Alligator			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
	BM	70	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	I
	SM	10	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
Vermilion Bay Marsh	OW	13	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Lo	I	I
	FM	5	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	I	I
	IM	25	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	I	I
	BM	30	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	I	I
	FS	5	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	I	I
	HF	18		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	I	I
Vermilion Bay	OW	99	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH				NH				NH				NH				NH				NH				NH				NH		
Big Woods	FM	8	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	HF	60		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
	AU	25	Mu	Lo	Sy	Sy	Ne	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Rainey Marsh	OW	12	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Mo	Sy	Sy		NH				NH				NH			Mu	Hi	I	I
	IM	11	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Hi	I	I
	BM	70	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Hi	I	I

Table 7-2. Region 4 wildlife functions, status, trends, and projections.

Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo = Moderate Numbers; Hi = High Numbers
Functions of Particular Interest: Ne = Nesting; St = Stopover Habitat; W = Wintering Area; Mu = Multiple Functions
Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna																																							
	Type	% of Unit	Brown Pelican				Bald Eagle				Seabirds				Wading Birds				Shorebirds				Dabbling Ducks				Diving Ducks				Geese				Raptors				Rails, Coots, and Gallinules			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Mermentau Basin																																											
Amoco	OW	14		NH				NH			Mu	Lo	Sy	Sy		NH				NH			W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Hi	I	I		NH			W	Mo	Sy	Sy
	FM	80		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Hi	I	I	Mu	Lo	Sy	D	Mu	Mo	Sy	Sy
Big Marsh	OW	11		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Mo	D	D	W	Mo	D	D	W	Lo	D	D		NH			W	Mo	Sy	Sy
	FM	57		NH			St	Lo	U	U	Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Mo	D	D	W	Mo	D	D	W	Lo	D	D	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
	IM	25		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Mo	D	D	W	Mo	D	D	W	Lo	D	D	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
Big Burn	OW	18		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy		NH			W	Mo	Sy	Sy
	AB	6		NH				NH				NH				NH				NH			W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy		NH			Mu	Mo	Sy	Sy
	FM	67		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	D	Mu	Mo	Sy	Sy
Cameron Prairie	OW	6		NH				NH			Mu	Lo	Sy	Sy		NH				NH			W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy		NH			W	Mo	Sy	Sy
	AB	14		NH				NH				NH				NH				NH			W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy		NH			Mu	Mo	Sy	Sy
	FM	67		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	D	Mu	Mo	Sy	Sy
	AU	11		NH				NH				NH			St	Lo	I	Sy	Mu	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Grand Chenier Ridge	OW	11		NH				NH			Mu	Lo	Sy	Sy		NH				NH			W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy		NH			W	Mo	Sy	Sy
	FM	23		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
	IM	24		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
	BM	5		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	HF	8		NH				NH				NH				NH				NH			Ne	Lo	Sy	Sy		NH				NH			Mu	Hi	Sy	D		NH		
	AU	30		NH				NH				NH			St	Lo	I	Sy	Mu	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Grand Lake	OW	99		NH				NH			Mu	Hi	Sy	Sy		NH				NH			W	Lo	Sy	Sy	W	Lo	Sy	Sy		NH				NH				NH		

Table 7-2. Region 4 wildlife functions, status, trends, and projections.

Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
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Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna																																							
	Type	% of Unit	Brown Pelican				Bald Eagle				Seabirds				Wading Birds				Shorebirds				Dabbling Ducks				Diving Ducks				Geese				Raptors				Rails, Coots, and Gallinules			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Mermentau Basin																																											
Amoco	OW	14		NH				NH			Mu	Lo	Sy	Sy		NH				NH			W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Hi	I	I		NH			W	Mo	Sy	Sy
	FM	80		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Hi	I	I	Mu	Lo	Sy	D	Mu	Mo	Sy	Sy
Big Marsh	OW	11		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Mo	D	D	W	Mo	D	D	W	Lo	D	D		NH			W	Mo	Sy	Sy
	FM	57		NH			St	Lo	U	U	Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Mo	D	D	W	Mo	D	D	W	Lo	D	D	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
	IM	25		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Mo	D	D	W	Mo	D	D	W	Lo	D	D	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
Big Burn	OW	18		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy		NH			W	Mo	Sy	Sy
	AB	6		NH				NH				NH				NH				NH			W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy		NH			Mu	Mo	Sy	Sy
	FM	67		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	D	Mu	Mo	Sy	Sy
Cameron Prairie	OW	6		NH				NH			Mu	Lo	Sy	Sy		NH				NH			W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy		NH			W	Mo	Sy	Sy
	AB	14		NH				NH				NH				NH				NH			W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy		NH			Mu	Mo	Sy	Sy
	FM	67		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	D	Mu	Mo	Sy	Sy
	AU	11		NH				NH				NH			St	Lo	I	Sy	Mu	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Grand Chenier Ridge	OW	11		NH				NH			Mu	Lo	Sy	Sy		NH				NH			W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy		NH			W	Mo	Sy	Sy
	FM	23		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
	IM	24		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
	BM	5		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	HF	8		NH				NH				NH				NH				NH			Ne	Lo	Sy	Sy		NH				NH			Mu	Hi	Sy	D		NH		
	AU	30		NH				NH				NH			St	Lo	I	Sy	Mu	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Grand Lake	OW	99		NH				NH			Mu	Hi	Sy	Sy		NH				NH			W	Lo	Sy	Sy	W	Lo	Sy	Sy		NH				NH				NH		

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Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna																Furbearer												Game												Reptiles			
	Type	% of Unit	Other Marsh/ OW Residents				Other Wood-land Resid.				Other Marsh/ OW Migrants				Other Wood-land Mig.				Nutria				Muskrat				Mink, Otter, and Raccoon				Rabbits				Squirrels				Deer				American Alligator			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Mermentau Basin																																															
Amoco	OW	14	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	I
	FM	80	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	I
Big Marsh	OW	11	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Hi	I	I
	FM	57	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	I
	IM	25	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Hi	I	I
Big Burn	OW	18	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	I
	AB	6	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	I
	FM	67	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	I
Cameron Prairie	OW	6	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	Sy
	AB	14	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	Sy
	FM	67	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Mo	I	Sy
	AU	11	Mu	Mo	Sy	Sy	Ne	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Grand Chenier Ridge	OW	11	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Lo	I	Sy
	FM	23	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	I	Sy
	IM	24	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	I	Sy
	BM	5	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	I	Sy
	HF	8		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	AU	30	Mu	Lo	Sy	Sy	Ne	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Grand Lake	OW	99	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH				NH				NH				NH				NH				NH				NH				NH		

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Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat Type	% of Unit	Avifauna: Brown Pelican				Bald Eagle				Seabirds				Wading Birds				Shorebirds			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Grand/White Lake Land Bridge	OW	35		NH				NH			Mu	Mo	Sy	Sy		NH				NH		
	FM	54		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy
	HF	9		NH				NH				NH				NH				NH		
Grand Lake East	OW	14		NH				NH			Mu	Lo	Sy	Sy		NH				NH		
	AB	6		NH				NH				NH				NH				NH		
	FM	64		NH				NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D
	HF	14		NH				NH				NH				NH				NH		
Hog Bayou	OW	34	W	Lo	I	I		NH			Mu	Hi	Sy	Sy		NH				NH		
	FM	5		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy
	BM	32		NH				NH			Mu	Hi	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy
	SM	25		NH				NH			Mu	Hi	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy
	BB	1		NH				NH			Mu	Hi	Sy	Sy	St	Lo	Sy	Sy	Mu	Hi	Sy	Sy
Lacassine	OW	20		NH				NH			Mu	Mo	Sy	Sy		NH				NH		
	AB	20		NH				NH				NH				NH				NH		
	FM	55		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	D
	HF	5		NH				NH				NH				NH				NH		
Little Prairie	OW	6		NH				NH			Mu	Lo	Sy	Sy		NH				NH		
	FM	30		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Hi	Sy	Sy
	HF	14		NH				NH				NH				NH				NH		
	AU	50		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Hi	Sy	Sy

Mapping Unit	1988 Habitat Type	% of Unit	Avifauna: Dabbling Ducks				Diving Ducks				Geese				Raptors				Rails, Coots, and Gallinules			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Grand/White Lake Land Bridge	OW	35	W	Mo	D	D	W	Mo	D	D	W	Lo	D	D		NH			W	Lo	Sy	Sy
	FM	54	W	Mo	D	D	W	Mo	D	D	W	Lo	D	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	HF	9		NH				NH				NH			Mu	Hi	Sy	D		NH		
Grand Lake East	OW	14	W	Mo	D	D	W	Mo	D	D	W	Lo	D	D		NH			W	Lo	Sy	Sy
	AB	6	W	Mo	D	D	W	Mo	D	D	W	Lo	D	D		NH			Mu	Lo	Sy	Sy
	FM	64	W	Mo	D	D	W	Mo	D	D	W	Lo	D	D		NH			Mu	Lo	Sy	Sy
	HF	14		NH				NH				NH			Mu	Hi	Sy	D		NH		
Hog Bayou	OW	34	W	Mo	D	D	W	Mo	D	D	W	Lo	D	D		NH			W	Lo	Sy	Sy
	FM	5	W	Mo	D	D	W	Mo	D	D	W	Lo	D	D		NH			Mu	Lo	Sy	Sy
	BM	32	W	Mo	D	D	W	Mo	D	D	W	Lo	D	D		NH			Mu	Lo	Sy	Sy
	SM	25	W	Lo	D	D	W	Lo	D	D	W	Lo	D	D		NH			Mu	Lo	Sy	Sy
	BB	1		NH				NH				NH				NH				NH		
Lacassine	OW	20	W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy		NH			W	Mo	Sy	Sy
	AB	20	W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy		NH			W	Mo	Sy	Sy
	FM	55	W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy		NH			W	Mo	Sy	Sy
	HF	5	Ne	Lo	Sy	Sy		NH				NH			Mu	Hi	Sy	D		NH		
Little Prairie	OW	6	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy
	FM	30	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	W	Mo	Sy	Sy	Mu	Mo	Sy	Sy
	HF	14	Ne	Lo	Sy	Sy		NH				NH			W	Mo	Sy	Sy		NH		
	AU	50	W	Mo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Mo	Sy	Sy	Mu	Lo	Sy	Sy

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Mapping Unit	1988 Habitat		Avifauna																Furbeare												Game												Reptiles			
	Type	% of Unit	Other Marsh/ OW Residents				Other Wood-land Resid.				Other Marsh/ OW Migrants				Other Wood-land Mig.				Nutria				Muskrat				Mink, Otter, and Raccoon				Rabbits				Squirrels				Deer				American Alligator			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Grand/White Lake Land Bridge	OW	35	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	I
	FM	54	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	D	D		NH			Mu	Lo	D	D	Mu	Mo	I	I
	HF	9		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	D	D		NH			Mu	Lo	D	D	Mu	Lo	Sy	Sy
Grand Lake East	OW	14	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	Sy
	AB	6	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	Sy
	FM	64	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	D	D		NH			Mu	Lo	D	D	Mu	Mo	I	Sy
	HF	14		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Hog Bayou	OW	34	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Lo	Sy	Sy
	FM	5	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	BM	32	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	SM	25	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	BB	1		NH				NH				NH				NH				NH				NH				NH				NH				NH				NH				NH		
Lacassine	OW	20	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Hi	I	Sy
	AB	20	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Hi	I	Sy
	FM	55	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy
	HF	5		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
Little Prairie	OW	6	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	Sy
	FM	30	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Mo	I	Sy
	HF	14		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
	AU	50	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy

Table 7-2. Region 4 wildlife functions, status, trends, and projections.

Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo = Moderate Numbers; Hi = High Numbers
Functions of Particular Interest: Ne = Nesting; St = Stopover Habitat; W = Wintering Area; Mu = Multiple Functions
Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna																																							
	Type	% of Unit	Brown Pelican				Bald Eagle				Seabirds				Wading Birds				Shorebirds				Dabbling Ducks				Diving Ducks				Geese				Raptors				Rails, Coots, and Gallinules			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Little Pecan	OW	15		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Mo	D	D	W	Mo	Sy	Sy	W	Lo	Sy	Sy		NH			W	Mo	Sy	Sy
	FM	75		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Mo	D	D	W	Mo	D	D	W	Lo	Sy	Sy		NH			Mu	Mo	Sy	Sy
	HF	3		NH				NH				NH				NH				NH			Ne	Lo	Sy	Sy		NH				NH				NH				NH		
Locust Island	OW	9		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy
	FM	9		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	W	Mo	Sy	Sy	Mu	Mo	Sy	Sy
	IM	31		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	W	Mo	Sy	Sy	Mu	Mo	Sy	Sy
	BM	13		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	W	Mo	Sy	Sy	Mu	Mo	Sy	Sy
	AU	36		NH				NH			Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Hi	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Lower Mud Lake	OW	11	W	Lo	I	I		NH			Mu	Mo	Sy	Sy		NH				NH			W	Mo	D	D	W	Mo	D	D	W	Lo	D	D		NH			W	Lo	Sy	Sy
	SM	77		NH				NH			Mu	Mo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Lo	D	D	W	Lo	D	D	W	Lo	D	D		NH			Mu	Lo	Sy	Sy
	HF	4		NH				NH				NH				NH				NH				NH				NH				NH				NH				NH		
	BB	2		NH				NH			Mu	Hi	Sy	Sy	St	Lo	Sy	Sy	Mu	Hi	Sy	Sy		NH				NH				NH				NH				NH		
Middle Marsh	OW	7		NH				NH			Mu	Lo	Sy	Sy		NH				NH			W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy		NH			W	Mo	Sy	Sy
	FM	10		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	D	Mu	Mo	Sy	Sy
	IM	69		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Hi	Sy	Sy	W	Hi	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	D	Mu	Mo	Sy	Sy
	AU	10		NH				NH				NH			Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	D	Mu	Mo	Sy	Sy
North White Lake	FM	92		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy
	HF	6		NH				NH				NH				NH				NH			Mu	Lo	Sy	Sy		NH				NH			Mu	Hi	Sy	D		NH		

Table 7-2. Region 4 wildlife functions, status, trends, and projections.

Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo = Moderate Numbers; Hi = High Numbers
Functions of Particular Interest: Ne = Nesting; St = Stopover Habitat; W = Wintering Area; Mu = Multiple Functions
Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna															
	Type	% of Unit	Other Marsh/ OW Residents				Other Wood-land Resid.				Other Marsh/ OW Migrants				Other Wood-land Mig.			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Little Pecan	OW	15	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH		
	FM	75	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH		
	HF	3		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D
Locust Island	OW	9	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH		
	FM	9	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH		
	IM	31	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH		
	BM	13	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH		
	AU	36	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH		
Lower Mud Lake	OW	11	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH		
	SM	77	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH		
	HF	4		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	Sy
	BB	2		NH				NH				NH				NH		
Middle Marsh	OW	7	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH		
	FM	10	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH		
	IM	69	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH		
	AU	10	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH		
North White Lake	FM	92	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy
	HF	6		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D

Mapping Unit	1988 Habitat		Furbear												Game												Reptiles			
	Type	% of Unit	Nutria				Muskrat				Mink, Otter, and Raccoon				Rabbits				Squirrels				Deer				American Alligator			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Little Pecan	OW	15	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH				NH				NH			Mu	Hi	I	I
	FM	75	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Hi	I	I
	HF	3	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Locust Island	OW	9	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	Sy
	FM	9	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Mo	I	Sy
	IM	31	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	Sy
	BM	13	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	Sy
	AU	36	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Lower Mud Lake	OW	11	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Lo	Sy	Sy
	SM	77	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	HF	4	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	BB	2		NH				NH				NH				NH				NH				NH				NH		
Middle Marsh	OW	7	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	Sy
	FM	10	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Mo	I	Sy
	IM	69	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	Sy
	AU	10	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
North White Lake	FM	92	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	Sy
	HF	6	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy

Table 7-2. Region 4 wildlife functions, status, trends, and projections.

Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
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Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna																																							
	Type	% of Unit	Brown Pelican				Bald Eagle				Seabirds				Wading Birds				Shorebirds				Dabbling Ducks				Diving Ducks				Geese				Raptors				Rails, Coots, and Gallinules			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
North Grand Lake	OW	20		NH				NH			Mu	Lo	Sy	Sy		NH				NH			W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy		NH			W	Lo	Sy	Sy
	FM	68		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
	HF	7		NH				NH				NH				NH				NH			Mu	Lo	Sy	Sy		NH				NH			Mu	Hi	Sy	D		NH		
Oak Grove	IM	73		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
	BM	13		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	AU	8		NH				NH				NH			St	Lo	Sy	Sy	Mu	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Rockefeller	OW	23	W	Lo	I	I		NH			Mu	Hi	Sy	Sy		NH				NH			W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy
	FM	15		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Mo	D	D	W	Mo	D	D	W	Mo	Sy	Sy	Mu	Lo	Sy	D	Mu	Mo	D	D
	IM	14		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Mo	D	D	W	Mo	D	D	W	Mo	Sy	Sy	Mu	Lo	Sy	D	Mu	Mo	D	D
	BM	30		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Mo	D	D	W	Mo	D	D	W	Mo	Sy	Sy	Mu	Lo	Sy	D	Mu	Mo	D	D
	SM	15		NH				NH			Mu	Hi	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Lo	D	D	W	Lo	D	D	W	Mo	Sy	Sy		NH			Mu	Lo	D	D
South Pecan Island	OW	26	W	Lo	I	I		NH			Mu	Hi	Sy	Sy		NH				NH			W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy
	IM	5		NH				NH			Mu	Mo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Mo	D	D	W	Mo	D	D	W	Lo	Sy	Sy	Mu	Lo	Sy	D	Mu	Mo	D	D
	BM	61		NH				NH			Mu	Hi	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Mo	D	D	W	Mo	D	D	W	Lo	Sy	Sy	Mu	Lo	Sy	D	Mu	Mo	D	D
South White Lake	OW	7		NH				NH			Mu	Lo	Sy	Sy		NH				NH			W	Mo	D	D	W	Mo	D	D	W	Lo	D	D					W	Mo	Sy	Sy
	FM	70		NH			Ne	Lo	I	I	Mu	Lo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Mo	D	D	W	Mo	D	D	W	Lo	D	D	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
	HF	11		NH				NH				NH				NH				NH				NH				NH				NH				NH				NH		
	AU	10		NH				NH				NH			St	Lo	Sy	Sy	Mu	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	Mu	Lo	Sy	Sy
White Lake	OW	99		NH				NH			Mu	Hi	Sy	Sy		NH				NH			W	Lo	Sy	Sy	W	Lo	Sy	Sy		NH				NH				NH		

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Mapping Unit	1988 Habitat		Avifauna																Furbeare												Game												Reptiles			
	Type	% of Unit	Other Marsh/ OW Residents				Other Wood-land Resid.				Other Marsh/ OW Migrants				Other Wood-land Mig.				Nutria				Muskrat				Mink, Otter, and Raccoon				Rabbits				Squirrels				Deer				American Alligator			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
North Grand Lake	OW	20	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH				NH				NH			Mu	Mo	I	Sy
	FM	68	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	W	Lo	Sy	Sy		NH			W	Lo	Sy	Sy	Mu	Mo	I	Sy
	HF	7		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Oak Grove	IM	73	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	Sy
	BM	13	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	Sy
	AU	8	Mu	Lo	Sy	Sy	Ne	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Rockefeller	OW	23		NH				NH				NH				NH				NH				NH				NH				NH				NH				NH			Mu	Hi	I	Sy
	FM	15	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Mo	Sy	D		NH			Mu	Mo	Sy	D	Mu	Hi	I	Sy
	IM	14	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Mo	Sy	D		NH			Mu	Mo	Sy	D	Mu	Hi	I	Sy
	BM	30	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Mo	Sy	D		NH			Mu	Mo	Sy	D	Mu	Hi	I	Sy
	SM	15	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	D		NH			Mu	Mo	Sy	D	Mu	Lo	Sy	Sy
South Pecan Island	OW	26		NH				NH				NH				NH				NH				NH				NH				NH				NH				NH			Mu	Mo	I	Sy
	IM	5	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Mo	I	Sy
	BM	61	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Mo	I	Sy
South White Lake	OW	7	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	Sy
	FM	70	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	Sy
	HF	11	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
	AU	10	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
White Lake	OW	99	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH				NH				NH				NH				NH				NH				NH				NH		

Table 7-2. Region 4 wildlife functions, status, trends, and projections.

Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo = Moderate Numbers; Hi = High Numbers
Functions of Particular Interest: Ne = Nesting; St = Stopover Habitat; W = Wintering Area; Mu = Multiple Functions
Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna																																							
	Type	% of Unit	Brown Pelican				Bald Eagle				Seabirds				Wading Birds				Shorebirds				Dabbling Ducks				Diving Ducks				Geese				Raptors				Rails, Coots, and Gallinules			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Calcasieu/Sabine Basin																																											
Big Lake	OW	24		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy		NH			W	Mo	Sy	Sy
	FM	14		NH				NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy		NH			Mu	Mo	Sy	Sy
	IM	9		NH				NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy		NH			Mu	Mo	Sy	Sy
	BM	18		NH				NH			Mu	Mo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy		NH			Mu	Mo	Sy	Sy
	HF	10		NH				NH				NH				NH				NH			Ne	Lo	Sy	Sy		NH				NH				NH				NH		
	AU	25		NH				NH			St	Lo	Sy	Sy	St	Mo	Sy	Sy	Mu	Mo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH		
Black Bayou	OW	34	W	Lo	I	I		NH			Mu	Mo	Sy	Sy		NH				NH			W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			W	Lo	Sy	D
	IM	23		NH				NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	BM	34		NH				NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	HF	5		NH				NH				NH				NH				NH				NH				NH				NH				NH				NH		
Black Lake	OW	68		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Lo	I	D	W	Lo	I	D	W	Lo	I	D	W	Lo	I	D	W	Lo	Sy	D
	IM	5		NH				NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Lo	I	D	W	Lo	I	D	W	Lo	I	D	W	Lo	I	D	Mu	Lo	Sy	D
	BM	11		NH				NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Lo	I	D	W	Lo	I	D	W	Lo	I	D	W	Lo	I	D	Mu	Lo	Sy	D
	AU	10		NH				NH			St	Lo	Sy	Sy	St	Mo	Sy	Sy	Mu	Mo	Sy	Sy		NH				NH				NH				NH				NH		
Brown Lake	OW	52		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	FM	7		NH				NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	IM	5		NH				NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	BM	34		NH				NH			Mu	Mo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D

Table 7-2. Region 4 wildlife functions, status, trends, and projections.

Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo = Moderate Numbers; Hi = High Numbers
Functions of Particular Interest: Ne = Nesting; St = Stopover Habitat; W = Wintering Area; Mu = Multiple Functions
Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna																Furbear												Game												Reptiles			
	Type	% of Unit	Other Marsh/ OW Residents				Other Wood- land Resid.				Other Marsh/ OW Migrants				Other Wood- land Mig.				Nutria				Muskrat				Mink, Otter, and Raccoon				Rabbits				Squirrels				Deer				American Alligator			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Calcasieu/Sabine Basin																																														
Big Lake	OW	24	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	Sy
	FM	14	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	Sy
	IM	9	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	Sy
	BM	18	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	Sy
	HF	10		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
	AU	25	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Black Bayou	OW	34	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Lo	Sy	Sy
	IM	23	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Mo	I	Sy
	BM	34	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Mo	I	Sy
	HF	5		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
Black Lake	OW	68	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Lo	Sy	Sy
	IM	5	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
	BM	11	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
	AU	10	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	D		NH			Mu	Mo	Sy	D	Mu	Lo	Sy	Sy
Brown Lake	OW	52	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Lo	Sy	Sy
	FM	7	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Mo	I	Sy
	IM	5	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Mo	I	Sy
	BM	34	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Mo	I	Sy

Table 7-2. Region 4 wildlife functions, status, trends, and projections.

Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
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Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna																																							
	Type	% of Unit	Brown Pelican				Bald Eagle				Seabirds				Wading Birds				Shorebirds				Dabbling Ducks				Diving Ducks				Geese				Raptors				Rails, Coots, and Gallinules			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Cameron	OW	6		NH				NH			Mu	Mo	Sy	Sy		NH				NH				NH				NH				NH				NH				NH		
	FM	19		NH				NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy		NH				NH				NH			Mu	Lo	Sy	Sy		NH		
	IM	22		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
	BM	14		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	SM	6		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Lo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	HF	1		NH				NH				NH				NH				NH				NH				NH				NH				NH				NH		
	BB	1		NH				NH			Mu	Hi	Sy	Sy	St	Lo	Sy	Sy	Mu	Hi	Sy	Sy		NH				NH				NH				NH				NH		
Calcasieu Lake	OW	94	W	Lo	I	I		NH			Mu	Hi	Sy	Sy		NH				NH			W	Lo	Sy	Sy	W	Lo	Sy	Sy		NH				NH				NH		
Cameron-Creole Watershed	OW	38		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Hi	I	Sy	W	Hi	I	Sy	W	Lo	Sy	Sy		NH			W	Lo	Sy	Sy
	IM	26		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Hi	I	Sy	W	Hi	I	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	BM	35		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Hi	I	Sy	W	Hi	I	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
Choupique Island	OW	33		NH				NH			Mu	Lo	Sy	Sy		NH				NH			W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy		NH			W	Lo	Sy	Sy
	FM	29		NH				NH			Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	BM	31		NH				NH			Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	AU	5		NH				NH				NH			St	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH				NH				NH				NH				NH		
Clear Marais	OW	21		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Hi	I	Sy	W	Hi	I	Sy	W	Mo	I	I		NH			W	Mo	Sy	Sy
	AB	10		NH				NH				NH				NH				NH			W	Hi	I	Sy	W	Hi	I	Sy	W	Mo	I	I		NH			Mu	Mo	Sy	Sy
	FM	58		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Hi	I	Sy	W	Hi	I	Sy	W	Mo	I	I	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
	AU	6		NH				NH				NH			St	Lo	Sy	Sy	Mu	Mo	Sy	Sy	W	Mo	I	Sy	W	Mo	I	Sy	W	Mo	I	I	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
Gum Cove	FM	21		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	Mu	Lo	Sy	Sy	W	Lo	Sy	Sy
	AU	77		NH				NH				NH			St	Lo	Sy	Sy	Mu	Mo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	W	Lo	Sy	Sy	Mu	Mo	Sy	Sy	W	Lo	Sy	Sy

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Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
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Mapping Unit	1988 Habitat		Avifauna															
			Other Marsh/ OW Residents				Other Wood-land Resid.				Other Marsh/ OW Migrants				Other Wood-land Mig.			
	Type	% of Unit	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Cameron	OW	6	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH		
	FM	19	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH		
	IM	22	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH		
	BM	14	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH		
	SM	6	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH		
	HF	1	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH		
	BB	1		NH				NH				NH				NH		
Calcasieu Lake	OW	94	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH		
Cameron-Creole Watershed	OW	38	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH		
	IM	26	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH		
	BM	35	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH		
Choupique Island	OW	33	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH		
	FM	29	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH		
	BM	31	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH		
	AU	5		NH			Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy
Clear Marais	OW	21	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH		
	AB	10	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH		
	FM	58	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH		
	AU	6	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
Gum Cove	FM	21	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH		
	AU	77	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy

Mapping Unit	1988 Habitat		Furbeare												Ga me												Reptiles			
			Nutria				Muskrat				Mink, Otter, and Raccoon				Rabbits				Squirrels				Deer				American Alligator			
	Type	% of Unit	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Cameron	OW	6	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	Sy
	FM	19	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	Sy
	IM	22	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	Sy
	BM	14	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	Sy
	SM	6	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	HF	1	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
	BB	1		NH				NH				NH				NH				NH				NH				NH		
Calcasieu Lake	OW	94		NH				NH				NH				NH				NH				NH				NH		
Cameron-Creole Watershed	OW	38	Mu	Lo	I	I	Mu	Mo	I	I	Mu	Mo	I	I		NH				NH				NH			Mu	Mo	I	I
	IM	26	Mu	Lo	I	I	Mu	Mo	I	I	Mu	Mo	I	I	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	I
	BM	35	Mu	Lo	I	I	Mu	Mo	I	I	Mu	Mo	I	I	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	I
Choupique Island	OW	33	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Lo	Sy	Sy
	FM	29	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	W	Lo	Sy	Sy		NH			W	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	BM	31	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	W	Lo	Sy	Sy		NH			W	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	AU	5	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	W	Lo	Sy	Sy		NH			W	Lo	Sy	Sy	Mu	Lo	Sy	Sy
Clear Marais	OW	21	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	I
	AB	10	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	I
	FM	58	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	I
	AU	6	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Gum Cove	FM	21	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy
	AU	77	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy

Table 7-2. Region 4 wildlife functions, status, trends, and projections.

Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo = Moderate Numbers; Hi = High Numbers
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Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna																																							
	Type	% of Unit	Brown Pelican				Bald Eagle				Seabirds				Wading Birds				Shorebirds				Dabbling Ducks				Diving Ducks				Geese				Raptors				Rails, Coots, and Gallinules			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Hackberry Ridge	OW	12		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	BM	21		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	I	Sy	Mu	Hi	Sy	Sy	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	HF	9		NH				NH				NH				NH				NH			Ne	Lo	Sy	Sy		NH				NH			Mu	Mo	Sy	D		NH		
	AU	53		NH				NH				NH			St	Lo	Sy	Sy	Mu	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy
Hog Island Gully	OW	37		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	BM	22		NH				NH			Mu	Mo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Mo	I	D	W	Mo	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	SM	36		NH				NH			Mu	Mo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Lo	Sy	D	W	Lo	Sy	D	W	Lo	Sy	D		NH			Mu	Lo	Sy	D
East Johnson's Bayou	OW	7		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			W	Lo	Sy	Sy
	FM	7		NH				NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D	Mu	Lo	Sy	D	Mu	Lo	Sy	D
	IM	80		NH				NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D	Mu	Lo	Sy	D	Mu	Lo	Sy	D
West Johnson's Bayou	OW	13	W	Lo	I	I		NH			Mu	Hi	Sy	Sy		NH				NH			W	Mo	I	D	W	Mo	I	D	W	Mo	I	D		NH			W	Lo	Sy	Sy
	BM	83		NH				NH			Mu	Mo	Sy	D	Mu	Hi	I	D	Mu	Hi	Sy	D	W	Mo	I	D	W	Mo	I	D	W	Mo	I	D	Mu	Lo	Sy	D	Mu	Lo	Sy	D
Johnson's Bayou Ridge	OW	5	W	Lo	I	I		NH			Mu	Mo	Sy	Sy		NH				NH			W	Mo	I	D	W	Mo	I	D	W	Mo	I	D		NH			W	Lo	Sy	Sy
	BM	31		NH				NH			Mu	Mo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Mo	I	D	W	Mo	I	D	W	Hi	I	D	Mu	Lo	Sy	D	Mu	Lo	Sy	D
	SM	44		NH				NH			Mu	Mo	Sy	D	Mu	Hi	I	Sy	Mu	Hi	Sy	D	W	Mo	I	D	W	Mo	I	D	W	Hi	I	D	Mu	Lo	Sy	D	Mu	Lo	Sy	D
	HF	3		NH				NH				NH				NH				NH			Ne	Lo	Sy	Sy		NH				NH				NH				NH		
	BB	1		NH				NH			Mu	Hi	Sy	Sy	St	Lo	Sy	Sy	Mu	Hi	Sy	Sy		NH				NH				NH				NH				NH		
	AU	16		NH				NH				NH			St	Lo	Sy	Sy	Mu	Mo	Sy	Sy	W	Mo	I	D	W	Mo	I	D	W	Hi	I	D	Mu	Lo	Sy	D	Mu	Lo	Sy	D
Martin Beach-Ship Can. Shore	OW	9	W	Mo	I	I		NH			Mu	Mo	Sy	Sy		NH				NH			W	Mo	I	D	W	Mo	I	D	W	Lo	I	D		NH			W	Lo	Sy	Sy
	IM	33		NH				NH			Mu	Lo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Mo	I	D	W	Mo	I	D	W	Mo	I	D	Mu	Lo	Sy	D	Mu	Lo	Sy	D
	BM	26		NH				NH			Mu	Mo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Mo	I	D	W	Mo	I	D	W	Mo	I	D	Mu	Lo	Sy	D	Mu	Lo	Sy	D
	SM	7		NH				NH			Mu	Mo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Mo	I	D	W	Mo	I	D	W	Mo	I	D	Mu	Lo	Sy	D	Mu	Lo	Sy	D
	BB	1		NH				NH			Mu	Hi	Sy	Sy	St	Lo	Sy	Sy	Mu	Hi	Sy	Sy		NH				NH				NH				NH				NH		
	AU	24		NH				NH				NH			St	Lo	Sy	Sy	Mu	Mo	Sy	Sy	W	Lo	I	D	W	Lo	I	D	W	Mo	I	D	Mu	Lo	Sy	D	Mu	Lo	Sy	D

Table 7-2. Region 4 wildlife functions, status, trends, and projections.

Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
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Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna																Furbeare												Game												Reptiles			
	Type	% of Unit	Other Marsh/ OW Residents				Other Wood-land Resid.				Other Marsh/ OW Migrants				Other Wood-land Mig.				Nutria				Muskrat				Mink, Otter, and Raccoon				Rabbits				Squirrels				Deer				American Alligator			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Hackberry Ridge	OW	12	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Lo	Sy	Sy
	BM	21	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
	HF	9	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH				NH				NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH		
	AU	53	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH		
Hog Island Gully	OW	37	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Lo	Sy	Sy
	BM	22	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
	SM	36	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
East Johnson's Bayou	OW	7	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy		NH				NH				NH			Mu	Hi	I	Sy
	FM	7	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy
	IM	80	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy
West Johnson's Bayou	OW	13	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy		NH				NH				NH			Mu	Hi	I	Sy
	BM	83	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy
Johnson's Bayou Ridge	OW	5	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy		NH				NH				NH			Mu	Lo	Sy	Sy
	BM	31	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
	SM	44	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
	HF	3		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	BB	1		NH				NH				NH				NH				NH				NH				NH				NH				NH				NH				NH		
	AU	16	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
Martin Beach-Ship Can. Shore	OW	9	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy		NH				NH				NH			Mu	Lo	Sy	Sy
	IM	33	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
	BM	26	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
	SM	7	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
	BB	1		NH				NH				NH				NH				NH				NH				NH				NH				NH				NH				NH		
	AU	24	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	D		NH			Mu	Mo	Sy	D	Mu	Lo	Sy	Sy

Table 7-2. Region 4 wildlife functions, status, trends, and projections.

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Mapping Unit	1988 Habitat		Avifauna																																							
	Type	% of Unit	Brown Pelican				Bald Eagle				Seabirds				Wading Birds				Shorebirds				Dabbling Ducks				Diving Ducks				Geese				Raptors				Rails, Coots, and Gallinules			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Mud Lake	OW	34	W	Lo	I	I		NH			Mu	Hi	Sy	Sy		NH				NH			W	Mo	I	Sy	W	Mo	I	Sy	W	Lo	I	Sy		NH			W	Lo	Sy	Sy
	BM	62		NH				NH			Mu	Mo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Mo	I	Sy	W	Mo	I	Sy	W	Lo	I	Sy	Mu	Lo	Sy	D	W	Lo	Sy	Sy
Perry Ridge	OW	30		NH				NH			Mu	Mo	Sy	D		NH				NH			W	Hi	I	Sy	W	Hi	I	Sy	W	Mo	I	Sy		NH			W	Lo	Sy	Sy
	FM	30		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Hi	Sy	Sy	W	Hi	I	Sy	W	Hi	I	Sy	W	Mo	I	Sy		NH			Mu	Lo	Sy	Sy
	IM	28		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Hi	Sy	Sy	W	Hi	I	Sy	W	Hi	I	Sy	W	Mo	I	Sy		NH			Mu	Lo	Sy	Sy
	HF	10		NH			Mu	Lo	Sy	Sy		NH				NH				NH			Ne	Lo	Sy	Sy		NH				NH				NH				NH		
Sabine Pool No. 3	OW	32		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Hi	I	Sy	W	Hi	I	Sy	W	Hi	I	Sy		NH			W	Lo	Sy	Sy
	AB	7		NH				NH				NH				NH				NH			W	Hi	I	Sy	W	Hi	I	Sy	W	Hi	I	Sy		NH			Mu	Mo	Sy	Sy
	FM	61		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Hi	Sy	Sy	W	Hi	I	Sy	W	Hi	I	Sy	W	Hi	I	Sy		NH			Mu	Mo	Sy	Sy
Sabine Lake Ridges	OW	5	W	Lo	I	I		NH			Mu	Hi	Sy	Sy		NH				NH			W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Hi	I	Sy		NH			W	Mo	Sy	Sy
	FM	5		NH				NH			Mu	Lo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Hi	I	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
	IM	24		NH				NH			Mu	Lo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Mo	Sy	D	W	Mo	Sy	D	W	Hi	I	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D
	BM	35		NH				NH			Mu	Mo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Mo	Sy	D	W	Mo	Sy	D	W	Hi	I	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D
	SM	11		NH				NH			Mu	Mo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Lo	Sy	D	W	Lo	Sy	D	W	Mo	I	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D
	HF	1		NH				NH				NH				NH				NH				NH				NH				NH				NH				NH		
	BB	2		NH				NH			Mu	Hi	Sy	Sy	St	Lo	Sy	Sy	Mu	Hi	Sy	Sy		NH				NH				NH				NH				NH		
	AU	17		NH				NH				NH			St	Lo	Sy	Sy	Mu	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Hi	I	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
Second Bayou	OW	13		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			W	Lo	Sy	Sy
	IM	72		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Hi	Sy	Sy	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D	Mu	Lo	Sy	D	Mu	Lo	Sy	D
	BM	14		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Hi	Sy	Sy	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D	Mu	Lo	Sy	D	Mu	Lo	Sy	D

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Mapping Unit	1988 Habitat		Avifauna																Furbear												Game												Reptiles			
	Type	% of Unit	Other Marsh/ OW Residents				Other Wood- land Resid.				Other Marsh/ OW Migrants				Other Wood- land Mig.				Nutria				Muskrat				Mink, Otter, and Raccoon				Rabbits				Squirrels				Deer				American Alligator			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Mud Lake	OW	34	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	Sy
	BM	62	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	I	Sy
Perry Ridge	OW	30	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Hi	I	Sy
	FM	30	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy
	IM	28	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Hi	I	Sy
	HF	10		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
Sabine Pool No. 3	OW	32		NH				NH				NH				NH				NH				NH				NH				NH				NH				NH			Mu	Hi	Sy	Sy
	AB	7	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Hi	Sy	Sy
	FM	61	Mu	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy
Sabine Lake Ridges	OW	5	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	Sy	Sy
	FM	5	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
	IM	24	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Mo	Sy	Sy
	BM	35	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Mo	Sy	Sy
	SM	11	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
	HF	1		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
	BB	2		NH				NH				NH				NH				NH				NH				NH				NH				NH				NH				NH		
	AU	17	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
Second Bayou	OW	13	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy		NH				NH				NH			Mu	Hi	I	I
	IM	72	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Hi	I	I
	BM	14	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Hi	I	I

Table 7-2. Region 4 wildlife functions, status, trends, and projections.

Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo = Moderate Numbers; Hi = High Numbers
Functions of Particular Interest: Ne = Nesting; St = Stopover Habitat; W = Wintering Area; Mu = Multiple Functions
Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna																																							
	Type	% of Unit	Brown Pelican				Bald Eagle				Seabirds				Wading Birds				Shorebirds				Dabbling Ducks				Diving Ducks				Geese				Raptors				Rails, Coots, and Gallinules			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Southeast Sabine	OW	9		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			W	Lo	Sy	Sy
	IM	59		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Hi	Sy	Sy	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D	Mu	Lo	Sy	D	Mu	Lo	Sy	D
	BM	31		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Hi	Sy	Sy	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D	Mu	Lo	Sy	D	Mu	Lo	Sy	D
SW Gum Cove	OW	17		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			W	Lo	Sy	D
	FM	41		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Hi	Sy	Sy	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	IM	24		NH				NH			Mu	Lo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Hi	Sy	Sy	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	BM	8		NH				NH			Mu	Mo	Sy	Sy	Mu	Hi	Sy	Sy	Mu	Hi	Sy	Sy	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	HF	6		NH				NH				NH				NH				NH			Ne	Lo	Sy	Sy		NH				NH				NH				NH		
	AU	5		NH				NH				NH			St	Lo	Sy	Sy	Mu	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy
Sweet/Willow Lakes	OW	43		NH				NH			Mu	Lo	Sy	Sy		NH				NH			W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy		NH			W	Mo	Sy	Sy
	AB	6		NH				NH				NH				NH				NH			W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy		NH			Mu	Mo	Sy	Sy
	FM	46		NH				NH			Mu	Lo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Lo	Sy	Sy		NH			Mu	Mo	Sy	Sy
West Black Lake	OW	61		NH				NH			Mu	Mo	Sy	Sy		NH				NH			W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	FM	20		NH				NH			Mu	Lo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	Sy	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	IM	9		NH				NH			Mu	Lo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	Sy	W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	AU	6		NH				NH				NH			St	Lo	Sy	Sy	Mu	Mo	Sy	Sy	W	Hi	I	Sy	W	Hi	I	Sy	W	Mo	I	Sy		NH			Mu	Lo	Sy	Sy
West Cove	OW	24	W	Mo	I	I		NH			Mu	Hi	Sy	Sy		NH				NH			W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	AB	7		NH				NH				NH				NH				NH			W	Hi	I	D	W	Hi	I	D	W	Mo	I	D		NH			Mu	Lo	Sy	D
	FM	65		NH				NH			Mu	Lo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	Sy	W	Hi	Sy	D	W	Hi	Sy	D	W	Mo	Sy	D		NH			Mu	Lo	Sy	D
Willow Bayou	OW	40	W	Lo	I	I		NH			Mu	Mo	Sy	Sy		NH				NH			W	Hi	D	D	W	Hi	D	D	W	Mo	Sy	D		NH			W	Lo	Sy	D
	IM	8		NH				NH			Mu	Lo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	Sy	W	Hi	D	D	W	Hi	D	D	W	Mo	Sy	D		NH			Mu	Lo	Sy	D
	BM	52		NH				NH			Mu	Mo	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	Sy	W	Hi	D	D	W	Hi	D	D	W	Mo	Sy	D		NH			Mu	Lo	Sy	D

Table 7-2. Region 4 wildlife functions, status, trends, and projections.

Habitat Types: OW = Open Water; AB = Aquatic Bed; FM = Fresh Marsh; IM = Intermediate Marsh; BM = Brackish Marsh; SM = Saline Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agriculture/Upland. Habitat types comprising less than 5% of unit are shown only if habitat is particularly rare or important to wildlife.
Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo = Moderate Numbers; Hi = High Numbers
Functions of Particular Interest: Ne = Nesting; St = Stopover Habitat; W = Wintering Area; Mu = Multiple Functions
Trends (since 1985) / **Projections** (through 2050)**:** Sy = Steady; D = Decrease; I = Increase; U = Unknown

Mapping Unit	1988 Habitat		Avifauna																Furbear												Game												Reptiles			
	Type	% of Unit	Other Marsh/ OW Residents				Other Wood-land Resid.				Other Marsh/ OW Migrants				Other Wood-land Mig.				Nutria				Muskrat				Mink, Otter, and Raccoon				Rabbits				Squirrels				Deer				American Alligator			
			Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.	Func.	Status	Trend	Proj.
Southeast Sabine	OW	9	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy		NH				NH				NH			Mu	Hi	I	Sy
	IM	59	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy
	BM	31	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy
SW Gum Cove	OW	17	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	Sy	Sy
	FM	41	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Mo	Sy	Sy
	IM	24	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Mo	Sy	Sy
	BM	8	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Mo	Sy	Sy
	HF	6		NH			Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	Sy
	AU	5	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy	W	Mo	Sy	Sy		NH			W	Mo	Sy	Sy	Mu	Lo	Sy	Sy
Sweet/Willow Lakes	OW	43	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Lo	Sy	Sy
	AB	6	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	Sy	Sy
	FM	46	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy
West Black Lake	OW	61	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Lo	Sy	Sy
	FM	20	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	I
	IM	9	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Lo	Sy	I
	AU	6	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
West Cove	OW	24	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Hi	I	Sy
	AB	7	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Hi	I	Sy
	FM	65	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Hi	I	Sy
Willow Bayou	OW	40	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	Sy
	IM	8	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Mo	I	Sy
	BM	52	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH			Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Lo	Sy	D		NH			Mu	Lo	Sy	D	Mu	Mo	I	Sy

SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

ANNEX S

Flood and Storms of Record

1. FLOODS AND STORMS OF RECORD

C.1.8. There have been several floods in the study area caused by runoff from heavy rainfall. Some of the major events that occurred over the last thirty years, including Hurricanes Juan, Lili, and Katrina and Tropical Storms Frances, Allison, and Isidore are discussed below.

May 1978. Extremely heavy rain that began early on 3 May and continued throughout the day caused widespread flooding over the New Orleans metropolitan area. Storm totals for Audubon Park and Moisant Airport during 2-3 May were 10.6 and 6.8 inches, respectively. The Algiers station received a total of 11.72 inches during 3-4 May.

April 1980. There were two separate storms during April 1980. The first event occurred 2-3 April and averaged over 5 inches of rain throughout the New Orleans metropolitan area. The Audubon Park station measured nearly 7 inches on 2 April. This storm set the stage for the intense 12-13 April event, which averaged 9.5 inches over the same area. Most of the rain fell during the morning of the 13th. The Algiers gage had a 2-day storm total of 11.86 inches with 9.71 inches falling on the 13th. Moisant Airport had a maximum 24-hour rainfall of 7.95 inches on the 13th. Flash flooding occurred rapidly, since the ground was already heavily saturated from the first April storm. Orleans and Jefferson Parishes experienced the greatest flooding.

October 1985. Hurricane Juan (25-31 October) was responsible for this flood. Juan was in the vicinity of Louisiana for six days. Most flooding was associated with the storm surge and backwater flooding produced by prolonged, strong easterly to southerly winds. Backwater flooding was aggravated by excessive rainfall that fell mostly during the first days of the storm. In the New Orleans metropolitan area, 3-day storm totals (27-29 October) ranged from 5 to 10 inches, with 10.33 inches at Gretna, 7.59 inches at Algiers, and 7.55 inches at Moisant Airport. This storm also caused the peak stages of 4.74 feet NGVD at IWW at Harvey Lock and 4.25 feet NGVD on Bayou Barataria at Barataria.

April 1988. This flood was associated with squall lines ahead of a slow-moving cold front during 1-3 April over the New Orleans area. Storm totals were over 10 inches at several stations. Most of the rain fell in a 12-hour period on 2 April, with nearly 9 inches recorded throughout the area. Some 3-day storm totals reported were 11.08 inches at Gretna, 10.72 inches at Algiers, and 10.63 inches at Audubon Park.

November 1989. A narrow, almost stationary east-west band of strong thunderstorms developed across the New Orleans metropolitan area on the morning of 7 November. As a result, heavy rains persisted over the study area before decreasing in the afternoon. The prolonged storm triggered flash floods throughout the area. Rainfall amounts of 8-12 inches were common from 9:00 AM to 6:00 PM during this day. In Jefferson Parish, rainfall reports from several of the parish's pumping stations indicated 10-12 inches of rain occurred between 8:00 AM and 2:00 PM. The Gretna gage totaled 17.13 inches over 7-9 November, with 13.70 inches recorded on the 8th. The Algiers station recorded 10.85 inches for the same period. Many homes throughout the metropolitan area received some type of water damage.

May 1995**.** This flood resulted from torrential rain that accompanied 50 miles per hour winds and tornadoes. Intense rainfall began around 6:00 PM in the evening on 8 May and continued until midnight. Two to three inches of rain per hour fell for several hours during the peak storm period. At Moisant Airport 9.69 inches of rain fell in three hours, and 12.24 inches fell in less than five hours. The highest 1-hour rainfall total of 6.5 inches was reported at a National Weather Service hourly recording station at Audubon Park. Three and six hour totals from this storm exceeded the same hourly totals for the 1978 and 1989 rainfall events and when compared to rainfall totals in NWS Technical Paper No. 40, 3 and 6 hour rainfall totals reported for this storm exceeded amounts projected for 500-year frequency events. Jefferson Parish experienced extensive flooding from this storm and recorded a maximum 19.53 inches of rainfall at a local gage. Other measurements include 13.70 inches at Gretna and 10.92 inches at Algiers, both occurring on 9 May.

September 1998. Tropical Storm Frances (8-13 September) brought torrential rains and strong winds to southeastern Louisiana. Storm totals topped 15 to 20 inches over much of the greater New Orleans area. Algiers and Gretna received 19.91 and 17.37 inches, respectively, over a 4 day period (10-13 September), while Audubon totaled 16.9 inches over 8-13 September. Frances set a new peak stage at the Intracoastal Waterway at Algiers Lock with a 4.63 feet NGVD reading.

June 2001. Tropical Storm Allison (6-11 June) brought extensive urban flooding in metropolitan areas around New Orleans. Rainfall totals over this period were 21.3 inches at Gretna and 14.28 inches at Audubon.

September 2002. Tropical Storm Isidore (18-26 September) first made landfall at Grand Isle, before moving across Lake Pontchartrain to the north. Tide levels were 4 to 6 feet above normal, but many areas flooded due to heavy rainfall. The rainfall totals near the study area ranged from 18.50 inches at the New Orleans Algiers station to 12.78 inches at Terrytown. Algiers recorded 15.34 inches on the 26th.

October 2002. Hurricane Lili (23 September - 3 October) was originally a Category 4 hurricane and first made landfall as a downgraded Category 2 hurricane near Intracoastal City, LA to the west. Wind gusts up to 61 mph were reported near the study area. Rainfall estimates were rather low at 5 inches, due to the rapid forward movement of the storm. Tide levels were 4 to 7 feet above normal, with many areas outside of the study area being flooded. The stage at Harvey Canal at Lapalco reached 9.84 feet NGVD on the 5th.

August 2005. Hurricane Katrina (29 August) first made landfall near Empire, LA as a slow moving Category 4 hurricane, and continued on a northerly track. The Slidell rain gage recorded at least 7 inches of rainfall, whereas rainfall totals from other gages are not available. Storm surge ranged from 14 feet near the eye wall to 32 feet at the center. Many of the hurricane protection structures in the New Orleans and Chalmette areas were overtopped, and many failed as a consequence, causing catastrophic loss of property and life. However, the west bank area of New Orleans is completely surrounded by levees which were not overtopped, mainly due to its distance from Lake Pontchartrain and being bordered by the Mississippi River and its two levees. Gage data from all nearby gages was insufficient.

September 2005. Hurricane Rita (September 24-26) Hurricane Rita first made landfall just west of Johnson's Bayou, LA as a Category 3 hurricane after downgrading from a 180 mph Category 5 hurricane. The coastal communities of southwest Louisiana were all heavily damaged or totally destroyed by the 20-foot surge. The storm surge also completely overtopped the Calcasieu Lock structure. Many low lying areas in Lake Charles also flooded.

September 2008. Hurricane Gustav (August 25-September 2) first made landfall on the morning of Sept. 1, 2008 near Cocodrie, LA as a Category 2 hurricane with 105 mph winds. Twelve hours later, Gustav was downgraded to a Tropical Storm with 60 mph winds near Alexandria, LA. Due to improved hurricane protection measures made in the metropolitan New Orleans area since 2005, the entire city was spared from damages due to storm surge. Rainfall amounts were:

September 2008. Hurricane Ike (September 1-14) first made landfall near Galveston, Texas as a Category 2 hurricane with 110 mph winds on September 13, 2008. Although landfall was to the west in Texas, this storm caused extensive flooding due to storm surge created by the large wind field along the south central and southwest coastal parishes of Louisiana. The storm surge also completely overtopped the Calcasieu Lock structure.

SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

ANNEX T

Wetland Value Assessments

Model Name	Wetland Value Assessment - Fresh/Intermediate Marsh Community Model
Model Version	
Date of Last Update	December 19, 2011

Objective of Model The coastal marsh models were developed to determine the suitability of marsh and open water habitats in the Louisiana coastal zone. These models were designed to function at a community level and therefore attempt to define an optimal combination of habitat conditions for all fish and wildlife species utilizing coastal marsh ecosystems.

Instructions

Enter data in green cells. All green cells must contain values (including 0's) in order for the HSI calculation to compute for that year.

Always error check data following entry.

Click on variable name in column B for a brief description of the variable.

Intermediate Calculations are "over flow" calculations that were too long or complex to fit within one cell within the table.

Refer to WVA documents for model structure and background.

Notes

Enter data in units noted.

All percentages should be entered as whole numbers between 0 and 100.

Color Coding Key:

Input
Calculation
Output

TSP features:

Mermentau:	Calcasieu/Sabine
13	74a
47a1	3a1
47a2	3c1
47c1	124c
127c3	124d
306a1	5a
6b1	CR
6b2	ORP
6b3	
16b	
CR	

Summary of WVA Outputs

Feature	Net Acres	AAHU
3a1	454	252
3c1	1451	705
3c2	733	396
3c3	829	460
3c4	678	379
3c5	2189	1193
6b1	2140	678
6b2	1,583	499
6b3	1,098	326
16b-west	355	130
16b-northeast	271	87
16b-southeast(direct)	603	196
16b-southeast(indirect)	59	16
16b-southeast(total)	**662**	**212**
47a1	895	378
47a2	1218	517
47c1	1135	497
47c2	372	171
47f	736	340
47h	1151	462
49b1	251	86
99a(marsh)	48	11
99a(barrier headland)	0	0
99a (total)	**48**	**11**
113b2	431	168
124a	888	470
124b	266	123
124c	1915	1059
124d	168	104
127c1	1026	444
127c2	1131	546
127c3	735	320
135a	896	373
306a1(direct)	645	336
306a1(indirect)	98	26
306a1 (total)	**743**	**362**
306a2	1435	602
306b1(direct)	421	216
306b1(indirect)	31	9
306b1 (total)	**452**	**225**
306b2	605	276
306b3	629	292
5a(barrier headland)	26	56
99a(barrier headland)	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 47a1 Project Area: 1021

Condition: Future Without Project

Variable		TY 0 Value	SI	TY 1 Value	SI	TY 25 Value	SI
V1	% Emergent	9	0.18	8	0.17	5	0.15
V2	% Aquatic	20	0.28	20	0.28	10	0.19
V3	Interspersion	%		%		%	
	Class 1	0	0.20	0	0.20	0	0.20
	Class 2	0		0		0	
	Class 3	0		0		0	
	Class 4	100		100		100	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	80	1.00	77	1.00	41	0.63
V5	Salinity (ppt)	12	0.70	12	0.70	12	0.70
V6	Access Value	0.25	0.33	0.25	0.33	0.25	0.33
	Emergent Marsh HSI =		0.26	EM HSI =	0.25	EM HSI =	0.24
	Open Water HSI =		0.37	OW HSI =	0.37	OW HSI =	0.30

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0.2	0.2	0.2
0	0	0

Project: SWC - 47a1 Project Area: 1021

FWOP

Variable		TY 49 Value	SI	TY 50 Value	SI	TY Value	SI
V1	% Emergent	0	0.10	0	0.10		
V2	% Aquatic	3	0.13	3	0.13		
V3	Interspersion	%		%		%	
	Class 1	0	0.10	0	0.10		
	Class 2	0		0			
	Class 3	0		0			
	Class 4	0		0			
	Class 5	100		100			
V4	%OW <= 1.5ft	9	0.22	8	0.20		
V5	Salinity (ppt)	12	0.70	12	0.70		
V6	Access Value	0.25	0.33	0.25	0.33		
		EM HSI =	0.19	EM HSI =	0.19	EM HSI =	
		OW HSI =	0.22	OW HSI =	0.22	OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0.1	0.1	0

Project: SWC - 47a1 Project Area: 1021

FWOP

Variable		TY Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 47a1 Project Area: 1021

Condition: Future With Project

Variable		TY	0	TY	1	TY	3
		Value	SI	Value	SI	Value	SI
V1	% Emergent	9	0.18	13	0.22	34	0.41
V2	% Aquatic	20	0.28	0	0.10	0	0.10
V3	Interspersion	%		%		%	
	Class 1	0	0.20	0	0.10	0	0.40
	Class 2	0		0		0	
	Class 3	0		0		100	
	Class 4	100		0		0	
	Class 5	0		100		0	
V4	%OW <= 1.5ft	80	1.00	100	0.60	100	0.60
V5	Salinity (ppt)	12	0.70	12	0.70	12	0.70
V6	Access Value	0.25	0.33	0.0001	0.10	0.0001	0.10
	Emergent Marsh HSI =		0.26	EM HSI =	0.23	EM HSI =	0.35
	Open Water HSI =		0.37	OW HSI =	0.18	OW HSI =	0.20

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0.4
0.2	0	0
0	0.1	0

Project: SWC - 47a1 Project Area: 1021

FWP

Variable		TY	5	TY	6	TY	29
		Value	SI	Value	SI	Value	SI
V1	% Emergent	94	0.95	94	0.95	88	0.89
V2	% Aquatic	30	0.37	40	0.46	40	0.46
V3	Interspersion	%		%		%	
	Class 1	50	0.70	100	1.00	80	0.92
	Class 2	0		0		20	
	Class 3	50		0		0	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.60	100	0.60	84	0.92
V5	Salinity (ppt)	12	0.70	12	0.70	12	0.70
V6	Access Value	0.25	0.33	0.25	0.33	0.25	0.33
		EM HSI =	0.73	EM HSI =	0.76	EM HSI =	0.73
		OW HSI =	0.42	OW HSI =	0.48	OW HSI =	0.50

Intermediate Calculations		
Interspersion		
1	1	1
0	0	0.6
0.4	0	0
0	0	0
0	0	0

Project: SWC - 47a1 Project Area: 1021

FWP

Variable		TY	30	TY	32	TY	50
		Value	SI	Value	SI	Value	SI
V1	% Emergent	48	0.53	94	0.95	88	0.89
V2	% Aquatic	15	0.24	30	0.37	40	0.46
V3	Interspersion	%		%		%	
	Class 1	100	1.00	85	0.94	80	0.92
	Class 2	0		15		20	
	Class 3	0		0		0	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.60	96	0.68	80	1.00
V5	Salinity (ppt)	12	0.70	12	0.70	12	0.70
V6	Access Value	0.25	0.33	0.25	0.33	0.25	0.33
		EM HSI =	0.56	EM HSI =	0.76	EM HSI =	0.73
		OW HSI =	0.38	OW HSI =	0.45	OW HSI =	0.51

Intermediate Calculations		
Interspersion		
1	1	1
0	0.6	0.6
0	0	0
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 47a1

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	88	0.26	22.98	
1	87	0.25	22.18	22.58
25	51	0.24	12.03	407.76
49	0	0.19	0.00	135.19
50	0	0.19	0.00	0.00
Max TY=	50		AAHUs =	11.31

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	88	0.26	22.98	
1	132	0.23	30.37	26.90
3	349	0.35	122.43	144.07
5	961	0.73	702.06	747.03
6	959	0.76	732.57	717.33
29	900	0.73	656.62	15967.96
30	485	0.56	270.72	451.82
32	963	0.76	729.21	968.21
50	895	0.73	652.98	12433.99
Max TY=	50		AAHUs	629.15

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	629.15
B. Future Without Project Emergent Marsh AAHUs =	11.31
Net Change (FWP - FWOP) =	617.84

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AAHU CALCULATION - OPEN WATER

Project: SWC - 47a1

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	933	0.37	346.98	
1	934	0.37	347.35	347.16
25	970	0.30	287.41	7628.06
49	1021	0.22	223.68	6148.94
50	1021	0.22	222.71	223.20
Max TY=	50		AAHUs =	286.95

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	933	0.37	346.98	
1	53	0.18	9.62	150.38
3	56	0.20	11.41	21.01
5	60	0.42	25.28	36.40
6	62	0.48	29.87	27.55
29	121	0.50	60.44	1034.52
30	51	0.38	19.30	38.46
32	58	0.45	25.81	44.96
50	126	0.51	63.68	793.18
Max TY=	50		AAHUs	42.93

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	42.93
B. Future Without Project Open Water AAHUs =	286.95
Net Change (FWP - FWOP) =	-244.02

TOTAL BENEFITS IN AAHUs DUE TO PROJECT	
A. Emergent Marsh Habitat Net AAHUs =	617.84
B. Open Water Habitat Net AAHUs =	-244.02
Net Benefits= (2.6xEMAAHUs+OWAAHUs)/3.6	378.43

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WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 47a2 Project Area: 1423

Condition: Future Without Project

Variable		TY Value	0 SI	TY Value	1 SI	TY Value	25 SI
V1	% Emergent	9	0.18	9	0.18	4	0.14
V2	% Aquatic	20	0.28	20	0.28	12	0.21
V3	Interspersion	%		%		%	
	Class 1	0	0.20	0	0.20	0	0.20
	Class 2	0		0		0	
	Class 3	0		0		0	
	Class 4	100		100		100	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	80	1.00	77	1.00	41	0.63
V5	Salinity (ppt)	12	0.70	12	0.70	12	0.70
V6	Access Value	0.25	0.33	0.25	0.33	0.25	0.33
	Emergent Marsh HSI =		0.26	EM HSI =	0.26	EM HSI =	0.23
	Open Water HSI =		0.37	OW HSI =	0.37	OW HSI =	0.31

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0.2	0.2	0.2
0	0	0

Project: SWC - 47a2 Project Area: 1423

FWOP

Variable		TY Value	42 SI	TY Value	50 SI	TY Value	SI
V1	% Emergent	0	0.10	0	0.10		
V2	% Aquatic	8	0.17	3	0.13		
V3	Interspersion	%		%		%	
	Class 1	0	0.10	0	0.10		
	Class 2	0		0			
	Class 3	0		0			
	Class 4	0		0			
	Class 5	100		100			
V4	%OW <= 1.5ft	9	0.22	9	0.22		
V5	Salinity (ppt)	12	0.70	12	0.70		
V6	Access Value	0.25	0.33	0.25	0.33		
		EM HSI =	0.19	EM HSI =	0.19	EM HSI =	
		OW HSI =	0.25	OW HSI =	0.22	OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0.1	0.1	0

Project: SWC - 47a2 Project Area: 1423

FWOP

Variable		TY Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 47a2 Project Area: 1423

Condition: Future With Project

Variable		TY	0	TY	1	TY	3
		Value	SI	Value	SI	Value	SI
V1	% Emergent	9	0.18	13	0.22	34	0.41
V2	% Aquatic	20	0.28	0	0.10	0	0.10
V3	Interspersion	%		%		%	
	Class 1	0	0.20	0	0.10	0	0.40
	Class 2	0		0		0	
	Class 3	0		0		100	
	Class 4	100		0		0	
	Class 5	0		100		0	
V4	%OW <= 1.5ft	80	1.00	100	0.60	100	0.60
V5	Salinity (ppt)	12	0.70	12	0.70	12	0.70
V6	Access Value	0.25	0.33	0.0001	0.10	0.0001	0.10
	Emergent Marsh HSI =		0.26	EM HSI =	0.23	EM HSI =	0.35
	Open Water HSI =		0.37	OW HSI =	0.18	OW HSI =	0.20

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0.4
0.2	0	0
0	0.1	0

Project: SWC - 47a2 Project Area: 1423

FWP

Variable		TY	5	TY	6	TY	29
		Value	SI	Value	SI	Value	SI
V1	% Emergent	94	0.95	94	0.95	86	0.87
V2	% Aquatic	30	0.37	40	0.46	40	0.46
V3	Interspersion	%		%		%	
	Class 1	50	0.70	100	1.00	80	0.92
	Class 2	0		0		20	
	Class 3	50		0		0	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.60	100	0.60	82	0.96
V5	Salinity (ppt)	12	0.70	12	0.70	12	0.70
V6	Access Value	0.25	0.33	0.25	0.33	0.25	0.33
		EM HSI =	0.73	EM HSI =	0.76	EM HSI =	0.72
		OW HSI =	0.42	OW HSI =	0.48	OW HSI =	0.50

Intermediate Calculations		
Interspersion		
1	1	1
0	0	0.6
0.4	0	0
0	0	0
0	0	0

Project: SWC - 47a2 Project Area: 1423

FWP

Variable		TY	30	TY	32	TY	50
		Value	SI	Value	SI	Value	SI
V1	% Emergent	48	0.53	94	0.95	86	0.87
V2	% Aquatic	15	0.24	30	0.37	40	0.46
V3	Interspersion	%		%		%	
	Class 1	100	1.00	85	0.94	80	0.92
	Class 2	0		15		20	
	Class 3	0		0		0	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.60	95	0.70	78	1.00
V5	Salinity (ppt)	12	0.70	12	0.70	12	0.70
V6	Access Value	0.25	0.33	0.25	0.33	0.25	0.33
		EM HSI =	0.56	EM HSI =	0.76	EM HSI =	0.72
		OW HSI =	0.38	OW HSI =	0.45	OW HSI =	0.51

Intermediate Calculations		
Interspersion		
1	1	1
0	0.6	0.6
0	0	0
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 47a2

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	126	0.26	32.90	
1	124	0.26	32.38	32.64
25	60	0.23	13.76	545.55
42	0	0.19	0.00	110.44
50	0	0.19	0.00	0.00
Max TY=	50		AAHUs =	13.77

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	126	0.26	32.90	
1	185	0.23	42.56	38.04
3	488	0.35	171.19	201.56
5	1336	0.73	976.02	1039.87
6	1332	0.76	1017.50	996.78
29	1227	0.72	884.70	21858.11
30	676	0.56	377.33	616.06
32	1340	0.76	1014.68	1347.96
50	1218	0.72	878.22	17022.80
Max TY=	50		AAHUs	862.42

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	862.42
B. Future Without Project Emergent Marsh AAHUs =	13.77
Net Change (FWP - FWOP) =	848.65

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AAHU CALCULATION - OPEN WATER

Project: SWC - 47a2

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	1297	0.37	482.35	
1	1299	0.37	483.09	482.72
25	1363	0.31	417.80	10827.39
42	1423	0.25	352.61	6558.44
50	1423	0.22	311.76	2657.47
Max TY=	50		AAHUs =	410.52

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	1297	0.37	482.35	
1	74	0.18	13.43	209.08
3	80	0.20	16.30	29.69
5	87	0.42	36.66	52.45
6	91	0.48	43.84	40.21
29	196	0.50	98.48	1628.35
30	71	0.38	26.87	60.09
32	83	0.45	37.06	63.66
50	205	0.51	103.61	1244.56
Max TY=	50		AAHUs	66.56

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	66.56
B. Future Without Project Open Water AAHUs =	410.52
Net Change (FWP - FWOP) =	-343.96

TOTAL BENEFITS IN AAHUs DUE TO PROJECT	
A. Emergent Marsh Habitat Net AAHUs =	848.65
B. Open Water Habitat Net AAHUs =	-343.96
Net Benefits= (2.6xEMAAHUs+OWAAHUs)/3.6	517.37

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WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 47c1 Project Area: 1308

Condition: Future Without Project

Variable		TY	0	TY	1	TY	3
		Value	SI	Value	SI	Value	SI
V1	% Emergent	0	0.10	0	0.10	0	0.10
V2	% Aquatic	20	0.28	20	0.28	20	0.28
V3	Interspersion	%		%		%	
	Class 1	0	0.10	0	0.10	0	0.10
	Class 2	0		0		0	
	Class 3	0		0		0	
	Class 4	0		0		0	
	Class 5	100		100		100	
V4	%OW <= 1.5ft	58	0.85	56	0.82	52	0.77
V5	Salinity (ppt)	12	0.70	12	0.70	12	0.70
V6	Access Value	0.25	0.33	0.25	0.33	0.25	0.33
	Emergent Marsh HSI =		0.19	EM HSI =	0.19	EM HSI =	0.19
	Open Water HSI =		0.35	OW HSI =	0.35	OW HSI =	0.35

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0.1	0.1	0.1

Project: SWC - 47c1 Project Area: 1308

FWOP

Variable		TY	25	TY	50	TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent	0	0.10	0	0.10		
V2	% Aquatic	12	0.21	3	0.13		
V3	Interspersion	%		%		%	
	Class 1	0	0.10	0	0.10		
	Class 2	0		0			
	Class 3	0		0			
	Class 4	0		0			
	Class 5	100		100			
V4	%OW <= 1.5ft	28	0.46	0	0.10		
V5	Salinity (ppt)	12	0.70	12	0.70		
V6	Access Value	0.25	0.33	0.25	0.33		
		EM HSI =	0.19	EM HSI =	0.19	EM HSI =	
		OW HSI =	0.29	OW HSI =	0.21	OW HSI =	

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0.1	0.1	0

Project: SWC - 47c1 Project Area: 1308

FWOP

Variable		TY		TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

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WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 47c1 Project Area: 1308

Condition: Future With Project

Variable		TY Value	0 SI	TY Value	1 SI	TY Value	3 SI
V1	% Emergent	0	0.10	10	0.19	28	0.35
V2	% Aquatic	20	0.28	0	0.10	0	0.10
V3	Interspersion	%		%		%	
	Class 1	0	0.10	0	0.10	0	0.40
	Class 2	0		0		0	
	Class 3	0		0		100	
	Class 4	0		0		0	
	Class 5	100		100		0	
V4	%OW <= 1.5ft	58	0.85	100	0.60	100	0.60
V5	Salinity (ppt)	12	0.70	12	0.70	12	0.70
V6	Access Value	0.25	0.33	0.0001	0.10	0.0001	0.10
	Emergent Marsh HSI =		0.19	EM HSI =	0.22	EM HSI =	0.33
	Open Water HSI =		0.35	OW HSI =	0.18	OW HSI =	0.20

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0.4
0	0	0
0.1	0.1	0

Project: SWC - 47c1 Project Area: 1308

FWP

Variable		TY Value	5 SI	TY Value	6 SI	TY Value	29 SI
V1	% Emergent	94	0.95	94	0.95	91	0.92
V2	% Aquatic	30	0.37	40	0.46	40	0.46
V3	Interspersion	%		%		%	
	Class 1	50	0.70	100	1.00	80	0.92
	Class 2	0		0		20	
	Class 3	50		0		0	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.60	100	0.60	88	0.84
V5	Salinity (ppt)	12	0.70	12	0.70	12	0.70
V6	Access Value	0.25	0.33	0.25	0.33	0.25	0.33
		EM HSI =	0.73	EM HSI =	0.76	EM HSI =	0.74
		OW HSI =	0.42	OW HSI =	0.48	OW HSI =	0.49

Intermediate Calculations

Interspersion

1	1	1
0	0	0.6
0.4	0	0
0	0	0
0	0	0

Project: SWC - 47c1 Project Area: 1308

FWP

Variable		TY Value	30 SI	TY Value	32 SI	TY Value	50 SI
V1	% Emergent	48	0.53	94	0.95	87	0.88
V2	% Aquatic	15	0.24	30	0.37	40	0.46
V3	Interspersion	%		%		%	
	Class 1	100	1.00	85	0.94	80	0.92
	Class 2	0		15		20	
	Class 3	0		0		0	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.60	96	0.68	79	1.00
V5	Salinity (ppt)	12	0.70	12	0.70	12	0.70
V6	Access Value	0.25	0.33	0.25	0.33	0.25	0.33
		EM HSI =	0.56	EM HSI =	0.76	EM HSI =	0.73
		OW HSI =	0.38	OW HSI =	0.45	OW HSI =	0.51

Intermediate Calculations

Interspersion

1	1	1
0	0.6	0.6
0	0	0
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 47c1

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	4	0.19	0.76	
1	2	0.19	0.38	0.57
3	0	0.19	0.00	0.38
25	0	0.19	0.00	0.00
50	0	0.19	0.00	0.00
Max TY=	50		AAHUs =	0.02

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	4	0.19	0.76	
1	125	0.22	27.04	13.39
3	371	0.33	121.33	139.30
5	1232	0.73	900.04	905.57
6	1231	0.76	940.35	920.20
29	1188	0.74	881.89	20952.21
30	621	0.56	346.63	596.86
32	1233	0.76	933.66	1239.69
50	1135	0.73	823.23	15802.57
Max TY=	50		AAHUs	811.40

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	811.40
B. Future Without Project Emergent Marsh AAHUs =	0.02
Net Change (FWP - FWOP) =	811.38

12/5/2013

AAHU CALCULATION - OPEN WATER

Project: SWC - 47c1

Future Without Project				
TY	Water Acres	x HSI	Total HUs	Cummulative HUs
0	1304	0.35	460.41	
1	1306	0.35	458.62	459.52
3	1308	0.35	454.34	912.97
25	1308	0.29	375.05	9123.31
50	1308	0.21	275.35	8129.96
Max TY=	50		AAHUs =	372.52

Future With Project				
TY	Water Acres	x HSI	Total HUs	Cummulative HUs
0	1304	0.35	460.41	
1	68	0.18	12.34	201.03
3	73	0.20	14.87	27.18
5	76	0.42	32.02	46.68
6	77	0.48	37.09	34.55
29	120	0.49	59.23	1105.76
30	65	0.38	24.60	40.86
32	75	0.45	33.38	57.76
50	173	0.51	87.44	1069.65
Max TY=	50		AAHUs	51.67

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	51.67
B. Future Without Project Open Water AAHUs =	372.52
Net Change (FWP - FWOP) =	-320.85

12/5/2013

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 127c3 Project Area: 894

Condition: Future Without Project

Variable		TY	0	TY	1	TY	22
		Value	SI	Value	SI	Value	SI
V1	% Emergent	7	0.16	7	0.16	0	0.10
V2	% Aquatic	60	0.64	60	0.64	38	0.44
V3	Interspersion	%		%		%	
	Class 1	0	0.20	0	0.20	0	0.10
	Class 2	0		0		0	
	Class 3	0		0		0	
	Class 4	100		100		0	
	Class 5	0		0		100	
V4	%OW <= 1.5ft	40	0.61	39	0.60	26	0.43
V5	Salinity (ppt)	4	1.00	4	1.00	4	1.00
V6	Access Value	0.34	0.41	0.34	0.41	0.34	0.41
	Emergent Marsh HSI =		0.29	EM HSI =	0.29	EM HSI =	0.23
	Open Water HSI =		0.55	OW HSI =	0.55	OW HSI =	0.45

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0.2	0.2	0
0	0	0.1

Project: SWC - 127c3 Project Area: 894

FWOP

Variable		TY	25	TY	50	TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent	0	0.10	0	0.10		
V2	% Aquatic	37	0.43	10	0.19		
V3	Interspersion	%		%		%	
	Class 1	0	0.10	0	0.10		
	Class 2	0		0			
	Class 3	0		0			
	Class 4	0		0			
	Class 5	100		100			
V4	%OW <= 1.5ft	25	0.42	7	0.19		
V5	Salinity (ppt)	4	1.00	4	1.00		
V6	Access Value	0.34	0.41	0.34	0.41		
		EM HSI =	0.23	EM HSI =	0.23	EM HSI =	
		OW HSI =	0.44	OW HSI =	0.30	OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0.1	0.1	0

Project: SWC - 127c3 Project Area: 894

FWOP

Variable		TY		TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 127c3 Project Area: 894

Condition: Future With Project

Variable		TY 0 Value	SI	TY 1 Value	SI	TY 3 Value	SI
V1	% Emergent	7	0.16	12	0.21	33	0.40
V2	% Aquatic	60	0.64	0	0.10	0	0.10
V3	Interspersion	%		%		%	
	Class 1	0	0.20	0	0.10	0	0.40
	Class 2	0		0		0	
	Class 3	0		0		100	
	Class 4	100		0		0	
	Class 5	0		100		0	
V4	%OW <= 1.5ft	40	0.61	100	0.60	100	0.60
V5	Salinity (ppt)	4	1.00	4	1.00	4	1.00
V6	Access Value	0.34	0.41	0.0001	0.10	0.0001	0.10
	Emergent Marsh HSI =		0.29	EM HSI =	0.26	EM HSI =	0.38
	Open Water HSI =		0.55	OW HSI =	0.20	OW HSI =	0.23

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0.4
0.2	0	0
0	0.1	0

Project: SWC - 127c3 Project Area: 894

FWP

Variable		TY 5 Value	SI	TY 6 Value	SI	TY 29 Value	SI
V1	% Emergent	93	0.94	93	0.94	82	0.84
V2	% Aquatic	60	0.64	70	0.73	70	0.73
V3	Interspersion	%		%		%	
	Class 1	50	0.70	100	1.00	75	0.90
	Class 2	0		0		25	
	Class 3	50		0		0	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.60	100	0.60	80	1.00
V5	Salinity (ppt)	4	1.00	4	1.00	4	1.00
V6	Access Value	0.34	0.41	0.34	0.41	0.34	0.41
		EM HSI =	0.79	EM HSI =	0.82	EM HSI =	0.76
		OW HSI =	0.59	OW HSI =	0.64	OW HSI =	0.66

Intermediate Calculations

Interspersion

1	1	1
0	0	0.6
0.4	0	0
0	0	0
0	0	0

Project: SWC - 127c3 Project Area: 894

FWP

Variable		TY 30 Value	SI	TY 32 Value	SI	TY 50 Value	SI
V1	% Emergent	48	0.53	94	0.95	82	0.84
V2	% Aquatic	30	0.37	60	0.64	70	0.73
V3	Interspersion	%		%		%	
	Class 1	100	1.00	85	0.94	75	0.90
	Class 2	0		15		25	
	Class 3	0		0		0	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.60	94	0.72	76	1.00
V5	Salinity (ppt)	4	1.00	4	1.00	4	1.00
V6	Access Value	0.34	0.41	0.34	0.41	0.34	0.41
		EM HSI =	0.61	EM HSI =	0.82	EM HSI =	0.76
		OW HSI =	0.49	OW HSI =	0.61	OW HSI =	0.66

Intermediate Calculations

Interspersion

1	1	1
0	0.6	0.6
0	0	0
0	0	0
0	0	0

12/5/2013

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 127c3

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	62	0.29	17.97	
1	59	0.29	17.10	17.53
22	0	0.23	0.00	167.13
25	0	0.23	0.00	0.00
50	0	0.23	0.00	0.00
Max TY=	50		AAHUs =	3.69

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	62	0.29	17.97	
1	109	0.26	28.22	23.34
3	292	0.38	111.03	131.84
5	833	0.79	657.86	695.04
6	829	0.82	682.34	670.12
29	732	0.76	558.16	14243.25
30	425	0.61	259.67	401.16
32	839	0.82	688.70	919.40
50	735	0.76	560.45	11224.13
Max TY=	50		AAHUs	566.17

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	566.17
B. Future Without Project Emergent Marsh AAHUs =	3.69
Net Change (FWP - FWOP) =	562.47

12/5/2013

AAHU CALCULATION - OPEN WATER

Project: SWC - 127c3

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	832	0.55	457.04	
1	835	0.55	457.89	457.47
22	894	0.45	398.68	9015.16
25	894	0.44	394.18	1189.29
50	894	0.30	264.43	8232.63
Max TY=	50		AAHUs =	377.89

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	832	0.55	457.04	
1	48	0.20	9.78	188.25
3	54	0.23	12.20	21.94
5	61	0.59	35.70	47.07
6	65	0.64	41.70	38.67
29	162	0.66	107.54	1708.05
30	45	0.49	22.11	61.46
32	55	0.61	33.66	55.36
50	159	0.66	105.55	1236.68
Max TY=	50		AAHUs	67.15

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	67.15
B. Future Without Project Open Water AAHUs =	377.89
Net Change (FWP - FWOP) =	-310.74

TOTAL BENEFITS IN AAHUs DUE TO PROJECT	
A. Emergent Marsh Habitat Net AAHUs =	562.47
B. Open Water Habitat Net AAHUs =	-310.74
Net Benefits= (2.6xEMAAHUs+OWAAHUs)/3.6	319.91

12/5/2013

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 306a1 (direct) Project Area: 1896

Condition: Future Without Project

Variable		TY	0	TY	1	TY	25
		Value	SI	Value	SI	Value	SI
V1	% Emergent	67	0.70	67	0.70	57	0.61
V2	% Aquatic	50	0.55	50	0.55	31	0.38
V3	Interspersion	%		%		%	
	Class 1	0	0.20	0	0.20	0	0.20
	Class 2	0		0		0	
	Class 3	0		0		0	
	Class 4	100		100		100	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	90	0.80	87	0.86	56	0.82
V5	Salinity (ppt)	5.6	1.00	5.6	1.00	5.6	1.00
V6	Access Value	0.2	0.28	0.2	0.28	0.2	0.28
	Emergent Marsh HSI =		0.58	EM HSI =	0.58	EM HSI =	0.53
	Open Water HSI =		0.47	OW HSI =	0.48	OW HSI =	0.41

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0
0.2	0.2	0.2
0	0	0

Project: SWC - 306a1 (direct) Project Area: 1896

FWOP

Variable		TY	50	TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent	44	0.50				
V2	% Aquatic	22	0.30				
V3	Interspersion	%		%		%	
	Class 1	0	0.20				
	Class 2	0					
	Class 3	0					
	Class 4	100					
	Class 5	0					
V4	%OW <= 1.5ft	40	0.61				
V5	Salinity (ppt)	5.6	1.00				
V6	Access Value	0.2	0.28				
		EM HSI =	0.47	EM HSI =		EM HSI =	
		OW HSI =	0.36	OW HSI =		OW HSI =	

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0
0.2	0	0
0	0	0

Project: SWC - 306a1 (direct) Project Area: 1896

FWOP

Variable		TY		TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

12/5/2013

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 306a1 (direct) Project Area: 1896

Condition: Future With Project

Variable		TY 0 Value	SI	TY 1 Value	SI	TY 3 Value	SI
V1	% Emergent	67	0.70	36	0.42	74	0.77
V2	% Aquatic	50	0.55	0	0.10	0	0.10
V3	Interspersion	%		%		%	
	Class 1	0	0.20	0	0.10	0	0.40
	Class 2	0		0		0	
	Class 3	0		0		100	
	Class 4	100		0		0	
	Class 5	0		100		0	
V4	%OW <= 1.5ft	90	0.80	100	0.60	100	0.60
V5	Salinity (ppt)	5.6	1.00	5.6	1.00	5.6	1.00
V6	Access Value	0.2	0.28	0.0001	0.10	0.0001	0.10
	Emergent Marsh HSI =		0.58	EM HSI =	0.36	EM HSI =	0.53
	Open Water HSI =		0.47	OW HSI =	0.20	OW HSI =	0.23

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0.4
0.2	0	0
0	0.1	0

Project: SWC - 306a1 (direct) Project Area: 1896

FWP

Variable		TY 5 Value	SI	TY 6 Value	SI	TY 29 Value	SI
V1	% Emergent	93	0.94	92	0.93	78	0.80
V2	% Aquatic	50	0.55	60	0.64	60	0.64
V3	Interspersion	%		%		%	
	Class 1	50	0.70	100	1.00	30	0.70
	Class 2	0		0		60	
	Class 3	50		0		10	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.60	100	0.60	79	1.00
V5	Salinity (ppt)	5.6	1.00	5.6	1.00	5.6	1.00
V6	Access Value	0.2	0.28	0.2	0.28	0.2	0.28
		EM HSI =	0.74	EM HSI =	0.77	EM HSI =	0.68
		OW HSI =	0.50	OW HSI =	0.55	OW HSI =	0.56

Intermediate Calculations

Interspersion

1	1	1
0	0	0.6
0.4	0	0.4
0	0	0
0	0	0

Project: SWC - 306a1 (direct) Project Area: 1896

FWP

Variable		TY 30 Value	SI	TY 32 Value	SI	TY 50 Value	SI
V1	% Emergent	48	0.53	94	0.95	78	0.80
V2	% Aquatic	25	0.33	50	0.55	60	0.64
V3	Interspersion	%		%		%	
	Class 1	100	1.00	85	0.94	30	0.70
	Class 2	0		15		60	
	Class 3	0		0		10	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.60	92	0.76	75	1.00
V5	Salinity (ppt)	5.6	1.00	5.6	1.00	5.6	1.00
V6	Access Value	0.2	0.28	0.2	0.28	0.2	0.28
		EM HSI =	0.58	EM HSI =	0.77	EM HSI =	0.68
		OW HSI =	0.43	OW HSI =	0.53	OW HSI =	0.56

Intermediate Calculations

Interspersion

1	1	1
0	0.6	0.6
0	0	0.4
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 306a1 (direct)

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	1269	0.58	730.26	
1	1263	0.58	726.81	728.54
25	1084	0.53	575.87	15600.47
50	837	0.47	394.58	12069.04
Max TY=	50		AAHUs =	567.96

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	1269	0.58	730.26	
1	685	0.36	245.61	466.83
3	1412	0.53	745.61	950.15
5	1758	0.74	1301.59	2022.71
6	1749	0.77	1346.09	1323.88
29	1484	0.68	1006.41	26960.88
30	901	0.58	521.71	754.43
32	1773	0.77	1367.19	1833.07
50	1482	0.68	1005.06	21269.09
Max TY=	50		AAHUs	1111.62

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	1111.62
B. Future Without Project Emergent Marsh AAHUs =	567.96
Net Change (FWP - FWOP) =	543.66

AAHU CALCULATION - OPEN WATER

Project: SWC - 306a1 (direct)

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	627	0.47	297.63	
1	633	0.48	303.29	300.46
25	812	0.41	333.57	7691.24
50	1059	0.36	381.74	8993.16
Max TY=	50		AAHUs =	339.70

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	627	0.47	297.63	
1	103	0.20	20.98	135.64
3	120	0.23	27.11	47.97
5	138	0.50	68.57	94.06
6	147	0.55	80.88	74.65
29	412	0.56	229.74	3564.64
30	95	0.43	40.92	128.63
32	123	0.53	64.76	104.79
50	414	0.56	230.86	2633.45
Max TY=	50		AAHUs	135.68

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	135.68
B. Future Without Project Open Water AAHUs =	339.70
Net Change (FWP - FWOP) =	-204.02

TOTAL BENEFITS IN AAHUs DUE TO PROJECT	
A. Emergent Marsh Habitat Net AAHUs =	543.66
B. Open Water Habitat Net AAHUs =	[illegible]

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 306a1 (indirect) Project Area: 3037

Condition: Future Without Project

Variable		TY Value	0 SI	TY Value	1 SI	TY Value	25 SI
V1	% Emergent	63	0.67	62	0.66	51	0.56
V2	% Aquatic	40	0.46	40	0.46	35	0.42
V3	Interspersion	%		%		%	
	Class 1	0	0.30	0	0.30	0	0.29
	Class 2	0		0		0	
	Class 3	50		50		45	
	Class 4	50		50		55	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	75	1.00	72	1.00	50	0.74
V5	Salinity (ppt)	5.25	1.00	5.25	1.00	5.25	1.00
V6	Access Value	1	1.00	1	1.00	1	1.00
	Emergent Marsh HSI =		0.71	EM HSI =	0.71	EM HSI =	0.64
	Open Water HSI =		0.66	OW HSI =	0.66	OW HSI =	0.61

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0.4	0.4	0.4
0.2	0.2	0.2
0	0	0

Project: SWC - 306a1 (indirect) Project Area: 3037

FWOP

Variable		TY Value	50 SI	TY Value	SI	TY Value	SI
V1	% Emergent	36	0.42				
V2	% Aquatic	30	0.37				
V3	Interspersion	%		%		%	
	Class 1	0	0.25				
	Class 2	0					
	Class 3	25					
	Class 4	75					
	Class 5	0					
V4	%OW <= 1.5ft	41	0.63				
V5	Salinity (ppt)	5.25	1.00				
V6	Access Value	1	1.00				
		EM HSI =	0.54	EM HSI =		EM HSI =	
		OW HSI =	0.57	OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0.4	0	0
0.2	0	0
0	0	0

Project: SWC - 306a1 (indirect) Project Area: 3037

FWOP

Variable		TY Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 306a1 (indirect) Project Area: 3037

Condition: Future With Project

Variable		TY 0 Value	SI	TY 1 Value	SI	TY 25 Value	SI
V1	% Emergent	63	0.67	62	0.66	53	0.58
V2	% Aquatic	40	0.46	40	0.46	35	0.42
V3	Interspersion	%		%		%	
	Class 1	0	0.30	0	0.30	0	0.29
	Class 2	0		0		0	
	Class 3	50		50		45	
	Class 4	50		50		55	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	75	1.00	72	1.00	49	0.73
V5	Salinity (ppt)	5.25	1.00	5.25	1.00	5.25	1.00
V6	Access Value	1	1.00	1	1.00	1	1.00
	Emergent Marsh HSI =		0.71	EM HSI =	0.71	EM HSI =	0.65
	Open Water HSI =		0.66	OW HSI =	0.66	OW HSI =	0.61

Intermediate Calculations

Interspersion		
0	0	0
0	0	0
0.4	0.4	0.4
0.2	0.2	0.2
0	0	0

Project: SWC - 306a1 (indirect) Project Area: 3037

FWP

Variable		TY 50 Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent	40	0.46				
V2	% Aquatic	30	0.37				
V3	Interspersion	%		%		%	
	Class 1	0	0.25				
	Class 2	0					
	Class 3	27					
	Class 4	73					
	Class 5	0					
V4	%OW <= 1.5ft	37	0.58				
V5	Salinity (ppt)	5.25	1.00				
V6	Access Value	1	1.00				
		EM HSI =	0.57	EM HSI =		EM HSI =	
		OW HSI =	0.56	OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion		
0	0	0
0	0	0
0.4	0	0
0.2	0	0
0	0	0

Project: SWC - 306a1 (indirect) Project Area: 3037

FWP

Variable		TY Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 306a1 (indirect)

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	1902	0.71	1358.11	
1	1890	0.71	1338.35	1348.22
25	1562	0.64	1000.56	27978.24
50	1108	0.54	599.29	19809.57
Max TY=	50		AAHUs =	982.72

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	1902	0.71	1358.11	
1	1892	0.71	1339.76	1348.93
25	1610	0.65	1051.06	28627.55
50	1206	0.57	684.20	21546.82
Max TY=	50		AAHUs	1030.47

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	1030.47
B. Future Without Project Emergent Marsh AAHUs =	982.72
Net Change (FWP - FWOP) =	47.75

AAHU CALCULATION - OPEN WATER

Project: SWC - 306a1 (indirect)

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	1136	0.66	748.02	
1	1147	0.66	755.27	751.65
25	1476	0.61	899.56	19922.41
50	1929	0.57	1094.48	25004.95
Max TY=	50		AAHUs =	913.58

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	1136	0.66	748.02	
1	1145	0.66	753.95	750.99
25	1427	0.61	868.34	19523.80
50	1832	0.56	1033.01	23842.15
Max TY=	50		AAHUs	882.34

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	882.34
B. Future Without Project Open Water AAHUs =	913.58
Net Change (FWP - FWOP) =	-31.24

TOTAL BENEFITS IN AAHUs DUE TO PROJECT

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Saline Marsh

Project: SWC - 6b1 Project Area: 4949

Condition: Future Without Project

Variable		TY Value	0 SI	TY Value	1 SI	TY Value	25 SI
V1	% Emergent	98	0.98	97	0.97	52	0.57
V2	% Aquatic	10	0.37	10	0.37	5	0.34
V3	Interspersion	%		%		%	
	Class 1	100	1.00	100	1.00	50	0.55
	Class 2	0		0		0	
	Class 3	0		0		0	
	Class 4	0		0		0	
	Class 5	0		0		50	
V4	%OW <= 1.5ft	70	1.00	69	0.99	37	0.58
V5	Salinity (ppt)	13	1.00	13	1.00	13	1.00
V6	Access Value	1.00	1.00	1.00	1.00	1.00	1.00
	Emergent Marsh HSI =		0.99	EM HSI =	0.98	EM HSI =	0.68
	Open Water HSI =		0.81	OW HSI =	0.81	OW HSI =	0.73

Intermediate Calculations

Interspersion

1	1	1
0	0	0
0	0	0
0	0	0
0	0	0.1

Project: SWC - 6b1 Project Area: 4949

FWOP

Variable		TY Value	50 SI	TY Value	SI	TY Value	SI
V1	% Emergent	0	0.10				
V2	% Aquatic	0	0.30				
V3	Interspersion	%		%		%	
	Class 1	0	0.10				
	Class 2	0					
	Class 3	0					
	Class 4	0					
	Class 5	100					
V4	%OW <= 1.5ft	0	0.10				
V5	Salinity (ppt)	13	1.00				
V6	Access Value	1.00	1.00				
		EM HSI =	0.26	EM HSI =		EM HSI =	
		OW HSI =	0.64	OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0.1	0	0

Project: SWC - 6b1 Project Area: 4949

FWOP

Variable		TY Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Saline Marsh

Project: SWC - 6b1 Project Area: 4949

Condition: Future With Project

Variable		TY	0	TY	1	TY	25
		Value	SI	Value	SI	Value	SI
V1	% Emergent	98	0.98	97	0.97	74	0.77
V2	% Aquatic	10	0.37	10	0.37	10	0.37
V3	Interspersion	%		%		%	
	Class 1	100	1.00	100	1.00	70	0.73
	Class 2	0		0		0	
	Class 3	0		0		0	
	Class 4	0		0		0	
	Class 5	0		0		30	
V4	%OW <= 1.5ft	70	1.00	69	0.99	52	0.77
V5	Salinity (ppt)	13	1.00	13	1.00	13	1.00
V6	Access Value	1.00	1.00	1.00	1.00	1.00	1.00
	Emergent Marsh HSI =		0.99	EM HSI =	0.98	EM HSI =	0.83
	Open Water HSI =		0.81	OW HSI =	0.81	OW HSI =	0.77

Intermediate Calculations

Interspersion

1	1	1
0	0	0
0	0	0
0	0	0
0	0	0.1

Project: SWC - 6b1 Project Area: 4949
FWP

Variable		TY	50	TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent	43	0.49				
V2	% Aquatic	5	0.34				
V3	Interspersion	%		%		%	
	Class 1	40	0.46				
	Class 2	0					
	Class 3	0					
	Class 4	0					
	Class 5	60					
V4	%OW <= 1.5ft	31	0.50				
V5	Salinity (ppt)	13	1.00				
V6	Access Value	1.00	1.00				
		EM HSI =	0.62	EM HSI =		EM HSI =	
		OW HSI =	0.71	OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

1	0	0
0	0	0
0	0	0
0	0	0
0.1	0	0

Project: SWC - 6b1 Project Area: 4949
FWP

Variable		TY		TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 6b1

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	4867	0.99	4815.78	
1	4781	0.98	4705.44	4760.54
25	2578	0.68	1755.89	74865.09
50	0	0.26	0.00	17430.94
Max=	50		AAHUs =	1941.13

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	4,867	0.99	4815.78	
1	4,824	0.98	4747.76	4781.73
25	3,648	0.83	3024.40	92536.20
50	2,140	0.62	1317.48	52932.55
Max=	50		AAHUs	3005.01

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	3005.01
B. Future Without Project Emergent Marsh AAHUs =	1941.13
Net Change (FWP - FWOP) =	1063.88

AAHU CALCULATION - OPEN WATER

Project: SWC - 6b1

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	82	0.81	66.23	
1	168	0.81	135.53	100.89
25	2371	0.73	1722.59	23004.15
50	4949	0.64	3168.76	62068.16
Max=	50		AAHUs =	1703.46

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	82	0.81	66.23	
1	125	0.81	100.84	83.54
25	1,301	0.77	1002.46	13409.91
50	2,809	0.71	2006.02	37960.40
Max=	50		AAHUs	1029.08

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	1029.08
B. Future Without Project Open Water AAHUs =	1703.46
Net Change (FWP - FWOP) =	-674.39

TOTAL BENEFITS IN AAHUs DUE TO PROJECT	
A. Emergent Marsh Habitat Net AAHUs =	1063.88
B. Open Water Habitat Net AAHUs =	-674.39
Net Benefits= (3.5xEMAAHUs+OWAAHUs)/4.5	677.60

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Saline Marsh

Project: SWC - 6b2 Project Area: 3691

Condition: Future Without Project

Variable		TY Value	0 SI	TY Value	1 SI	TY Value	25 SI
V1	% Emergent	98	0.98	96	0.96	52	0.57
V2	% Aquatic	10	0.37	10	0.37	5	0.34
V3	Interspersion	%		%		%	
	Class 1	100	1.00	95	0.96	50	0.55
	Class 2	0		0		0	
	Class 3	0		0		0	
	Class 4	0		0		0	
	Class 5	0		5		50	
V4	%OW <= 1.5ft	70	1.00	69	0.99	37	0.58
V5	Salinity (ppt)	13	1.00	13	1.00	13	1.00
V6	Access Value	1.00	1.00	1.00	1.00	1.00	1.00
	Emergent Marsh HSI	=	0.99	EM HSI =	0.97	EM HSI =	0.68
	Open Water HSI	=	0.81	OW HSI =	0.80	OW HSI =	0.73

Intermediate Calculations

Interspersion

1	1	1
0	0	0
0	0	0
0	0	0
0	0.1	0.1

Project: SWC - 6b2 Project Area: 3691

FWOP

Variable		TY Value	50 SI	TY Value	SI	TY Value	SI
V1	% Emergent	0	0.10				
V2	% Aquatic	0	0.30				
V3	Interspersion	%		%		%	
	Class 1	0	0.10				
	Class 2	0					
	Class 3	0					
	Class 4	0					
	Class 5	100					
V4	%OW <= 1.5ft	0	0.10				
V5	Salinity (ppt)	13	1.00				
V6	Access Value	1.00	1.00				
		EM HSI =	0.26	EM HSI =		EM HSI =	
		OW HSI =	0.64	OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0.1	0	0

Project: SWC - 6b2 Project Area: 3691

FWOP

Variable		TY Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Saline Marsh

Project: SWC - 6b2 Project Area: 3691

Condition: Future With Project

Variable		TY	0	TY	1	TY	25
		Value	SI	Value	SI	Value	SI
V1	% Emergent	98	0.98	97	0.97	73	0.76
V2	% Aquatic	10	0.37	10	0.37	10	0.37
V3	Interspersion	%		%		%	
	Class 1	100	1.00	95	0.98	70	0.73
	Class 2	0		0		0	
	Class 3	0		0		0	
	Class 4	0		0		0	
	Class 5	0		5		30	
V4	%OW <= 1.5ft	70	1.00	69	0.99	52	0.77
V5	Salinity (ppt)	13	1.00	13	1.00	13	1.00
V6	Access Value	1.00	1.00	1.00	1.00	1.00	1.00
	Emergent Marsh HSI =		0.99	EM HSI =	0.98	EM HSI =	0.82
	Open Water HSI =		0.81	OW HSI =	0.80	OW HSI =	0.77

Intermediate Calculations

Interspersion		
1	1	1
0	0	0
0	0	0
0	0	0
0	0.1	0.1

Project: SWC - 6b2 Project Area: 3691

FWP

Variable		TY	50	TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent	43	0.49				
V2	% Aquatic	5	0.34				
V3	Interspersion	%		%		%	
	Class 1	40	0.46				
	Class 2	0					
	Class 3	0					
	Class 4	0					
	Class 5	60					
V4	%OW <= 1.5ft	31	0.50				
V5	Salinity (ppt)	13	1.00				
V6	Access Value	1.00	1.00				
		EM HSI =	0.62	EM HSI =		EM HSI =	
		OW HSI =	0.71	OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion		
1	0	0
0	0	0
0	0	0
0	0	0
0.1	0	0

Project: SWC - 6b2 Project Area: 3691

FWP

Variable		TY		TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 6b2

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	3601	0.99	3563.10	
1	3537	0.97	3444.70	3503.74
25	1907	0.68	1298.87	55013.71
50	0	0.26	0.00	12894.03
Max=	50		AAHUs =	1428.23

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	3,601	0.99	3563.10	
1	3,569	0.98	3494.75	3528.87
25	2,699	0.82	2222.46	68064.47
50	1,583	0.62	974.56	38996.53
Max=	50		AAHUs	2211.80

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	2211.80
B. Future Without Project Emergent Marsh AAHUs =	1428.23
Net Change (FWP - FWOP) =	783.57

AAHU CALCULATION - OPEN WATER

Project: SWC - 6b2

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	90	0.81	72.69	
1	154	0.80	123.72	98.25
25	1784	0.73	1296.12	17539.27
50	3691	0.64	2363.28	46427.74
Max=	50		AAHUs =	1281.31

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	90	0.81	72.69	
1	122	0.80	98.01	85.37
25	992	0.77	764.37	10462.95
50	2,108	0.71	1505.41	28634.45
Max=	50		AAHUs	783.66

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	783.66
B. Future Without Project Open Water AAHUs =	1281.31
Net Change (FWP - FWOP) =	-497.65

TOTAL BENEFITS IN AAHUs DUE TO PROJECT	
A. Emergent Marsh Habitat Net AAHUs =	783.57
B. Open Water Habitat Net AAHUs =	-497.65
Net Benefits= (3.5xEMAAHUs+OWAAHUs)/4.5	498.85

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Saline Marsh

Project: SWC - 6b3 Project Area: 2587

Condition: Future Without Project

Variable		TY 0 Value	SI	TY 1 Value	SI	TY 25 Value	SI
V1	% Emergent	97	0.97	95	0.96	51	0.56
V2	% Aquatic	10	0.37	10	0.37	5	0.34
V3	Interspersion	%		%		%	
	Class 1	0	0.60	0	0.58	0	0.35
	Class 2	100		95		50	
	Class 3	0		0		0	
	Class 4	0		0		0	
	Class 5	0		5		50	
V4	%OW <= 1.5ft	70	1.00	69	0.99	37	0.58
V5	Salinity (ppt)	13	1.00	13	1.00	13	1.00
V6	Access Value	1.00	1.00	1.00	1.00	1.00	1.00
	Emergent Marsh HSI =		0.94	EM HSI =	0.93	EM HSI =	0.65
	Open Water HSI =		0.78	OW HSI =	0.78	OW HSI =	0.71

Intermediate Calculations

Interspersion

0	0	0
0.6	0.6	0.6
0	0	0
0	0	0
0	0.1	0.1

Project: SWC - 6b3 Project Area: 2587

FWOP

Variable		TY 50 Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent	0	0.10				
V2	% Aquatic	0	0.30				
V3	Interspersion	%		%		%	
	Class 1	0	0.10				
	Class 2	0					
	Class 3	0					
	Class 4	0					
	Class 5	100					
V4	%OW <= 1.5ft	0	0.10				
V5	Salinity (ppt)	13	1.00				
V6	Access Value	1.00	1.00				
		EM HSI =	0.26	EM HSI =		EM HSI =	
		OW HSI =	0.64	OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0.1	0	0

Project: SWC - 6b3 Project Area: 2587

FWOP

Variable		TY Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Saline Marsh

Project: SWC - 6b3 Project Area: 2587

Condition: Future With Project

Variable		TY Value	0 SI	TY Value	1 SI	TY Value	25 SI
V1	% Emergent	97	0.97	96	0.96	72	0.75
V2	% Aquatic	10	0.37	10	0.37	10	0.37
V3	Interspersion	%		%		%	
	Class 1	0	0.60	0	0.58	0	0.45
	Class 2	100		95		70	
	Class 3	0		0		0	
	Class 4	0		0		0	
	Class 5	0		5		30	
V4	%OW <= 1.5ft	70	1.00	69	0.99	52	0.77
V5	Salinity (ppt)	13	1.00	13	1.00	13	1.00
V6	Access Value	1.00	1.00	1.00	1.00	1.00	1.00
	Emergent Marsh HSI =		0.94	EM HSI =	0.93	EM HSI =	0.79
	Open Water HSI =		0.78	OW HSI =	0.78	OW HSI =	0.75

Intermediate Calculations

Interspersion

0	0	0
0.6	0.6	0.6
0	0	0
0	0	0
0	0.1	0.1

Project: SWC - 6b3 Project Area: 2587
FWP

Variable		TY Value	50 SI	TY Value	SI	TY Value	SI
V1	% Emergent	42	0.48				
V2	% Aquatic	5	0.34				
V3	Interspersion	%		%		%	
	Class 1	0	0.30				
	Class 2	40					
	Class 3	0					
	Class 4	0					
	Class 5	60					
V4	%OW <= 1.5ft	31	0.50				
V5	Salinity (ppt)	13	1.00				
V6	Access Value	1.00	1.00				
		EM HSI =	0.59	EM HSI =		EM HSI =	
		OW HSI =	0.70	OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0.6	0	0
0	0	0
0	0	0
0.1	0	0

Project: SWC - 6b3 Project Area: 2587
FWP

Variable		TY Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 6b3

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	2497	0.94	2346.56	
1	2453	0.93	2272.40	2309.38
25	1323	0.65	863.68	36396.58
50	0	0.26	0.00	8633.55
Max=	50		AAHUs =	946.79

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	2,497	0.94	2346.56	
1	2,475	0.93	2305.91	2326.21
25	1,872	0.79	1472.68	44993.42
50	1,098	0.59	649.54	25898.52
Max=	50		AAHUs	1464.36

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	1464.36
B. Future Without Project Emergent Marsh AAHUs =	946.79
Net Change (FWP - FWOP) =	517.57

AAHU CALCULATION - OPEN WATER

Project: SWC - 6b3

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	90	0.78	70.02	
1	134	0.78	103.88	86.97
25	1264	0.71	899.60	12328.97
50	2587	0.64	1656.41	32343.85
Max=	50		AAHUs =	895.20

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	90	0.78	70.02	
1	112	0.78	86.83	78.44
25	715	0.75	536.10	7536.54
50	1,489	0.70	1045.71	19925.82
Max=	50		AAHUs	550.82

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	550.82
B. Future Without Project Open Water AAHUs =	895.20
Net Change (FWP - FWOP) =	-344.38

TOTAL BENEFITS IN AAHUs DUE TO PROJECT	
A. Emergent Marsh Habitat Net AAHUs =	517.57
B. Open Water Habitat Net AAHUs =	-344.38
Net Benefits= (3.5xEMAAHUs+OWAAHUs)/4.5	326.03

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 16b-west   Project Area: 360

Condition: Future Without Project

Variable		TY	0	TY	1	TY	25
		Value	SI	Value	SI	Value	SI
V1	% Emergent	99	0.99	97	0.97	52	0.57
V2	% Aquatic	10	0.19	10	0.19	5	0.15
V3	Interspersion	%		%		%	
	Class 1	0	0.60	0	0.58	0	0.35
	Class 2	100		95		50	
	Class 3	0		0		0	
	Class 4	0		0		0	
	Class 5	0		5		50	
V4	%OW <= 1.5ft	10	0.23	10	0.23	5	0.16
V5	Salinity (ppt)	4	1.00	4	1.00	4	1.00
V6	Access Value	1	1.00	1	1.00	1	1.00
	Emergent Marsh HSI =		0.95	EM HSI =	0.94	EM HSI =	0.65
	Open Water HSI =		0.42	OW HSI =	0.42	OW HSI =	0.36

Intermediate Calculations		
Interspersion		
0	0	0
0.6	0.6	0.6
0	0	0
0	0	0
0	0.1	0.1

Project: SWC - 16b-west   Project Area: 360

FWOP

Variable		TY	50	TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent	0	0.10				
V2	% Aquatic	0	0.10				
V3	Interspersion	%		%		%	
	Class 1	0	0.10				
	Class 2	0					
	Class 3	0					
	Class 4	0					
	Class 5	100					
V4	%OW <= 1.5ft	0	0.10				
V5	Salinity (ppt)	4	1.00				
V6	Access Value	1	1.00				
		EM HSI =	0.25	EM HSI =		EM HSI =	
		OW HSI =	0.28	OW HSI =		OW HSI =	

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0.1	0	0

Project: SWC - 16b-west   Project Area: 360

FWOP

Variable		TY		TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 16b-west Project Area: 360

Condition: Future With Project

Variable		TY Value	0 SI	TY Value	1 SI	TY Value	25 SI
V1	% Emergent	99	0.99	99	0.99	99	0.99
V2	% Aquatic	10	0.19	10	0.19	10	0.19
V3	Interspersion	%		%		%	
	Class 1	0	0.60	0	0.60	0	0.60
	Class 2	100		100		100	
	Class 3	0		0		0	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	10	0.23	10	0.23	10	0.23
V5	Salinity (ppt)	4	1.00	4	1.00	4	1.00
V6	Access Value	1	1.00	1	1.00	1	1.00
	Emergent Marsh HSI =		0.95	EM HSI =	0.95	EM HSI =	0.95
	Open Water HSI =		0.42	OW HSI =	0.42	OW HSI =	0.42

Intermediate Calculations

Interspersion

0	0	0
0.6	0.6	0.6
0	0	0
0	0	0
0	0	0

Project: SWC - 16b-west Project Area: 360

FWP

Variable		TY Value	50 SI	TY Value	SI	TY Value	SI
V1	% Emergent	99	0.99				
V2	% Aquatic	10	0.19				
V3	Interspersion	%		%		%	
	Class 1	0	0.60				
	Class 2	100					
	Class 3	0					
	Class 4	0					
	Class 5	0					
V4	%OW <= 1.5ft	10	0.23				
V5	Salinity (ppt)	4	1.00				
V6	Access Value	1	1.00				
		EM HSI =	0.95	EM HSI =		EM HSI =	
		OW HSI =	0.42	OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0.6	0	0
0	0	0
0	0	0
0	0	0

Project: SWC - 16b-west Project Area: 360

FWP

Variable		TY Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 16b-west

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	355	0.95	337.31	
1	349	0.94	326.86	332.07
25	188	0.65	122.83	5214.01
50	0	0.25	0.00	1223.01
Max TY=	50		AAHUs =	135.38

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	355	0.95	337.31	
1	355	0.95	337.31	337.31
25	355	0.95	337.31	8095.41
50	355	0.95	337.31	8432.72
Max TY=	50		AAHUs	337.31

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	337.31
B. Future Without Project Emergent Marsh AAHUs =	135.38
Net Change (FWP - FWOP) =	201.93

AAHU CALCULATION - OPEN WATER

Project: SWC - 16b-west

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	5	0.42	2.11	
1	11	0.42	4.63	3.37
25	172	0.36	61.29	832.49
50	360	0.28	102.33	2101.73
Max TY=	50		AAHUs =	58.75

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	5	0.42	2.11	
1	5	0.42	2.11	2.11
25	5	0.42	2.11	50.71
50	5	0.42	2.11	52.83
Max TY=	50		AAHUs	2.11

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	2.11
B. Future Without Project Open Water AAHUs =	58.75
Net Change (FWP - FWOP) =	-56.64

TOTAL BENEFITS IN AAHUs DUE TO PROJECT	
A. Emergent Marsh Habitat Net AAHUs =	201.93
B. Open Water Habitat Net AAHUs =	-56.64
Net Benefits= (2.6xEMAAHUs+OWAAHUs)/3.6	130.10

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 16b-northeast　　Project Area: 365

Condition: Future Without Project

Variable		TY Value	0 SI	TY Value	1 SI	TY Value	25 SI
V1	% Emergent	74	0.77	73	0.76	39	0.45
V2	% Aquatic	30	0.37	30	0.37	10	0.19
V3	Interspersion	%		%		%	
	Class 1	50	0.70	50	0.70	0	0.22
	Class 2	0		0		0	
	Class 3	50		50		40	
	Class 4	0		0		0	
	Class 5	0		0		60	
V4	%OW <= 1.5ft	40	0.61	39	0.60	21	0.37
V5	Salinity (ppt)	4	1.00	4	1.00	4	1.00
V6	Access Value	1	1.00	1	1.00	1	1.00
	Emergent Marsh HSI =		0.82	EM HSI =	0.82	EM HSI =	0.56
	Open Water HSI =		0.60	OW HSI =	0.60	OW HSI =	0.40

Intermediate Calculations

Interspersion		
1	1	0
0	0	0
0.4	0.4	0.4
0	0	0
0	0	0.1

Project: SWC - 16b-northeast　　Project Area: 365

FWOP

Variable		TY Value	50 SI	TY Value	SI	TY Value	SI
V1	% Emergent	0	0.10				
V2	% Aquatic	0	0.10				
V3	Interspersion	%		%		%	
	Class 1	0	0.10				
	Class 2	0					
	Class 3	0					
	Class 4	0					
	Class 5	100					
V4	%OW <= 1.5ft	0	0.10				
V5	Salinity (ppt)	4	1.00				
V6	Access Value	1	1.00				
		EM HSI =	0.25	EM HSI =		EM HSI =	
		OW HSI =	0.28	OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0.1	0	0

Project: SWC - 16b-northeast　　Project Area: 365

FWOP

Variable		TY Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 16b-northeast   Project Area: 365

Condition: Future With Project

Variable		TY 0 Value	SI	TY 1 Value	SI	TY 25 Value	SI
V1	% Emergent	74	0.77	74	0.77	74	0.77
V2	% Aquatic	30	0.37	30	0.37	30	0.37
V3	Interspersion	%		%		%	
	Class 1	50	0.70	50	0.70	50	0.70
	Class 2	0		0		0	
	Class 3	50		50		50	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	40	0.61	40	0.61	40	0.61
V5	Salinity (ppt)	4	1.00	4	1.00	4	1.00
V6	Access Value	1	1.00	1	1.00	1	1.00
	Emergent Marsh HSI =		0.82	EM HSI =	0.82	EM HSI =	0.82
	Open Water HSI =		0.60	OW HSI =	0.60	OW HSI =	0.60

Intermediate Calculations

Interspersion		
1	1	1
0	0	0
0.4	0.4	0.4
0	0	0
0	0	0

Project: SWC - 16b-northeast   Project Area: 365

FWP

Variable		TY 50 Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent	74	0.77				
V2	% Aquatic	30	0.37				
V3	Interspersion	%		%		%	
	Class 1	50	0.70				
	Class 2	0					
	Class 3	50					
	Class 4	0					
	Class 5	0					
V4	%OW <= 1.5ft	40	0.61				
V5	Salinity (ppt)	4	1.00				
V6	Access Value	1	1.00				
		EM HSI =	0.82	EM HSI =		EM HSI =	
		OW HSI =	0.60	OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion		
1	0	0
0	0	0
0.4	0	0
0	0	0
0	0	0

Project: SWC - 16b-northeast   Project Area: 365

FWP

Variable		TY Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 16b-northeast

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	271	0.82	222.89	
1	266	0.82	217.25	220.07
25	144	0.56	80.22	3442.97
50	0	0.25	0.00	821.24
Max TY=	50		AAHUs =	89.69

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	271	0.82	222.89	
1	271	0.82	222.89	222.89
25	271	0.82	222.89	5349.33
50	271	0.82	222.89	5572.22
Max TY=	50		AAHUs	222.89

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	222.89
B. Future Without Project Emergent Marsh AAHUs =	89.69
Net Change (FWP - FWOP) =	133.20

AAHU CALCULATION - OPEN WATER

Project: SWC - 16b-northeast

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	94	0.60	56.38	
1	99	0.60	59.28	57.83
25	221	0.40	89.49	1879.88
50	365	0.28	103.75	2487.95
Max TY=	50		AAHUs =	88.51

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	94	0.60	56.38	
1	94	0.60	56.38	56.38
25	94	0.60	56.38	1353.07
50	94	0.60	56.38	1409.45
Max TY=	50		AAHUs	56.38

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	56.38
B. Future Without Project Open Water AAHUs =	88.51
Net Change (FWP - FWOP) =	-32.14

TOTAL BENEFITS IN AAHUs DUE TO PROJECT	
A. Emergent Marsh Habitat Net AAHUs =	133.20
B. Open Water Habitat Net AAHUs =	-32.14
Net Benefits= (2.6xEMAAHUs+OWAAHUs)/3.6	87.28

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 16b-southeast (direct) Project Area: 722

Condition: Future Without Project

Variable		TY	0	TY	1	TY	25
		Value	SI	Value	SI	Value	SI
V1	% Emergent	83	0.85	82	0.84	44	0.50
V2	% Aquatic	25	0.33	25	0.33	15	0.24
V3	Interspersion	%		%		%	
	Class 1	30	0.58	30	0.58	0	0.22
	Class 2	0		0		0	
	Class 3	70		70		40	
	Class 4	0		0		0	
	Class 5	0		0		60	
V4	%OW <= 1.5ft	50	0.74	49	0.73	26	0.43
V5	Salinity (ppt)	5.25	1.00	5.25	1.00	5.25	1.00
V6	Access Value	1	1.00	1	1.00	1	1.00
	Emergent Marsh HSI =		0.86	EM HSI =	0.85	EM HSI =	0.59
	Open Water HSI =		0.57	OW HSI =	0.57	OW HSI =	0.45

Intermediate Calculations

Interspersion

1	1	0
0	0	0
0.4	0.4	0.4
0	0	0
0	0	0.1

Project: SWC - 16b-southeast (direct) Project Area: 722

FWOP

Variable		TY	50	TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent	0	0.10				
V2	% Aquatic	0	0.10				
V3	Interspersion	%		%		%	
	Class 1	0	0.10				
	Class 2	0					
	Class 3	0					
	Class 4	0					
	Class 5	100					
V4	%OW <= 1.5ft	0	0.10				
V5	Salinity (ppt)	5.25	1.00				
V6	Access Value	1	1.00				
		EM HSI =	0.25	EM HSI =		EM HSI =	
		OW HSI =	0.28	OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0.1	0	0

Project: SWC - 16b-southeast (direct) Project Area: 722

FWOP

Variable		TY		TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 16b-southeast (direct) Project Area: 722

Condition: Future With Project

Variable		TY	0	TY	1	TY	25
		Value	SI	Value	SI	Value	SI
V1	% Emergent	83	0.85	83	0.85	83	0.85
V2	% Aquatic	25	0.33	25	0.33	25	0.33
V3	Interspersion	%		%		%	
	Class 1	30	0.58	30	0.58	30	0.58
	Class 2	0		0		0	
	Class 3	70		70		70	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	50	0.74	50	0.74	50	0.74
V5	Salinity (ppt)	5.25	1.00	5.25	1.00	5.25	1.00
V6	Access Value	1	1.00	1	1.00	1	1.00
	Emergent Marsh HSI =		0.86	EM HSI =	0.86	EM HSI =	0.86
	Open Water HSI =		0.57	OW HSI =	0.57	OW HSI =	0.57

Intermediate Calculations		
Interspersion		
1	1	1
0	0	0
0.4	0.4	0.4
0	0	0
0	0	0

Project: SWC - 16b-southeast (direct) Project Area: 722

FWP

Variable		TY	50	TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent	83	0.85				
V2	% Aquatic	25	0.33				
V3	Interspersion	%		%		%	
	Class 1	30	0.58				
	Class 2	0					
	Class 3	70					
	Class 4	0					
	Class 5	0					
V4	%OW <= 1.5ft	50	0.74				
V5	Salinity (ppt)	5.25	1.00				
V6	Access Value	1	1.00				
		EM HSI =	0.86	EM HSI =		EM HSI =	
		OW HSI =	0.57	OW HSI =		OW HSI =	

Intermediate Calculations		
Interspersion		
1	0	0
0	0	0
0.4	0	0
0	0	0
0	0	0

Project: SWC - 16b-southeast (direct) Project Area: 722

FWP

Variable		TY		TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 16b-southeast (direct)

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	603	0.86	518.62	
1	592	0.85	505.84	512.22
25	319	0.59	187.92	8035.37
50	0	0.25	0.00	1904.33
Max TY=	50		AAHUs =	209.04

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	603	0.86	518.62	
1	603	0.86	518.62	518.62
25	603	0.86	518.62	12446.90
50	603	0.86	518.62	12965.52
Max TY=	50		AAHUs	518.62

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	518.62
B. Future Without Project Emergent Marsh AAHUs =	209.04
Net Change (FWP - FWOP) =	309.58

AAHU CALCULATION - OPEN WATER

Project: SWC - 16b-southeast (direct)

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	119	0.57	67.63	
1	130	0.57	73.76	70.70
25	403	0.45	180.85	3184.85
50	722	0.28	205.23	5044.67
Max TY=	50		AAHUs =	166.00

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	119	0.57	67.63	
1	119	0.57	67.63	67.63
25	119	0.57	67.63	1623.18
50	119	0.57	67.63	1690.81
Max TY=	50		AAHUs	67.63

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	67.63
B. Future Without Project Open Water AAHUs =	166.00
Net Change (FWP - FWOP) =	-98.37

TOTAL BENEFITS IN AAHUs DUE TO PROJECT	
A. Emergent Marsh Habitat Net AAHUs =	309.58
B. Open Water Habitat Net AAHUs =	-98.37
Net Benefits= (2.6xEMAAHUs+OWAAHUs)/3.6	196.26

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 16b-southeast (indirect) Project Area: 4019

Condition: Future Without Project

Variable		TY Value	0 SI	TY Value	1 SI	TY Value	25 SI
V1	% Emergent	60	0.64	60	0.64	50	0.55
V2	% Aquatic	40	0.46	40	0.46	35	0.42
V3	Interspersion	%		%		%	
	Class 1	0	0.32	0	0.32	0	0.30
	Class 2	0		0		0	
	Class 3	60		60		50	
	Class 4	40		40		50	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	75	1.00	75	1.00	25	0.42
V5	Salinity (ppt)	5.25	1.00	5.25	1.00	5.25	1.00
V6	Access Value	1	1.00	1	1.00	1	1.00
	Emergent Marsh HSI =		0.70	EM HSI =	0.70	EM HSI =	0.64
	Open Water HSI =		0.66	OW HSI =	0.66	OW HSI =	0.59

Intermediate Calculations

Interspersion		
0	0	0
0	0	0
0.4	0.4	0.4
0.2	0.2	0.2
0	0	0

Project: SWC - 16b-southeast (indirect) Project Area: 4019

FWOP

Variable		TY Value	50 SI	TY Value	SI	TY Value	SI
V1	% Emergent	36	0.42				
V2	% Aquatic	30	0.37				
V3	Interspersion	%		%		%	
	Class 1	0	0.27				
	Class 2	0					
	Class 3	35					
	Class 4	65					
	Class 5	0					
V4	%OW <= 1.5ft	23	0.40				
V5	Salinity (ppt)	5.25	1.00				
V6	Access Value	1	1.00				
		EM HSI =	0.54	EM HSI =		EM HSI =	
		OW HSI =	0.55	OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion		
0	0	0
0	0	0
0.4	0	0
0.2	0	0
0	0	0

Project: SWC - 16b-southeast (indirect) Project Area: 4019

FWOP

Variable		TY Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 16b-southeast (indirect) Project Area: 4019

Condition: Future With Project

Variable		TY	0	TY	1	TY	25
		Value	SI	Value	SI	Value	SI
V1	% Emergent	60	0.64	60	0.64	51	0.56
V2	% Aquatic	40	0.46	40	0.46	35	0.42
V3	Interspersion	%		%		%	
	Class 1	0	0.32	0	0.32	0	0.30
	Class 2	0		0		0	
	Class 3	60		60		50	
	Class 4	40		40		50	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	75	1.00	75	1.00	24	0.41
V5	Salinity (ppt)	5.25	1.00	5.25	1.00	5.25	1.00
V6	Access Value	1	1.00	1	1.00	1	1.00
	Emergent Marsh HSI =		0.70	EM HSI =	0.70	EM HSI =	0.64
	Open Water HSI =		0.66	OW HSI =	0.66	OW HSI =	0.59

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0.4	0.4	0.4
0.2	0.2	0.2
0	0	0

Project: SWC - 16b-southeast (indirect) Project Area: 4019

FWP

Variable		TY	50	TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent	38	0.44				
V2	% Aquatic	30	0.37				
V3	Interspersion	%		%		%	
	Class 1	0	0.27				
	Class 2	0					
	Class 3	35					
	Class 4	65					
	Class 5	0					
V4	%OW <= 1.5ft	22	0.38				
V5	Salinity (ppt)	5.25	1.00				
V6	Access Value	1	1.00				
		EM HSI =	0.56	EM HSI =		EM HSI =	
		OW HSI =	0.55	OW HSI =		OW HSI =	

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0.4	0	0
0.2	0	0
0	0	0

Project: SWC - 16b-southeast (indirect) Project Area: 4019

FWP

Variable		TY		TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 16b-southeast (indirect)

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	2423	0.70	1692.33	
1	2409	0.70	1682.55	1687.44
25	2009	0.64	1276.73	35410.63
50	1456	0.54	790.75	25630.61
Max TY=	50		AAHUs =	1254.57

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	2423	0.70	1692.33	
1	2410	0.70	1683.25	1687.79
25	2039	0.64	1308.37	35815.21
50	1515	0.56	842.59	26700.32
Max TY=	50		AAHUs	1284.07

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	1284.07
B. Future Without Project Emergent Marsh AAHUs =	1254.57
Net Change (FWP - FWOP) =	29.49

AAHU CALCULATION - OPEN WATER

Project: SWC - 16b-southeast (indirect)

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	1596	0.66	1053.29	
1	1610	0.66	1062.53	1057.91
25	2010	0.59	1178.63	27011.57
50	2562	0.55	1413.50	32481.41
Max TY=	50		AAHUs =	1211.02

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	1596	0.66	1053.29	
1	1608	0.66	1061.21	1057.25
25	1980	0.59	1159.15	26755.18
50	2503	0.55	1378.57	31797.05
Max TY=	50		AAHUs	1192.19

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	1192.19
B. Future Without Project Open Water AAHUs =	1211.02
Net Change (FWP - FWOP) =	-18.83

TOTAL BENEFITS IN AAHUs DUE TO PROJECT	
A. Emergent Marsh Habitat Net AAHUs =	29.49
B. Open Water Habitat Net AAHUs =	-18.83
Net Benefits= (2.6xEMAAHUs+OWAAHUs)/3.6	16.07

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 3a1 Project Area: 599

Condition: Future Without Project

Variable		TY	0	TY	1	TY	25
		Value	SI	Value	SI	Value	SI
V1	% Emergent	0	0.10	0	0.10	0	0.10
V2	% Aquatic	30	0.37	30	0.37	14	0.23
V3	Interspersion	%		%		%	
	Class 1	0	0.10	0	0.10	0	0.10
	Class 2	0		0		0	
	Class 3	0		0		0	
	Class 4	0		0		0	
	Class 5	100		100		100	
V4	%OW <= 1.5ft	35	0.55	34	0.54	17	0.32
V5	Salinity (ppt)	6	1.00	6	1.00	6	1.00
V6	Access Value	0.836	0.85	0.836	0.85	0.836	0.85
	Emergent Marsh HSI =		0.25	EM HSI =	0.25	EM HSI =	0.25
	Open Water HSI =		0.52	OW HSI =	0.52	OW HSI =	0.40

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0.1	0.1	0.1

Project: SWC - 3a1 Project Area: 599

FWOP

Variable		TY	50	TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent	0	0.10				
V2	% Aquatic	0	0.10				
V3	Interspersion	%		%		%	
	Class 1	0	0.10				
	Class 2	0					
	Class 3	0					
	Class 4	0					
	Class 5	100					
V4	%OW <= 1.5ft	0	0.10				
V5	Salinity (ppt)	6	1.00				
V6	Access Value	0.836	0.85				
		EM HSI =	0.25	EM HSI =		EM HSI =	
		OW HSI =	0.27	OW HSI =		OW HSI =	

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0.1	0	0

Project: SWC - 3a1 Project Area: 599

FWOP

Variable		TY		TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 3a1 Project Area: 599

Condition: Future With Project

Variable		TY	0	TY	1	TY	3
		Value	SI	Value	SI	Value	SI
V1	% Emergent	0	0.10	9	0.18	28	0.35
V2	% Aquatic	30	0.37	0	0.10	0	0.10
V3	Interspersion	%		%		%	
	Class 1	0	0.10	0	0.10	0	0.40
	Class 2	0		0		0	
	Class 3	0		0		100	
	Class 4	0		0		0	
	Class 5	100		100		0	
V4	%OW <= 1.5ft	35	0.55	100	0.60	100	0.60
V5	Salinity (ppt)	6	1.00	6	1.00	6	1.00
V6	Access Value	0.836	0.85	0.0001	0.10	0.0001	0.10
	Emergent Marsh HSI =		0.25	EM HSI =	0.25	EM HSI =	0.36
	Open Water HSI =		0.52	OW HSI =	0.20	OW HSI =	0.23

Intermediate Calculations

Interspersion		
0	0	0
0	0	0
0	0	0.4
0	0	0
0.1	0.1	0

Project: SWC - 3a1 Project Area: 599

FWP

Variable		TY	5	TY	6	TY	29
		Value	SI	Value	SI	Value	SI
V1	% Emergent	94	0.95	93	0.94	85	0.87
V2	% Aquatic	30	0.37	40	0.46	40	0.46
V3	Interspersion	%		%		%	
	Class 1	50	0.70	100	1.00	80	0.92
	Class 2	0		0		20	
	Class 3	50		0		0	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.60	100	0.60	82	0.96
V5	Salinity (ppt)	6	1.00	6	1.00	6	1.00
V6	Access Value	0.836	0.85	0.836	0.85	0.836	0.85
		EM HSI =	0.91	EM HSI =	0.94	EM HSI =	0.88
		OW HSI =	0.57	OW HSI =	0.65	OW HSI =	0.67

Intermediate Calculations

Interspersion		
1	1	1
0	0	0.6
0.4	0	0
0	0	0
0	0	0

Project: SWC - 3a1 Project Area: 599

FWP

Variable		TY	30	TY	32	TY	50
		Value	SI	Value	SI	Value	SI
V1	% Emergent	48	0.53	93	0.94	76	0.78
V2	% Aquatic	15	0.24	30	0.37	40	0.46
V3	Interspersion	%		%		%	
	Class 1	100	1.00	85	0.94	30	0.70
	Class 2	0		15		60	
	Class 3	0		0		10	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.60	91	0.78	74	1.00
V5	Salinity (ppt)	6	1.00	6	1.00	6	1.00
V6	Access Value	0.836	0.85	0.836	0.85	0.836	0.85
		EM HSI =	0.68	EM HSI =	0.93	EM HSI =	0.81
		OW HSI =	0.50	OW HSI =	0.60	OW HSI =	0.66

Intermediate Calculations

Interspersion		
1	1	1
0	0.6	0.6
0	0	0.4
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 3a1

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	0	0.25	0.00	
1	0	0.25	0.00	0.00
25	0	0.25	0.00	0.00
50	0	0.25	0.00	0.00
Max TY=	50		AAHUs =	0.00

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	0	0.25	0.00	
1	57	0.25	13.97	7.03
3	169	0.36	60.90	70.56
5	560	0.91	508.02	497.66
6	558	0.94	521.87	514.96
29	507	0.88	448.11	11144.71
30	285	0.68	194.81	314.05
32	559	0.93	519.08	691.52
50	454	0.81	367.99	7946.47
Max TY=	50		AAHUs	423.74

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	423.74
B. Future Without Project Emergent Marsh AAHUs =	0.00
Net Change (FWP - FWOP) =	423.74

AAHU CALCULATION - OPEN WATER

Project: SWC - 3a1

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	599	0.52	313.91	
1	599	0.52	313.34	313.62
25	599	0.40	242.01	6664.12
50	599	0.27	163.03	5062.95
Max TY=	50		AAHUs =	240.81

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	599	0.52	313.91	
1	32	0.20	6.52	129.94
3	35	0.23	7.91	14.41
5	39	0.57	22.32	29.76
6	41	0.65	26.67	24.47
29	92	0.67	61.75	1012.81
30	30	0.50	14.96	36.57
32	40	0.60	24.13	38.74
50	145	0.66	95.40	1058.55
Max TY=	50		AAHUs	46.91

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	46.91
B. Future Without Project Open Water AAHUs =	240.81
Net Change (FWP - FWOP) =	-193.91

TOTAL BENEFITS IN AAHUs DUE TO PROJECT	
A. Emergent Marsh Habitat Net AAHUs =	423.74
B. Open Water Habitat Net AAHUs =	-193.91
Net Benefits= (2.6xEMAAHUs+OWAAHUs)/3.6	252.17

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 3c1 Project Area: 2215

Condition: Future Without Project

Variable		TY	0	TY	1	TY	20
		Value	SI	Value	SI	Value	SI
V1	% Emergent	20	0.28	19	0.27	0	0.10
V2	% Aquatic	40	0.46	40	0.46	20	0.28
V3	Interspersion	%		%		%	
	Class 1	0	0.20	0	0.20	0	0.10
	Class 2	0		0		0	
	Class 3	0		0		0	
	Class 4	100		100		0	
	Class 5	0		0		100	
V4	%OW <= 1.5ft	70	1.00	68	0.97	35	0.55
V5	Salinity (ppt)	8.6	1.00	8.6	1.00	8.6	1.00
V6	Access Value	0.473	0.53	0.473	0.53	0.473	0.53
	Emergent Marsh HSI =		0.39	EM HSI =	0.38	EM HSI =	0.24
	Open Water HSI =		0.54	OW HSI =	0.54	OW HSI =	0.40

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0.2	0.2	0
0	0	0.1

Project: SWC - 3c1 Project Area: 2215

FWOP

Variable		TY	25	TY	50	TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent	0	0.10	0	0.10		
V2	% Aquatic	10	0.19	0	0.10		
V3	Interspersion	%		%		%	
	Class 1	0	0.10	0	0.10		
	Class 2	0		0			
	Class 3	0		0			
	Class 4	0		0			
	Class 5	100		100			
V4	%OW <= 1.5ft	17	0.32	0	0.10		
V5	Salinity (ppt)	8.6	1.00	8.6	1.00		
V6	Access Value	0.473	0.53	0.473	0.53		
		EM HSI =	0.24	EM HSI =	0.24	EM HSI =	
		OW HSI =	0.33	OW HSI =	0.24	OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0.1	0.1	0

Project: SWC - 3c1 Project Area: 2215

FWOP

Variable		TY		TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Brackish Marsh

Project: SWC - 3c1 Project Area: 2215

Condition: Future With Project

Variable		TY	0	TY	1	TY	3
		Value	SI	Value	SI	Value	SI
V1	% Emergent	20	0.28	17	0.25	41	0.47
V2	% Aquatic	40	0.46	0	0.10	0	0.10
V3	Interspersion	%		%		%	
	Class 1	0	0.20	0	0.10	0	0.40
	Class 2	0		0		0	
	Class 3	0		0		100	
	Class 4	100		0		0	
	Class 5	0		100		0	
V4	%OW <= 1.5ft	70	1.00	100	0.60	100	0.60
V5	Salinity (ppt)	8.6	1.00	8.6	1.00	8.6	1.00
V6	Access Value	0.473	0.53	0.0001	0.10	0.0001	0.10
	Emergent Marsh HSI =		0.39	EM HSI =	0.28	EM HSI =	0.41
	Open Water HSI =		0.54	OW HSI =	0.20	OW HSI =	0.23

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0.4
0.2	0	0
0	0.1	0

Project: SWC - 3c1 Project Area: 2215

FWP

Variable		TY	5	TY	6	TY	29
		Value	SI	Value	SI	Value	SI
V1	% Emergent	89	0.90	88	0.89	59	0.63
V2	% Aquatic	40	0.46	50	0.55	50	0.55
V3	Interspersion	%		%		%	
	Class 1	50	0.70	100	1.00	0	0.56
	Class 2	0		0		80	
	Class 3	50		0		20	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.60	100	0.60	77	1.00
V5	Salinity (ppt)	8.6	1.00	8.6	1.00	8.6	1.00
V6	Access Value	0.473	0.53	0.473	0.53	0.473	0.53
		EM HSI =	0.81	EM HSI =	0.84	EM HSI =	0.64
		OW HSI =	0.55	OW HSI =	0.61	OW HSI =	0.61

Intermediate Calculations

Interspersion

1	1	0
0	0	0.6
0.4	0	0.4
0	0	0
0	0	0

Project: SWC - 3c1 Project Area: 2215

FWP

Variable		TY	30	TY	32	TY	50
		Value	SI	Value	SI	Value	SI
V1	% Emergent	48	0.53	92	0.93	66	0.69
V2	% Aquatic	20	0.28	40	0.46	50	0.55
V3	Interspersion	%		%		%	
	Class 1	100	1.00	85	0.94	20	0.66
	Class 2	0		15		70	
	Class 3	0		0		10	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.60	88	0.84	72	1.00
V5	Salinity (ppt)	8.6	1.00	8.6	1.00	8.6	1.00
V6	Access Value	0.473	0.53	0.473	0.53	0.473	0.53
		EM HSI =	0.63	EM HSI =	0.85	EM HSI =	0.69
		OW HSI =	0.47	OW HSI =	0.58	OW HSI =	0.62

Intermediate Calculations

Interspersion

1	1	1
0	0.6	0.6
0	0	0.4
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 3c1

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	450	0.39	173.33	
1	428	0.38	162.18	167.74
20	0	0.24	0.00	1347.43
25	0	0.24	0.00	0.00
50	0	0.24	0.00	0.00
Max TY=	50		AAHUs =	30.30

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	450	0.39	173.33	
1	383	0.28	107.66	139.33
3	899	0.41	369.46	454.78
5	1982	0.81	1600.93	1827.15
6	1956	0.84	1635.82	1618.50
29	1317	0.64	847.97	28092.16
30	1052	0.63	667.88	757.52
32	2043	0.85	1733.73	2331.00
50	1451	0.69	1002.22	24343.11
Max TY=	50		AAHUs	1191.27

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	1191.27
B. Future Without Project Emergent Marsh AAHUs =	30.30
Net Change (FWP - FWOP) =	1160.97

AAHU CALCULATION - OPEN WATER

Project: SWC - 3c1

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	1765	0.54	953.75	
1	1787	0.54	962.26	958.01
20	2215	0.40	891.35	17793.66
25	2215	0.33	724.55	4039.74
50	2215	0.24	531.49	15700.41
Max TY=	50		AAHUs =	769.84

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	1765	0.54	953.75	
1	135	0.20	27.50	399.17
3	184	0.23	41.58	68.72
5	233	0.55	127.63	163.95
6	259	0.61	158.69	142.88
29	898	0.61	547.55	8129.04
30	111	0.47	52.48	282.05
32	172	0.58	100.33	150.56
50	764	0.62	471.50	5086.46
Max TY=	50		AAHUs	288.46

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	288.46
B. Future Without Project Open Water AAHUs =	769.84
Net Change (FWP - FWOP) =	-481.38

TOTAL BENEFITS IN AAHUs DUE TO PROJECT	
A. Emergent Marsh Habitat Net AAHUs =	1160.97
B. Open Water Habitat Net AAHUs =	-481.38
Net Benefits= (2.6xEMAAHUs+OWAAHUs)/3.6	704.76

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Saline Marsh

Project: SWC - 124c   Project Area: 2642

Condition: Future Without Project

Variable		TY Value	0 SI	TY Value	1 SI	TY Value	25 SI
V1	% Emergent	28	0.35	27	0.34	20	0.28
V2	% Aquatic	10	0.37	10	0.37	5	0.34
V3	Interspersion	%		%		%	
	Class 1	0	0.20	0	0.20	0	0.18
	Class 2	0		0		0	
	Class 3	0		0		0	
	Class 4	100		100		80	
	Class 5	0		0		20	
V4	%OW <= 1.5ft	85	0.88	82	0.95	47	0.70
V5	Salinity (ppt)	17	1.00	17	1.00	17	1.00
V6	Access Value	0.80	0.82	0.80	0.82	0.80	0.82
	Emergent Marsh HSI =		0.47	EM HSI =	0.47	EM HSI =	0.42
	Open Water HSI =		0.66	OW HSI =	0.67	OW HSI =	0.63

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0.2	0.2	0.2
0	0	0.1

Project: SWC - 124c   Project Area: 2642

FWOP

Variable		TY Value	50 SI	TY Value	SI	TY Value	SI
V1	% Emergent	9	0.18				
V2	% Aquatic	2	0.31				
V3	Interspersion	%		%		%	
	Class 1	0	0.17				
	Class 2	0					
	Class 3	0					
	Class 4	70					
	Class 5	30					
V4	%OW <= 1.5ft	20	0.36				
V5	Salinity (ppt)	17	1.00				
V6	Access Value	0.80	0.82				
		EM HSI =	0.34	EM HSI =		EM HSI =	
		OW HSI =	0.60	OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0.2	0	0
0.1	0	0

Project: SWC - 124c   Project Area: 2642

FWOP

Variable		TY Value	SI	TY Value	SI	TY Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Saline Marsh

Project: SWC - 124c Project Area: 2642

Condition: Future With Project

Variable		TY	0	TY	1	TY	3
		Value	SI	Value	SI	Value	SI
V1	% Emergent	28	0.35	21	0.29	47	0.52
V2	% Aquatic	10	0.37	0	0.30	0	0.30
V3	Interspersion	%		%		%	
	Class 1	0	0.20	0	0.10	0	0.40
	Class 2	0		0		0	
	Class 3	0		0		100	
	Class 4	100		0		0	
	Class 5	0		100		0	
V4	%OW <= 1.5ft	85	0.88	100	0.50	100	0.50
V5	Salinity (ppt)	17	1.00	17	1.00	17	1.00
V6	Access Value	0.80	0.82	0.00	0.10	0.00	0.10
	Emergent Marsh HSI	=	0.47	EM HSI =	0.29	EM HSI =	0.42
	Open Water HSI	=	0.66	OW HSI =	0.23	OW HSI =	0.25

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0	0	0.4
0.2	0	0
0	0.1	0

Project: SWC - 124c Project Area: 2642

FWP

Variable		TY	5	TY	6	TY	29
		Value	SI	Value	SI	Value	SI
V1	% Emergent	93	0.94	93	0.94	82	0.84
V2	% Aquatic	20	0.44	30	0.51	30	0.51
V3	Interspersion	%		%		%	
	Class 1	50	0.70	100	1.00	70	0.88
	Class 2	0		0		30	
	Class 3	50		0		0	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.50	100	0.50	80	1.00
V5	Salinity (ppt)	17	1.00	17	1.00	17	1.00
V6	Access Value	0.80	0.82	0.80	0.82	0.80	0.82
		EM HSI =	0.89	EM HSI =	0.93	EM HSI =	0.86
		OW HSI =	0.70	OW HSI =	0.74	OW HSI =	0.77

Intermediate Calculations

Interspersion

1	1	1
0	0	0.6
0.4	0	0
0	0	0
0	0	0

Project: SWC - 124c Project Area: 2642

FWP

Variable		TY	30	TY	32	TY	50
		Value	SI	Value	SI	Value	SI
V1	% Emergent	48	0.53	94	0.95	82	0.84
V2	% Aquatic	10	0.37	20	0.44	30	0.51
V3	Interspersion	%		%		%	
	Class 1	100	1.00	85	0.94	70	0.88
	Class 2	0		15		30	
	Class 3	0		0		0	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.50	94	0.65	76	1.00
V5	Salinity (ppt)	17	1.00	17	1.00	17	1.00
V6	Access Value	0.80	0.82	0.80	0.82	0.80	0.82
		EM HSI =	0.68	EM HSI =	0.93	EM HSI =	0.86
		OW HSI =	0.69	OW HSI =	0.73	OW HSI =	0.77

Intermediate Calculations

Interspersion

1	1	1
0	0.6	0.6
0	0	0
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 124c

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	734	0.47	346.13	
1	726	0.47	337.63	341.87
25	523	0.42	217.57	6622.59
50	248	0.34	83.18	3666.93
Max=	50		AAHUs =	212.63

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	734	0.47	346.13	
1	542	0.29	159.70	247.26
3	1248	0.42	529.91	659.03
5	2462	0.89	2200.45	2540.50
6	2451	0.93	2272.32	2236.45
29	2158	0.86	1849.70	47324.72
30	1255	0.68	857.50	1327.43
32	2479	0.93	2294.33	3052.99
50	2163	0.86	1853.99	37270.04
Max=	50		AAHUs	1893.17

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	1893.17
B. Future Without Project Emergent Marsh AAHUs =	212.63
Net Change (FWP - FWOP) =	1680.54

AAHU CALCULATION - OPEN WATER

Project: SWC - 124c

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	1908	0.66	1262.66	
1	1916	0.67	1278.60	1270.63
25	2119	0.63	1342.25	31477.70
50	2394	0.60	1431.43	34711.60
Max=	50		AAHUs =	1349.20

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	1,908	0.66	1262.66	
1	141	0.23	31.73	518.58
3	160	0.25	39.56	71.15
5	180	0.70	125.43	161.99
6	191	0.74	141.73	133.50
29	484	0.77	372.77	5885.15
30	132	0.69	91.51	227.63
32	163	0.73	118.29	209.46
50	479	0.77	368.92	4342.73
Max=	50		AAHUs	231.00

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	231.00
B. Future Without Project Open Water AAHUs =	1349.20
Net Change (FWP - FWOP) =	-1118.19

TOTAL BENEFITS IN AAHUs DUE TO PROJECT	
A. Emergent Marsh Habitat Net AAHUs =	1680.54
B. Open Water Habitat Net AAHUs =	-1118.19
Net Benefits= (3.5xEMAAHUs+OWAAHUs)/4.5	1058.60

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Saline Marsh

Project: SWC - 124d Project Area: 607

Condition: Future Without Project

Variable		TY	0	TY	1	TY	25
		Value	SI	Value	SI	Value	SI
V1	% Emergent	74	0.77	74	0.77	64	0.68
V2	% Aquatic	10	0.37	10	0.37	7	0.35
V3	Interspersion	%		%		%	
	Class 1	0	0.40	0	0.40	0	0.40
	Class 2	0		0		0	
	Class 3	100		100		100	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	85	0.88	82	0.95	57	0.83
V5	Salinity (ppt)	20	1.00	20	1.00	20	1.00
V6	Access Value	1.00	1.00	1.00	1.00	1.00	1.00
	Emergent Marsh HSI =		0.79	EM HSI =	0.79	EM HSI =	0.74
	Open Water HSI =		0.75	OW HSI =	0.76	OW HSI =	0.74

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0.4	0.4	0.4
0	0	0
0	0	0

Project: SWC - 124d Project Area: 607
FWOP

Variable		TY	50	TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent	50	0.55				
V2	% Aquatic	5	0.34				
V3	Interspersion	%		%		%	
	Class 1	0	0.34				
	Class 2	0					
	Class 3	70					
	Class 4	30					
	Class 5	0					
V4	%OW <= 1.5ft	47	0.70				
V5	Salinity (ppt)	20	1.00				
V6	Access Value	1.00	1.00				
		EM HSI =	0.65	EM HSI =		EM HSI =	
		OW HSI =	0.72	OW HSI =		OW HSI =	

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0.4	0	0
0.2	0	0
0	0	0

Project: SWC - 124d Project Area: 607
FWOP

Variable		TY		TY		TY	
		Value	SI	Value	SI	Value	SI
V1	% Emergent						
V2	% Aquatic						
V3	Interspersion	%		%		%	
	Class 1						
	Class 2						
	Class 3						
	Class 4						
	Class 5						
V4	%OW <= 1.5ft						
V5	Salinity (ppt)						
V6	Access Value						
		EM HSI =		EM HSI =		EM HSI =	
		OW HSI =		OW HSI =		OW HSI =	

Intermediate Calculations		
Interspersion		
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Saline Marsh

Project: SWC - 124d   Project Area: 607

Condition: Future With Project

Variable		TY 0 Value	SI	TY 1 Value	SI	TY 3 Value	SI
V1	% Emergent	74	0.77	39	0.45	79	0.81
V2	% Aquatic	10	0.37	0	0.30	0	0.30
V3	Interspersion	%		%		%	
	Class 1	0	0.40	0	0.10	0	0.40
	Class 2	0		0		0	
	Class 3	100		0		100	
	Class 4	0		0		0	
	Class 5	0		100		0	
V4	%OW <= 1.5ft	85	0.88	100	0.50	100	0.50
V5	Salinity (ppt)	20	1.00	20	1.00	20	1.00
V6	Access Value	1.00	1.00	0.00	0.10	0.00	0.10
	Emergent Marsh HSI =		0.79	EM HSI =	0.36	EM HSI =	0.53
	Open Water HSI =		0.75	OW HSI =	0.23	OW HSI =	0.25

Intermediate Calculations

Interspersion

0	0	0
0	0	0
0.4	0	0.4
0	0	0
0	0.1	0

Project: SWC - 124d   Project Area: 607
FWP

Variable		TY 5 Value	SI	TY 6 Value	SI	TY 29 Value	SI
V1	% Emergent	93	0.94	92	0.93	78	0.80
V2	% Aquatic	20	0.44	30	0.51	30	0.51
V3	Interspersion	%		%		%	
	Class 1	50	0.70	100	1.00	30	0.70
	Class 2	0		0		60	
	Class 3	50		0		10	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.50	100	0.50	79	1.00
V5	Salinity (ppt)	20	1.00	20	1.00	20	1.00
V6	Access Value	1.00	1.00	1.00	1.00	1.00	1.00
		EM HSI =	0.93	EM HSI =	0.96	EM HSI =	0.85
		OW HSI =	0.78	OW HSI =	0.83	OW HSI =	0.84

Intermediate Calculations

Interspersion

1	1	1
0	0	0.6
0.4	0	0.4
0	0	0
0	0	0

Project: SWC - 124d   Project Area: 607
FWP

Variable		TY 30 Value	SI	TY 32 Value	SI	TY 50 Value	SI
V1	% Emergent	48	0.53	94	0.95	78	0.80
V2	% Aquatic	10	0.37	20	0.44	30	0.51
V3	Interspersion	%		%		%	
	Class 1	100	1.00	85	0.94	30	0.70
	Class 2	0		15		60	
	Class 3	0		0		10	
	Class 4	0		0		0	
	Class 5	0		0		0	
V4	%OW <= 1.5ft	100	0.50	92	0.70	75	1.00
V5	Salinity (ppt)	20	1.00	20	1.00	20	1.00
V6	Access Value	1.00	1.00	1.00	1.00	1.00	1.00
		EM HSI =	0.71	EM HSI =	0.96	EM HSI =	0.85
		OW HSI =	0.77	OW HSI =	0.81	OW HSI =	0.84

Intermediate Calculations

Interspersion

1	1	1
0	0.6	0.6
0	0	0.4
0	0	0
0	0	0

AAHU CALCULATION - EMERGENT MARSH

Project: SWC - 124d

Future Without Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	448	0.79	354.99	
1	446	0.79	353.41	354.20
25	387	0.74	284.60	7642.65
50	307	0.65	198.21	6005.19
Max=	50		AAHUs =	280.04

Future With Project			Total	Cummulative
TY	Marsh Acres	x HSI	HUs	HUs
0	448	0.79	354.99	
1	236	0.36	85.66	205.16
3	481	0.53	254.65	326.72
5	563	0.93	523.38	767.09
6	560	0.96	536.26	529.83
29	474	0.85	401.97	10753.57
30	288	0.71	203.53	298.37
32	568	0.96	546.20	725.94
50	475	0.85	402.82	8509.47
Max=	50		AAHUs	442.32

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Emergent Marsh AAHUs =	442.32
B. Future Without Project Emergent Marsh AAHUs =	280.04
Net Change (FWP - FWOP) =	162.28

AAHU CALCULATION - OPEN WATER

Project: SWC - 124d

Future Without Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	159	0.75	119.88	
1	161	0.76	122.28	121.08
25	220	0.74	163.06	3428.38
50	300	0.72	216.15	4746.93
Max=	50		AAHUs =	165.93

Future With Project			Total	Cummulative
TY	Water Acres	x HSI	HUs	HUs
0	159	0.75	119.88	
1	33	0.23	7.43	52.55
3	39	0.25	9.64	17.03
5	44	0.78	34.24	43.00
6	47	0.83	38.86	36.53
29	133	0.84	111.94	1729.34
30	30	0.77	23.12	66.31
32	39	0.81	31.62	54.62
50	132	0.84	111.10	1275.82
Max=	50		AAHUs	65.50

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project Open Water AAHUs =	65.50
B. Future Without Project Open Water AAHUs =	165.93
Net Change (FWP - FWOP) =	-100.42

TOTAL BENEFITS IN AAHUs DUE TO PROJECT	
A. Emergent Marsh Habitat Net AAHUs =	162.28
B. Open Water Habitat Net AAHUs =	-100.42
Net Benefits= (3.5xEMAAHUs+OWAAHUs)/4.5	103.90

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Barrier Headland

Project: SWC - 5a   Acres: 426

Condition: Future Without Project

Variable		TY Value	0	TY Value	1 SI	TY Value	25 SI
V1	% Dune	10	0.70	10	0.70	5	0.40
V2	% Supratidal	90	0.83	90	0.83	95	0.67
V3	% Vegetative Cover	35	0.56	35	0.56	25	0.43
V4	% Woody Cover	5	0.40	5	0.40	5	0.40
V5	Beach/surf Zone	1	1.00	1	1.00	1	1.00
		HSI =	0.704	HSI =	0.704	HSI =	0.574

Project: SWC - 5a   Acres: 426

FWOP

Variable		TY Value	29 SI	TY Value	32 SI	TY Value	50 SI
V1	% Dune	0	0.10	0	0.10	0	0.10
V2	% Supratidal	100	0.50	0	0.10	0	0.10
V3	% Vegetative Cover	20	0.36	0	0.10	0	0.10
V4	% Woody Cover	5	0.40	0	0.10	0	0.10
V5	Beach/surf Zone	1	1.00	1	1.00	1	1.00
		HSI =	0.455	HSI =	0.262	HSI =	0.262

Project: SWC - 5a   Acres: 426

FWOP

Variable		TY Value	SI	TY Value	SI	TY Value	SI
V1	% Dune						
V2	% Supratidal						
V3	% Vegetative Cover						
V4	% Woody Cover						
V5	Beach/surf Zone						
		HSI =		HSI =		HSI =	

WETLAND VALUE ASSESSMENT COMMUNITY MODEL
Barrier Headland

Project: SWC - 5a   Acres: 426

Condition: Future With Project

Variable		TY Value	0 SI	TY Value	1 SI	TY Value	25 SI
V1	% Dune	10	0.70	10	0.70	5	0.40
V2	% Supratidal	90	0.83	90	0.83	95	0.67
V3	% Vegetative Cover	35	0.56	35	0.56	35	0.56
V4	% Woody Cover	5	0.40	5	0.40	5	0.40
V5	Beach/surf Zone	1	1.00	3	0.90	3	0.90
		HSI =	0.704	HSI =	0.686	HSI =	0.579

Project: SWC - 5a   Acres: 426

FWP

Variable		TY Value	50 SI	TY Value	SI	TY Value	SI
V1	% Dune	0	0.10				
V2	% Supratidal	100	0.50				
V3	% Vegetative Cover	20	0.36				
V4	% Woody Cover	5	0.40				
V5	Beach/surf Zone	3	0.90				
		HSI =	0.437	HSI =		HSI =	

Project: SWC - 5a   Acres: 426

FWP

Variable		TY Value	SI	TY Value	SI	TY Value	SI
V1	% Dune						
V2	% Supratidal						
V3	% Vegetative Cover						
V4	% Woody Cover						
V5	Beach/surf Zone						
		HSI =		HSI =		HSI =	

AAHU CALCULATION

Project: SWC - 5a

Future Without Project			Total	Cummulative
TY	Acres	x HSI	HUs	HUs
0	426	0.704	300.11	
1	414	0.704	291.66	295.89
25	90	0.574	51.64	3950.22
29	33	0.455	15.01	128.78
32	0	0.262	0.00	19.33
50	0	0.262	0.00	0.00
Max TY=	50		AAHUs =	87.88

Future With Project			Total	Cummulative
TY	Acres	x HSI	HUs	HUs
0	426	0.704	300.11	
1	420	0.686	288.33	294.20
25	247	0.579	143.06	5102.40
50	26	0.437	11.36	1799.10
Max TY=	50		AAHUs	143.91

NET CHANGE IN AAHU'S DUE TO PROJECT	
A. Future With Project AAHUs =	143.91
B. Future Without Project AAHUs =	87.88
Net Change (FWP - FWOP) =	56.03

SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

ANNEX U

Glossary

1. GLOSSARY

A

Acceptability. Adequate to satisfy a need, requirement, or standard. One of the USACE requirements for a project. (LCA Ecosystem Restoration Study, glossary)

Activity. A nonstructural action, (Planning Guidance Notebook, E-3).

Adaptive Management. An interdisciplinary approach acknowledging our insufficient information bas 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 other 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. (LCA Ecosystem Restoration Study, glossary)

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. (LCA Ecosystem Restoration Study, glossary)

Alternative Formulation. Creating alternatives.

Alternative Formulation Briefing (AFB). Purpose is to confirm that the plan formulation and selection process, the tentatively selected plan, and the definition of Federal and non-Federal responsibilities are consistent with applicable laws, statutes, Executive Orders, regulations and current policy guidance. The goal is to obtain a HQUSACE endorsement of the tentatively selected plan, to identify and resolve any legal or policy concerns that would otherwise delay or preclude Washington-level approval of the draft report, and to obtain HQUSACE approval to release the draft report and NEPA document to the public concurrent with the HQUSACE policy compliance review of the draft report. (Planning Guidance Notebook, H-7).

Alternative Plan is a set of one or more management measures functioning together to address one or more planning objectives subject to planning constraints. (Planning Guidance Notebook, 2-4).

Amplitude- The maximum absolute value of a periodically varying quantity (LCA Ecosystem Restoration Study, glossary)

Anoxia- Absence of oxygen (LCA Ecosystem Restoration Study, glossary)

Anthropogenic- Caused by human activity(LCA Ecosystem Restoration Study, glossary)

Aquaculture- The science and business of farming marine or freshwater food fish or shellfish, such as oysters and crawfish, under controlled conditions(LCA Ecosystem Restoration Study, glossary)

Astronomical Tides- Daily tides controlled by the moon, as opposed to wind-generated tides.

Average Annual Habitat Unit (AAHU)- represents a numerical combination of habitat quality and quantity (acres) existing at any given point in time. The habitat unites resulting from the future without- and future with-project scenarios are annualized, averaged over the project life, to determine Average Annual Habitat Units (AAHUs) (LCA Ecosystem Restoration Study, glossary)

B

Bathymetry- is the under water equivalent of Hypsometry, which is the measurement of land elevation relative to sea level. Originally, bathymetry referred to the measurement of ocean depth. (Online Encyclopedia)

Benefits- Valuation of positive performance measures. (LCA Ecosystem Restoration Study, glossary)

Benthic- Living on or in sea, lake, or stream bottoms(LCA Ecosystem Restoration Study, glossary)

Biomass- The total mass of living matter (plant and animal) within a giving unit of environmental area. (LCA Ecosystem Restoration Study, glossary)

Bottomland Hardwood Forest- Low-lying forested wetlands found along streams and rivers. (LCA Ecosystem Restoration Study, glossary)

Brackish Marsh (BRM)- Intertidal plant community typically found in the area of the estuary where salinity ranges between 4-15ppt. (LCA Ecosystem Restoration Study, glossary)

Brackish water- is water that has more salinity than fresh water, but not as much as seawater. It may result from mixing of seawater with fresh water, as in estuaries, or it may occur in brackish fossil aquifers; it contains between 0.5 to 30 grams of salt per litre—more often expressed as 0.5 to 30 parts per thousand (ppt or ‰). Thus, brackish covers a range of salinity regimes and is not considered a precisely defined condition. It is characteristic of many brackish surface waters that their salinity can vary considerably over space and/or time. (Webster Encyclopedia Online)

C

Chief's report- the report that approves or modifies the report and is the report that is transmitted to the Secretary Army for delivery to colleges (Troy).

Chenier Plan- Western part of coastal Louisiana with little influence from Mississippi and Atchafalaya rivers characterized by chenier ridges. (LCA Ecosystem Restoration Study, glossary)

Cheniers- elevated inland ridges parallel to the gulf shore; blocked drainage and salt water inflow from the Gulf of Mexico, resulting in the development of large freshwater basins on the landward side of the ridges. (ER Study, 1-14).

Clean Water Act Section 404 (b) (1)- There are several sections of this Act which pertain to regulating impacts to wetland. 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. (LCA Ecosystem Restoration Study, glossary)

Coastal Zone Consistency Determination- The US 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. (LCA Ecosystem Restoration Study, glossary)

Coast wide Plan- Combination of alternative plans assembled to address an objective or set of objectives across the entire Louisiana Coast. (LCA Ecosystem Restoration Study, glossary)

Coast wide Framework- Combination of plan components assembled to address an objective or set of objectives across the entire Louisiana Coast.

Collocated Team- A collection of scientists and professionals from the US Army Corps of Engineers, US Fish and Wildlife Service, NOAA Fisheries, Natural Resources Conservation Service, US Geological Survey, US Environmental Protection Agency, Louisiana Department of Natural Resources, and Louisiana Department of Wildlife and Fisheries that are located at the USACE-MVN office and work together on the LCA Plan. (LCA Ecosystem Restoration Study, glossary)

Compaction of Holocene Deposits- Deltaic mud that packs down under its own weight. (LCA Ecosystem Restoration Study, glossary)

Comparison of Alternatives- Describe how the plans in the final array of alternatives compare in meeting the planning objectives and constraints. Cite key risks and uncertainties associated with the plans, and explain how these factors have been treated. Identify key tradeoffs among the alternatives (could be among outputs and effects, or against risks and uncertainties), (Planning Guidance Notebook, H-45).

Completeness- The ability of a plan to address all of the objectives. One of the USACE four requirements for a project. (LCA Ecosystem Restoration Study, glossary)

Comprehensive Plan- Same as Coast wide Plan (LCA Ecosystem Restoration Study, glossary)

Comprehensive study -characterizes, measures, and evaluates a particular water resources problem or opportunity across a broad area or region. Typically, the focus of comprehensive studies is water resources problems related to the Corps main mission areas (flood damage reduction, ecosystem restoration or navigation).

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. (LCA Ecosystem Restoration Study, glossary)

Congressional Authorization- authorization for investigation to prepare necessary feasibility-level report to be recommended for authorization of potential future project construction by Congress(LCA Ecosystem Restoration Study, glossary)

Connectivity- Property of ecosystems that allows for exchange of resources and organisms throughout the broader ecosystem (LCA Ecosystem Restoration Study, glossary)

Constraint. A limitation or restriction on plans. Planning constraints may not be absolute restrictions but rather something to minimize or avoid.

Continental Shelf- The edge of the continent under gulf waters; the shallow Gulf of Mexico fringing the coast. (LCA Ecosystem Restoration Study, glossary)

Continuing Authorities Program (CAP) -means a group of 10 legislative authorities under which the Secretary of the Army, acting through the Chief of Engineers, is authorized to plan, design, and implement certain types of water resources projects without additional project specific congressional authorization. Table F-2 lists the CAP authorities and their project purposes. (Planning Guidance Notebook, F-3).

Control Structure- A gate, lock, or weir that controls the flow of water. (LCA Ecosystem Restoration Study, glossary)

Crevasse- A breach or gap in the levee or embankment of a river (natural or manmade), through which floodwaters flow. (LCA Ecosystem Restoration Study, glossary)

Cumulative Impacts- The combined effect of all direct and indirect impacts to a resource over time. (LCA Ecosystem Restoration Study, glossary).

D

Damage. This term from the Congressional language is interpreted to mean damage to real property.
Datum- A point, line, or surface used as a reference, as in surveying, mapping, or geology (LCA Ecosystem Restoration Study, glossary).

Deciduous Forest- Forest composed mostly of trees that lose their leaves in the winter (LCA Ecosystem Restoration Study, glossary).

Decision document- means the consolidated documentation of technical and policy analyses, findings, and conclusions upon which the District Commander bases the recommendation to the Major Subordinate Command Commander to approve the recommended project for implementation. The decision document will be used to support the PCA. Minimum decision document requirements are listed in Section II, paragraph F-10.f. (2) of this Appendix. (Planning Guidance Notebook, F-3).

Decomposition- Breakdown or decay of organic materials (LCA Ecosystem Restoration Study, glossary).

Degradation Phase- The phase of the deltaic cycle when sediments are no longer delivered to a delta, and it experience erosion, dieback, or breakup of marshes. (LCA Ecosystem Restoration Study, glossary).

Delineate –to define

Deltaic cycle- is a dynamic and episodic process alternating between periods of "delta-building" with seaward advancement (progradation) of deltas and the subsequent landward retreat (degradation) As deltas are abandoned, the seaward edges are reworked into barrier headlands and barrier islands. Subsequently, the wetland complex behind headlands and islands, without a significant source of sediment and nutrients, eventually becomes submerged by marine waters (ER Study, 1-7). Initiated when a River comes into contact with bodies of water, thus, decreasing the velocity of water in the River which decreases sediment delivery (ER Study, 1-8).

Deltaic Deposits- Mud and sand deposited at the mouth of a river (LCA Ecosystem Restoration Study, glossary).

Deltaic Plain- The land formed and reworked as the Mississippi River switched channels in the eastern part of the Louisiana coastal area.

Demersal- Dwelling at or near the bottom of a body of water (ex demersal fish) (LCA Ecosystem Restoration Study, glossary)

Detritus- The remains of plant material that has been destroyed or broken up. (LCA Ecosystem Restoration Study, glossary)

Design and implementation phase -means the phase of the project during which all post feasibility phase activities (except for operation, maintenance, repair, rehabilitation, or replacement activities) are performed including negotiation and execution of the PCA, final design, preparation of contract plans and specifications, construction, and any other activities required to construct or implement the approved project. (Planning Guidance Notebook, F-3).

Dewatering- The process of dredged sediments compacting while losing water after being deposited (LCA Ecosystem Restoration Study, glossary)

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. (LCA Ecosystem Restoration Study, glossary)

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. (LCA Ecosystem Restoration Study, glossary).

Direct Impacts- Those effects that result from the initial construction of a measure (ex marsh destroyed during the dredging of a canal). Contrast with "Indirect Impacts" (LCA Ecosystem Restoration Study, glossary).

Diurnal- Relating to or occurring in a 24-hour period; daily (LCA Ecosystem Restoration Study, glossary)

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. (LCA Ecosystem Restoration Study, glossary)

Drainage Basins- includes coastal zones and lake shores, as well as riverine drainage areas or any portion there of located within the boundaries of a state. (Planning Guidance Notebook, G-95).

Drainage projects -are usually undertaken in rural areas to increase agricultural outputs. Some portions of drainage improvements may be considered flood damage reduction measures in accordance with Section 2 of the Flood Control Act of 1944. The typical drainage system consists of drainage ditches, dikes, and related work. (Planning Guidance Notebook, 3-10).

Dredged material embankments (Spoil Banks, Side-cast Banks, Excavated Material Banks) –dredged material removed from canals and piled in a linear mound along the edge of canals. (LCA Ecosystem Restoration Study, glossary)

Dredging- The removal of sediment; used to create wetlands often. (Online)

Dynamic- Characterized by continuous change and activity(LCA Ecosystem Restoration Study, glossary)

E

Ecological- Refers to the relationship between living things and their environment (LCA Ecosystem Restoration Study, glossary)

Economic- Of or relating to the production, development, and management of material wealth, as of a country, household, or business enterprise (LCA Ecosystem Restoration Study, glossary)

Ecosystem Restoration- is one of the primary missions of the Corps of Engineers Civil Works Program. The Corps objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER). For ecosystem restoration projects, a plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective, shall be selected (Planning Guidance Notebook, 2-1). 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 (LCA Ecosystem Restoration Study, glossary)

Effectiveness- Having an intended or expected effect. One of the USACE four requirements for a project (LCA Ecosystem Restoration Study, glossary)

Efficiency- The quality of exhibiting a high ratio of output to input. One of the USACE four requirements for a project.

Egress- A path or opening for going out; an exit (LCA Ecosystem Restoration Study, glossary)

Electrical Conductivity- The ability of a medium to conduct electricity. Salt water has a higher electrical conductivity that freshwater, and this property allows the measurements of salinity through a simple meter (LCA Ecosystem Restoration Study, glossary)

Embankment- A linear mound of earth or stone existing or built to hold back water or to support a roadway(LCA Ecosystem Restoration Study, glossary)

Encroachment- Entering gradually into an area not previously occupied, such as a plant species distribution changing in response to environmental factors such as salinity (LCA Ecosystem Restoration Study, glossary).

Endangered Species- Animals and plants that are threatened with extinction (LCA Ecosystem Restoration Study, glossary)

Endpoints- see Objectives

Engineering News Record (ENR)- A magazine that provides news needed by anyone in or from the construction industry (LCA Ecosystem Restoration Study, glossary)
Enhance- To augment or increase/heighten the existing state of an area (LCA Ecosystem Restoration Study, glossary)

Entrenchment- Being firmly embedded (LCA Ecosystem Restoration Study, glossary)

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. (LCA Ecosystem Restoration Study, glossary)

Environmental Operating Principles- Describe how the recommendation supports the USACE Environmental Operating Principles, (Planning Guidance Notebook, H-45).

Environmental Sustainability- a synergistic process whereby environmental and economic considerations are effectively balanced through the life cycle of project planning, design, construction, operation and maintenance to improve the quality of life for present and future generations. (Planning Guidance Notebook, F6).

Estuary – a semi-enclosed coastal body of water with one or more rivers or streams flow into it and has a free connection open to the sea; often associated with high levels of biological activity. They are often characterized by sedimentation or silt carried in from terrestrial runoff and, frequently, from offshore; contains brackish water; estuaries are marine environments whose pH, salinity, and water levels vary, depending on the river that feeds the estuary and the ocean from which it derives its salinity (oceans and seas have different salinity levels), (Webster Encyclopedia Online).

Estuarine- Related to an estuary (LCA Ecosystem Restoration Study, glossary)

Eustatic sea level rise. Change in global average sea level brought about by an increase in the volume of the world ocean [Intergovernmental Panel of Climate Change (IPCC) 2007b]. See also **relative sea level rise**.

Evaporation- The process by which any substance is converted from a liquid state into, and carried off in, vapor; as, the evaporation of water (LCA Ecosystem Restoration Study, glossary)

Exotic Species- Animal and plant species not native to the area; usually undesirable (hyacinth, nutria, tallow tree, giant salvinia) (LCA Ecosystem Restoration Study, glossary)

F

Faulting- A fracture in the continuity of a rock formation caused by a shifting or dislodging of the earth's crust, in which adjacent surfaces are displaced relative to one another and parallel to the plane of fracture (LCA Ecosystem Restoration Study, glossary)

Feasibility Cost Sharing Agreement (FCSA) A type of Project Partnership Agreement (PPA) signed between the Corps of Engineers and non federal sponsor to share the cost of producing a feasibility study, (Angie).

Feasibility Scoping Meeting (FSM)- The purpose of the FSM is to bring the vertical team, the non-Federal sponsor, and resource agencies together to agree on the problems and solutions to be investigated and the scope of analyses required. An FSM will address the problems, opportunities, and needs; refine study constraints; identify the key alternatives; and further define the scope, depth, and methods of analyses required (Planning Guidance Notebook, H-7)

Feasibility-level Design -a viable document/standard that adheres to the Corps of Engineers requirements; deals with whether a project/aspects of a project is/are capable of being executed. Must be produced for recommended plan; is in accordance with Planning Guidance Notebook ER 1105-2-100 and pertinent ERs, ECs, and Ems (Troy).

Feasibility-level report –a report that meets Corps of Engineers requirements to produce a Chief's report containing a recommendation that can be authorized by Congress (Angie). The objective of feasibility studies is to investigate and recommend solutions to the water resource problems. (50% Federal funded and 50% non-federal funded) These reports document the feasibility study, and provide the basis for a decision on construction authorization of a project. Report includes: EA/EIS to comply with NEPA (Planning Guidance Notebook, G-1). 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 or 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-effective analysis (LCA Ecosystem Restoration Study, glossary).

Feasibility phase -means the project formulation phase during which all planning activities are performed that are required to demonstrate that Federal participation in a specific project is warranted, culminating in approval of the decision document. All plan formulation must be completed during this phase, including all technical analyses, policy compliance determinations, and Federal and non-Federal environmental and regulatory compliance activities required for approval of the decision document. (Planning Guidance Notebook, F-3).

Feature -a structural element that requires construction or assembly on-site, (Planning Guidance Notebook, E-3). (ex rock closure structure at Bayou La Loutre 950ft by 47ft, Angie). A constructible increment of an alternative plan (LCA Ecosystem Restoration Study, glossary).

Federal Interest- Define the Federal interest, consistent with Army policies, based on an appraisal of the costs, benefits and environmental impacts of the recommended project alternative, (Planning Guidance Notebook, H-44).

Federal Principles Group (FPG)- A collaboration among Federal agencies at the Washington level to facilitate the flow of information, to provide guidance and recommendations to the USACE and LDNR throughout the study process, and to facilitate resolution of any interagency issues that may be identified in the conduct of the study (LCA Ecosystem Restoration Study, glossary).

Final Array- the alternative that best meets the objectives but requires further analysis (Troy) The final grouping of the most effective coast wide plans from which a final recommendation can be made (LCA Ecosystem Restoration Study, glossary).

Final Array of Alternatives- Describe the plans that qualified for the final comparison, including the NED, NER or Combined Plan, and any Locally Preferred Plan. Discuss the rationale for eliminating alternative plans, (Planning Guidance Notebook, H-45).

Foreshore Dikes- An embankment of earth and rock built to prevent floods or erosion that is built in the area of a shore that lies between the average high tide mark and the average low tide mark.

Framework Development Team (FDT)- A group of professionals from various Federal and stage agencies, academia and the public formed to provide a forum for individual members to discuss LCA Comprehensive Study activities and technical issues and to provide individual comments to the Senior Management Committee (LCA Ecosystem Restoration Study, glossary).

Fresh Marsh- Intertidal herbaceous plant community typically found in that areas of the estuary with salinity ranging from 0-3 ppt. (LCA Ecosystem Restoration Study, glossary).

Furbearer- An animal whose skin is covered with fur (mammal), especially fur that is commercially valuable, such as a muskrat, nutria, and mink (LCA Ecosystem Restoration Study, glossary).

G

General navigation features -include dredged material disposal facilities required for construction or operation and maintenance of the other general navigation features. General navigation features of harbor or waterway projects are channels, jetties or breakwaters, locks and dams, basins or water areas for vessel maneuvering, turning, passing, mooring or anchoring incidental to transit of the channels and locks. Also included are dredged material disposal areas. (Planning Guidance Notebook, 3-1; F-32).

Geomorphic- Related to geological surface configuration (LCA Ecosystem Restoration Study, glossary).

Geosynclinal Down-warping- The downward bend or subsidence of the earth's crust, which allows of the gradual accumulation of sediment.

Geotropically- Downward growth in response to gravity, as in plant roots (LCA Ecosystem Restoration Study, glossary).

Glycophytes- A plant that cannot live in high salinity environments, most plants (LCA Ecosystem Restoration Study, glossary).

Goals- Statements on what to accomplish and or what is needed to address a problem without specific detail (LCA Ecosystem Restoration Study, glossary).

Gradient- A slope; a series of progressively increasing or decreasing differences in a system or organism (LCA Ecosystem Restoration Study, glossary).

H

Habitat- The place where an organism lives; part of physical environment in which a plant or animal lives (LCA Ecosystem Restoration Study, glossary).

Habitat Evaluation Team. A part of the Project Delivery Team composed of resource agency representatives.

Habitat loss- The disappearance of places where target groups of organisms once lived. In coastal restoration, usually refers to the conservation of marsh or swamp to open water (LCA Ecosystem Restoration Study, glossary).

Habitat Units (HUs)- represent a numerical combination of quality (HIS) and quantity (acres) existing at any given pint 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 the future with-project scenarios. The difference in AAHUs between the two scenarios represents the net benefit attribute to the project in terms of habitat quantity and quality (LCA Ecosystem Restoration Study, glossary).

Hazardous, Toxic, and Radioactive Wastes (HTRW) –Wastes that contain toxic constituents, or that may cause hazardous chemical reactions, including explosive or flammable material, or radioactive wastes, which, improperly managed may present a hazard to human health or the environment. (LCA Ecosystem Restoration Study, glossary).

Headland- A point of land projecting into the sea or other expanse of the water, still connected with the mainland. (LCA Ecosystem Restoration Study, glossary).

Herbaceous- A plant with no persistent woody stem above ground. (LCA Ecosystem Restoration Study, glossary).

Hydrodynamic- The continuous change or movement of water (LCA Ecosystem Restoration Study, glossary).

Hydrology- The pattern of water movement on the earth's surface, in the soil and underlying rocks, and in the atmosphere. (LCA Ecosystem Restoration Study, glossary).

Hypoxia- The condition of low dissolved oxygen concentrations (LCA Ecosystem Restoration Study, glossary).

I

Idemnification- Insurance against or compensation for loss of damage (LCA Ecosystem Restoration Study, glossary).

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. Constrast with "Direct Impacts" (LCA Ecosystem Restoration Study, glossary).

Infrastructure- The basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communication systems, water and power lines, and public institutions including schools, post offices, and prisons. (LCA Ecosystem Restoration Study, glossary).

Ingress- An entrance or the act of entering (LCA Ecosystem Restoration Study, glossary).

Initial Array- Every alternative thought of for a project (Troy).

Inorganic- Not derived from living organisms; mineral; matter other than plant or animal. (LCA Ecosystem Restoration Study, glossary).

Interdistributary Deposits- Sand and mud deposited between the river channels or between the bayous (LCA Ecosystem Restoration Study, glossary).

Intermediate Marsh (INM)- Intertidal herbaceous plant community typically found in that area of the estuary with salinity ranging from 2-5 ppt (LCA Ecosystem Restoration Study, glossary).

Intertidal- Alternately flooded and exposed by tides. (LCA Ecosystem Restoration Study, glossary).

Inundated- to cover or engulf with a flood; deluge (Online Dictionary)

Invertebrates- Animals without backbones, including shrimp, crabs, oysters, and worms. (LCA Ecosystem Restoration Study, glossary).

IWR-PLAN. A decision support software program that assists with plan formulation by combining user-defined solutions to planning problems and calculating the effects of each combination, or “plan.” The program can assist with plan comparison by conducting cost effectiveness and incremental cost analyses, identifying the plans which are best financial investments and displaying the effects of each on a range of decision variables.

L

Land-water Ratio- The relative proportion or wetlands and uplands to water in an area. (LCA Ecosystem Restoration Study, glossary)

Larvae- The stage in some animal’s life cycles between egg and adult (mostly in invertebrates) (LCA Ecosystem Restoration Study, glossary)

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.

Litigation –take legal action

LCA Plan (Louisiana Coastal Area) -is defined as the one that meets the study objectives, is based upon identification of the most critical natural and human ecological needs, and proposes a program of highly cost effective features to address those needs.

Legal and Policy Constraints- are those defined by law, Corps policy and guidance (LCA Ecosystem Restoration Study, glossary)

Loamy- Soil composed of a mixture of sand, clay, silt, and organic matter. (LCA Ecosystem Restoration Study, glossary)

Locally Preferred Plan (LPP) - Alternative plan preferred by local sponsor if other than the Recommended Plan. (LCA Ecosystem Restoration Study, glossary)

M

Maintain- To keep in exiting state. (LCA Ecosystem Restoration Study, glossary)

Magnetometer surveys- A magnetometer can detect ferrous metal buried tanks, drums, locate graves and archaeological sites containing ferrous metal or produce a magnetic anomaly. Magnetometer surveys are rapid and very accurate. (Online Encyclopedia)

Management Measure is a feature (a structural element that requires construction or assembly on-site) or an activity (a nonstructural action) that can be implemented at a specific geographic site that is to address one or more planning objectives. Management measures are the building blocks of alternative plans. (Planning Guidance Notebook, 2-4).

Marine Forcing- tidal action or exchange. (LCA Ecosystem Restoration Study, glossary)

Measure- a generic type of action that would be taken to address a problem (ex. Shoreline erosion –measure would be breakwaters (Angie).

Methodology- A set of practices, procedures, and rules (LCA Ecosystem Restoration Study, glossary)

Mineral Substrate- Soil composed predominately of mineral rather than organic materials; less than 20 percent organic material.

Mitigation- offsetting impacts that have been creating; the creation, restoration, or enhancement of wetlands; required to compensate for authorized activities which will cause unavoidable losses of wetlands (Online Dictionary)

Mudflats- Flat, unvegetated wetlands subject to periodic flooding and minor wave action. (LCA Ecosystem Restoration Study, glossary)

Myatt Series- Gray terrance soil, with whitish, pebbly subsoil. (LCA Ecosystem Restoration Study, glossary)

Management measures. A feature (a structural element that requires construction or assembly on-site) or an activity (a nonstructural action) that can be combined with other management measures to form alternative plans.

Marsh creation. A type of management measure that creates marsh in open water and nourishes the surrounding existing marsh. Marsh creation will include vegetative plantings. See also marsh nourishment.

Marsh nourishment. A type of management measure that nourishes existing marsh and decreases the depth of nearby open water. See also **marsh creation**.

Model Calibration/Validation. Calibration is an iterative procedure of parameter evaluation and refinement, as a result of comparing simulated and observed values of interest. Model validation is in reality an extension of the calibration process. Its purpose is to assure that the calibrated model properly assesses all the variables and conditions which can affect model results, and demonstrate the ability to predict field observations for periods separate from the calibration effort.

N

National Economic Development (NED) Plan.

National Ecosystem Restoration (NER)- USACE standard for cost-effectiveness based on ecosystem, not economics, benefits (LCA Ecosystem Restoration Study, glossary)

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

Net Gain- The amount of cumulated land gain less and land loss, when gain is greater than loss (LCA Ecosystem Restoration Study, glossary)

Net Loss- The amount of cumulative land gain less land loss, when gain is less than loss.

No Action Alternative- The alternative in the LCA Plan which describes the ecosystem of the coastal area if no restoration efforts/projects were done (LCA Ecosystem Restoration Study, glossary).

Nonstructural measures- reduce flood damages without significantly altering the nature or extent of flooding. Examples are flood proofing, relocation of structures, flood warning and preparedness systems (including associated emergency measures), and regulation of floodplain uses. (Planning Guidance Notebook, 3-10)

Nursery- A place for larval or juvenile animals to live, eat, and grow (LCA Ecosystem Restoration Study, glossary)

O

Objectives- More specific statements than “Goals” describing how to achieve the desired targets (LCA Ecosystem Restoration Study, glossary).

Oceanic-dumping- The discharge of wastes or pollutants into offshore waters (LCA Ecosystem Restoration Study, glossary).

Opportunities. Desirable conditions to be achieved.
Organic- Composed of or derived from living things (LCA Ecosystem Restoration Study, glossary)

Oscillations- Fluctuations back and forth, or up and down (LCA Ecosystem Restoration Study, glossary)

Outlet structure- is provided at the downstream end where the system empties into a larger channel. (Planning Guidance Notebook, 3-11).

Oxidation of Organic Matter- The decomposition (rotting, breaking down) of plant material through exposure to oxygen. (LCA Ecosystem Restoration Study, glossary)

Oxygen-depleted- Situation of low oxygen concentrations where living organisms are stressed. (LCA Ecosystem Restoration Study, glossary)

P

Peer Review- Describe how the plan and associated analyses were reviewed for quality, as well as any substantive peer review comments and their resolution, (Planning Guidance Notebook, H-45).

Period of analysis. The time horizon for which project benefits, deferred construction costs, and operation, maintenance, repair, rehabilitation, and replacement costs are analyzed. For this study, the period of analysis is from 2025 to 2075.

Petrochemical- Any compound derived from petroleum or natural gas.

Plan- Written account of intended future course of action (scheme) aimed at achieving specific goal(s) or objective(s) within a specific timeframe. It explains in detail what needs to be done, when, how, and by whom, and often includes best case, expected case, and worst case scenarios. (Online Business Dictionary).

Planning Objectives- Statement of the intended purposes of the planning process; what alternatives are intended to achieve. Planning Constraints. Restrictions that limit the extent of the planning process. (Planning Guidance Notebook, H-44).

Planning Objectives: are statements that describe the desired results of the planning process by solving the problems and taking advantage of the opportunities identified. The planning objectives must be directly related to the problems and opportunities identified for the study and will be used for the formulation and evaluation of plans. Objectives must be clearly defined and provide information on the effect desired (quantified, if possible), the subject of the objective (what will be changed by accomplishing the objective), the location where the expected result will occur, the timing of the effect (when would the effect occur) and the duration of the effect. (Planning Guidance Notebook, 2-3).

Plan formulation is the process of developing management measures and plans that meet planning objectives and avoid planning constraints, (Planning Guidance Notebook, E-3).

Plan Formulation Rationale- Strategies and approaches used to develop alternative plans, (Planning Guidance Notebook, H-45).

Planning Scale- Planning term that reflects the degree to which environmental processes would be restored or reestablished and the resulting ecosystem and landscape changes that would be expected over the next 50 years. The uppermost scale is referred to as “Increase.” No net loss of ecosystem function is “Maintain” Reducing the projected rate of loss of function is “Reduce.” The lowest possible scale was no futher action above and beyond existing projects and programs. (LCA Ecosystem Restoration Study, glossary)

Point-Bar Deposit- The shallow depositional area on the inside of a river bank. (LCA Ecosystem Restoration Study, glossary)

Post-larval- Stage in an animal’s lifecycle after metamorphosis from the larval stage, but not yet full grown. (LCA Ecosystem Restoration Study, glossary)

Potable Water- Water that is fit to drink. (LCA Ecosystem Restoration Study, glossary)

ppt- parts per thousand. The salinity of ocean water is approximately 35ppt. (LCA Ecosystem Restoration Study, glossary)
Primary Consolidation/ Secondary Compression- Two processes acting on a substrate that had a load applied to it to cause the sediment to increase in density, and to decrease in volume.

Prime Farmland- Land that has the best combination of physical and chemical characteristic 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 EIS. (LCA Ecosystem Restoration Study, glossary)

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. (LCA Ecosystem Restoration Study, glossary)

Prior Reports and Existing Water Projects -Include a concise discussion of relevant prior studies, reports, NEPA documents and Endangered Species Surveys, existing water projects, and other key related activities. Also include relevant documents and projects undertaken by entities other than the Corps, (Planning Guidance Notebook, H-44).

Problems. Undesirable conditions to be solved.

Problems and Opportunities- Specify the key problems being addressed and the opportunities for alleviating them, (Planning Guidance Notebook, H-44).

Produced water.

Productivity- Growth of plants and animals (LCA Ecosystem Restoration Study, glossary)

Programmatic Environmental Impact Statement (PEIS) –an Environmental Impact Statement that supports a broad authorization for action, contingent on more specific detailing of impacts from specific measures (LCA Ecosystem Restoration Study, glossary)

Project Delivery Team. A multi-disciplinary, multi-agency team responsible for the successful development and execution of all aspects of the study.

Project Location/Congressional District- Include a concise description of the study area and project location (including clear maps with all key features identified) and identify the Congressional District(s), (Planning Guidance Notebook, H-44).

Project Partnership Agreement (PPA)-A legal contract between the Corps and a sponsor; lays out scope of work, purpose of effort, roles, responsibility, cost, and schedule (Troy).

Province- A major diversion of the coastal area of Louisiana. (ex. Deltaic Plain and Chenier Plain) (LCA Ecosystem Restoration Study, glossary)

Pulsing- Letting a diversion flow periodically at a high rate for a short time, rather than continuously (LCA Ecosystem Restoration Study, glossary)

Q

Quantitative- Able to assign a specific number; susceptible to measurement. (LCA Ecosystem Restoration Study, glossary)

R

Radiocarbon Age Determination- The use of ratio of carbon isotopes to determine age. (LCA Ecosystem Restoration Study, glossary)

Rebuild- To some extent build back a structure/landform that has once exhisted (LCA Ecosystem Restoration Study, glossary)

Recommended plan- The alternative course of action proposed for implementation. (Caroline) Is the result of all of the scoping analysis refinement and decision making that determines the most acceptable course of action (Andy). **-**Identify the selected plan, and describe the rationale supporting the selection. List the significant features with one or two measures of scale for each one, (Planning Guidance Notebook, H-45).

Reconnaissance Report- A document prepared as part of major authorization that examines a problem or need and determines if sufficient methods and Federal interest exists to address the problem/need. If so, then a “Feasibility Report” is prepared, which details the solution and its impacts further. (LCA Ecosystem Restoration Study, glossary)

Reduce- To diminish the rate or speed of process (LCA Ecosystem Restoration Study, glossary)

Regional Working Group (RWG)- An inter-agency team formed to support the Washington-level change; the change in average water level with respect to the surface (LCA Ecosystem Restoration Study, glossary)

Rehabilitate- To focus on historical or pre-existing ecosystems as models or references while emphasizing the reparation of ecosystem processes, productivity and service (LCA Ecosystem Restoration Study, glossary)

Relative Sea Level Exchange- The sum of the sinking of the land (subsidence) and eustatic sea level change; the change in average water level with respect to the surface. (LCA Ecosystem Restoration Study, glossary)

Relative sea level rise. Sea level rise measured by a tide gauge with respect to the land upon which it is situated. Relative sea level rise occurs where there is a local change in the level of the ocean relative to the land, which might be due to ocean rise and/or land level subsidence. See also **eustatic sea level rise**.

Resource Constraints -are those associated with limits on knowledge, expertise, experience, ability, data, information, money, and time (Planning Guidance Notebook, 2-3).

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 (LCA Ecosystem Restoration Study, glossary)

Risk. A measure of the probability and severity of undesirable consequences (including, but not limited to, loss of life, threat to public safety, environmental and economic damages).

S

Sangamonian Interglacial Period- the last interglacial period before the Holocene period (the current geological period). (LCA Ecosystem Restoration Study, glossary)

Saline Marsh (SAM)- Intertidal herbaceous plant community typically found in that area of the estuary with salinity ranging from 12-32 ppt. (LCA Ecosystem Restoration Study, glossary)

Salinity- The concentration of dissolved salts in a body of water, commonly expressed as parts per thousand (LCA Ecosystem Restoration Study, glossary)

Salt Marshes- See "Saline Marsh"

Scoping- required by NEPA (involved with water resource planning); a process that determines the scope of issues to be addressed and identifies the significant issues related to a proposed action (Planning Guidance Notebook, 2-2 and 2-3) Soliciting and receiving public input to determine issues, resources, impacts, and alternatives to be addressed in the draft EIS. (LCA Ecosystem Restoration Study, glossary)

Scouring- the erosion and excavation of soil caused by river current (Online Dictionary)

Sea Level- Long-term average position of the sea surface (LCA Ecosystem Restoration Study, glossary)

Sediment Plume- Caused by sediment rich rainwater runoff entering the ocean. The runoff creates a visible pattern of brown water that is rich in nutrients and suspended sediments that forms a kind of cloud in the water spreading out from the coastline. Commonly forms at river and stream mouths, near sloughs, and along coasts where a large amount of rain runoff flows directly into the ocean. (LCA Ecosystem Restoration Study, glossary)

Sheet Flow- Flow of water, sediment, and nutrients across a flooded wetland surface, as opposed to through channels. (LCA Ecosystem Restoration Study, glossary)

Shoaling- The shallowing of an open-water area through deposition of sediments. (LCA Ecosystem Restoration Study, glossary)

Slikensides- The smooth or partially polished surface of rock caused by one rock mass sliding over another in a fault plane. (LCA Ecosystem Restoration Study, glossary)

Social- Relating to human society and its modes of organization. (LCA Ecosystem Restoration Study, glossary)

Socioeconomic- Involving both social and economic factors (LCA Ecosystem Restoration Study, glossary)

Stabilize- To fix the level or fluctuation of; to make stable (LCA Ecosystem Restoration Study, glossary)

State Historic Preservation Office (SHPO)- The part of the Louisiana Department of Culture, Recreation, and Tourism that deals with Native American sites and other archaeological/historic sites (LCA Ecosystem Restoration Study, glossary)

Stillstand- A period of time when sea level did not change (LCA Ecosystem Restoration Study, glossary)

Storm Overwash- The process by which sand is transposed landward over the dunes during a storm even by waves (LCA Ecosystem Restoration Study, glossary)

Storm Surge- An abnormal and sudden rise of the sea along a shore as a result of the winds of a storm. (LCA Ecosystem Restoration Study, glossary)

Stough soils- Yellowish brown coarse-loamy soil. (LCA Ecosystem Restoration Study, glossary)

Strategy- Ecosystem restoration concept from the Coast 2050 Plan. (LCA Ecosystem Restoration Study, glossary)

Stream Gaging Data- Records of water levels in streams and rivers. (LCA Ecosystem Restoration Study, glossary)

Study Authority- Include the full text of principal resolutions(s) or other authority, (Planning Guidance Notebook, H-44).

Study planning objectives: which are more specific in terms of expected or desired outputs. (Planning Guidance Notebook, 2-1).

Study Purpose and Scope- State whether the report is an interim or final response to the study authority. Succinctly identify the study purpose and scope, (Planning Guidance Notebook, H-44).

Study Sponsor- Include the name(s) of the study sponsor(s), (Planning Guidance Notebook, H-44).

Structural Measures- Structural measures are physical modifications designed to reduce the frequency of damaging levels of flood inundation. Structural measures include: dams with reservoirs, dry dams, channelization measures, levees, walls, diversion channels, pumps, ice-control structures, and bridge modifications. (Planning Guidance Notebook, 3-10).

Submergence- Going under water (LCA Ecosystem Restoration Study, glossary)

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. (LCA Ecosystem Restoration Study, glossary)

Subsidence- The gradual downward settling or sinking of the Earth's surface with little or no horizontal motion. (LCA Ecosystem Restoration Study, glossary)

Sustain- To support and provide with nourishment to keep in existence; maintain (LCA Ecosystem Restoration Study, glossary)

Systems / Watershed Context- Describe how the Recommended Plan is integrated with other watershed purposes. Discuss agency partnerships and cooperation. Include which other agencies were invited to be formal Cooperating Agencies and those which accepted, and identify the responsible lead agency, (Planning Guidance Notebook, H-45).

T

Tarbert Flow- Stream gage date recorded Tarbert's Landing on the Mississippi River. (LCA Ecosystem Restoration Study, glossary)

Target- A desired ecosystem state that meets an objective or set of objectives. (LCA Ecosystem Restoration Study, glossary)

Tentatively Selected Plan- a plan that teams select, which is the recommended plan but remains tentative until approved by the chief of Engineers (Troy).

Terrestrial Habitat- The land area or environment where an organism lives; as distinct from water or air habitats. (LCA Ecosystem Restoration Study, glossary)

Third Delta- A proposed project that would divert up to 120,000 cubic feet of water per second from the Mississippi River near Donaldsonville, Louisiana down a conveyance channel to the marshes in southern Barataria and Terrebonne Basins. (LCA Ecosystem Restoration Study, glossary)

Toxicity- The measure of how poisonous something is (LCA Ecosystem Restoration Study, glossary)

Transpiration- The process by which water passes through living plants into the atmosphere (LCA Ecosystem Restoration Study, glossary)

Trenasse- A small manmade trench through a swamp or marsh allowing travel by small boats. (LCA Ecosystem Restoration Study, glossary)

Turbidity- The level of suspended sediments in water; opposite of clarity or clearness. (LCA Ecosystem Restoration Study, glossary)

U

Uncertainty. Uncertainty is the result of imperfect knowledge concerning the present or future state of a system, event, situation, or (sub) population under consideration. There are two types of uncertainty: aleatory and epistemic. Aleatory uncertainty is the uncertainty attributed to inherent variation which is understood as variability over time and/or space. Epistemic uncertainty is the uncertainty attributed to our lack of knowledge about the system (e.g., what value to use for an input to a model or what model to use). Uncertainty can lead to lack of confidence in predictions, inferences, or conclusions.

Unique Farmland- Land other than Prime Farmland (see "Prime Farmland") that is used for the production of specific high-value food and fiber crops, such as citrus, tree nuts, olives, cranberries, fruits, and vegetables. (LCA Ecosystem Restoration Study, glossary)

Upconing- The tendency of underground salt water to move closer to the surface in the vicinity of a well as it fills the areas where the freshwater is drawn out. (LCA Ecosystem Restoration Study, glossary)

Upland (UPL)- A general term for non-wetland elevated land above low areas along streams or between hills. (LCA Ecosystem Restoration Study, glossary)

W

Water Resource Units (WRU)- Stage-damage data developed as part of the Flood Damage Estimation System (FDES) in 1980 for the Mississippi River and Tributaries (MR&T) project were used to estimate the flood damages that are expected to occur in Subprovinces 1, 2, and 3. The date collected for the FDES were delineated into geographic areas with homogenous physical and hydraulic characteristics. These geographic areas were numerically coded and designated as Water Resource Units (WRUs). Within each WRU, land-use elements (structures, cropland, roads, bridges, railroads, ect) were categorized by location, value, and corresponding depth-damage relationship. The structural damage categories included: residential, commercial, industrial, public, and farm building. (LCA Ecosystem Restoration Study, glossary)

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. (LCA Ecosystem Restoration Study, glossary)

Weir- A dam placed across a canal or river to raise, divert, regulate or measure the flow of water. (LCA Ecosystem Restoration Study, glossary)

Wetland Value Assessment (WVA). A quantitative habitat-based assessment methodology used to determine wetland benefits of restoration measures. The WVA quantifies changes in fish and wildlife habitat quality and quantity that are expected to result from a proposed wetland restoration project. The results of the WVA, measured in Average Annual Habitat Units (AAHUs), can be combined with cost data to provide a measure of the effectiveness of a proposed project in terms of annualized cost per AAHU gained. In addition, the WVA methodology provides an estimate of the number of acres benefited or enhanced by the project and the net acres of habitat protected/restored.

SOUTHWEST COASTAL LOUISIANA
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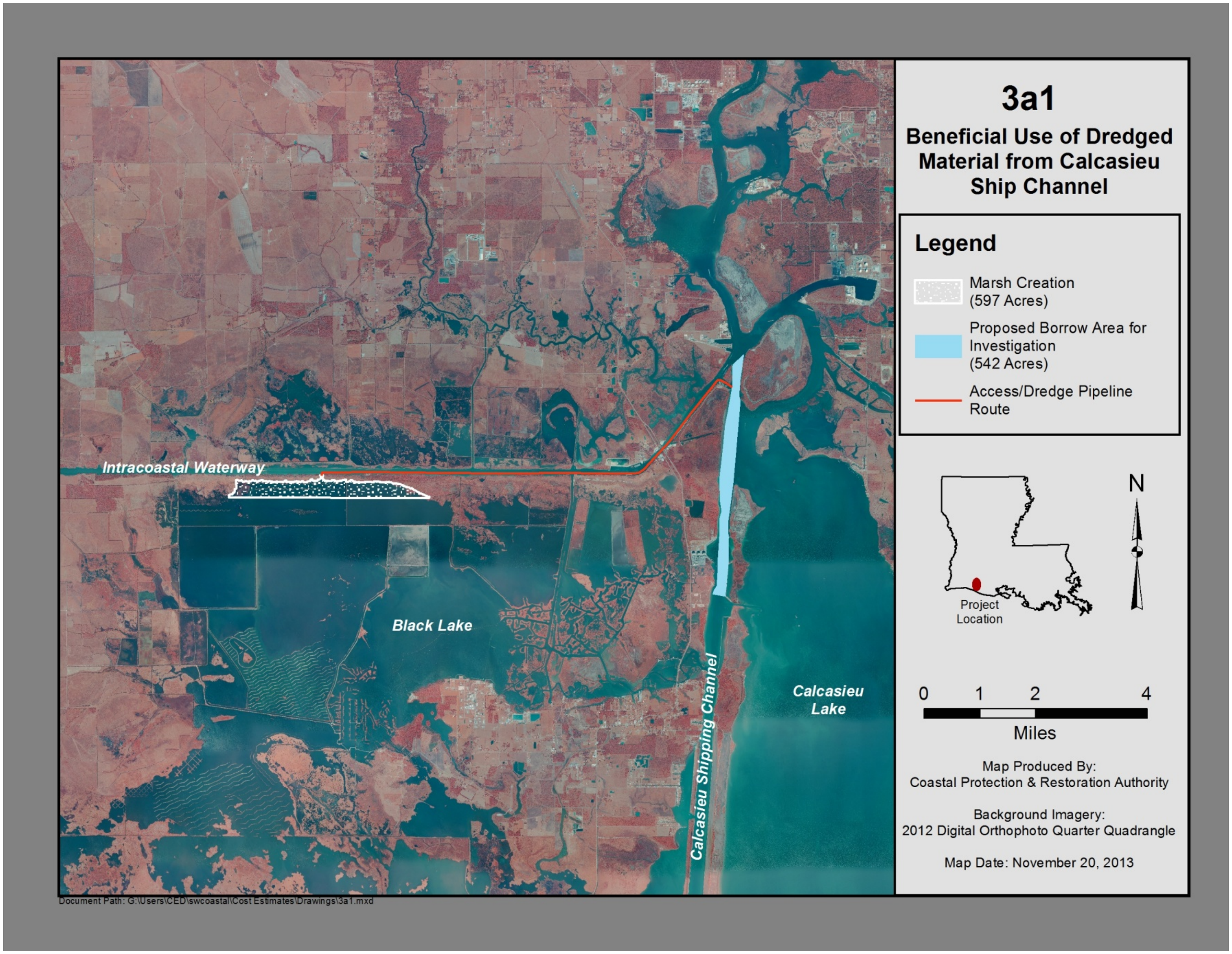
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

ANNEX V

Borrow Maps


3a1
Beneficial Use of Dredged Material from Calcasieu Ship Channel
Legend
Marsh Creation (597 Acres)
Proposed Borrow Area for Investigation (542 Acres)
Access/Dredge Pipeline Route
Intracoastal Waterway
Black Lake
Calcasieu Shipping Channel
Calcasieu Lake
Project Location
N
0 1 2 4
Miles
Map Produced By:
Coastal Protection & Restoration Authority
Background Imagery:
2012 Digital Orthophoto Quarter Quadrangle
Map Date: November 20, 2013
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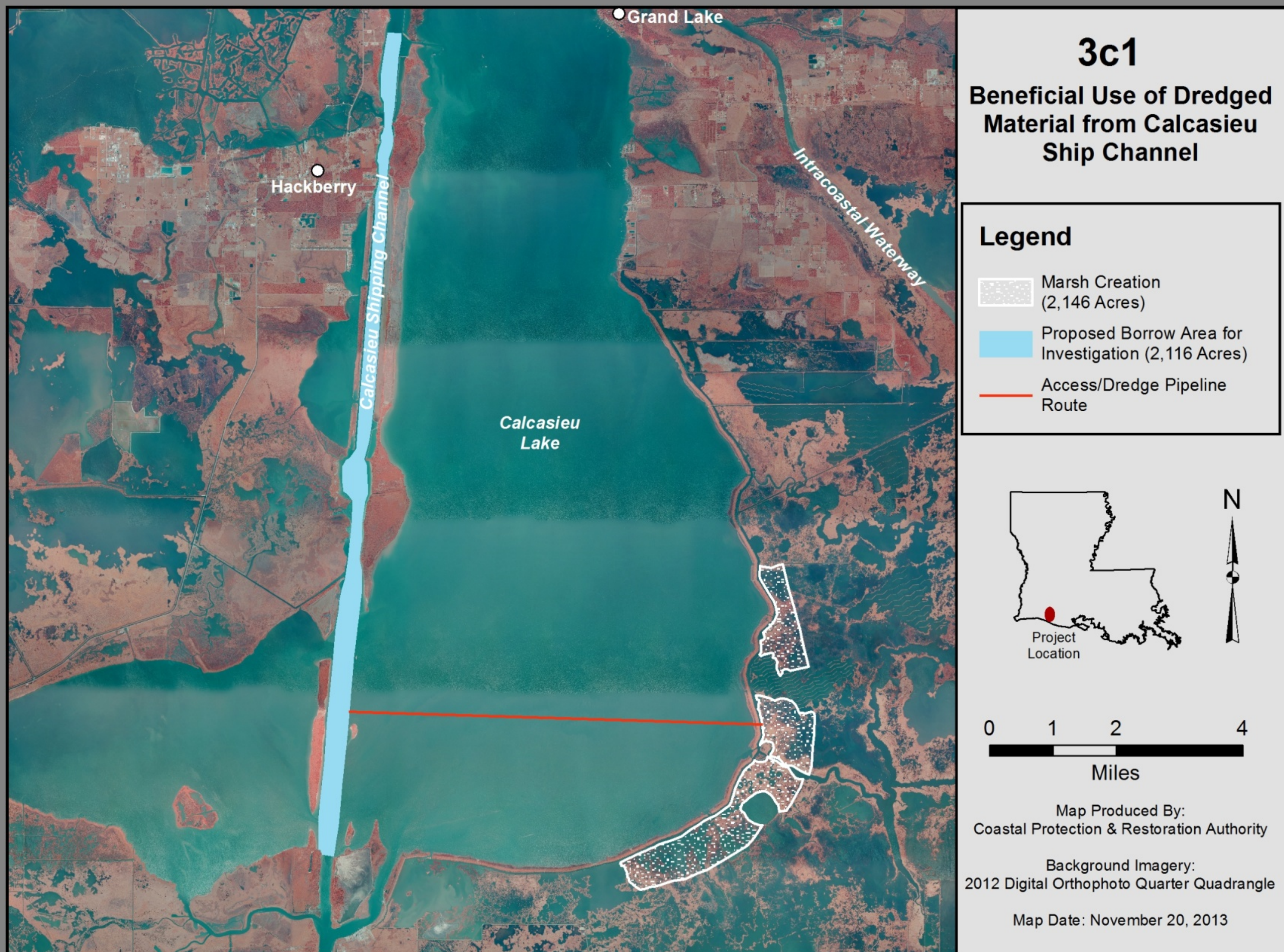

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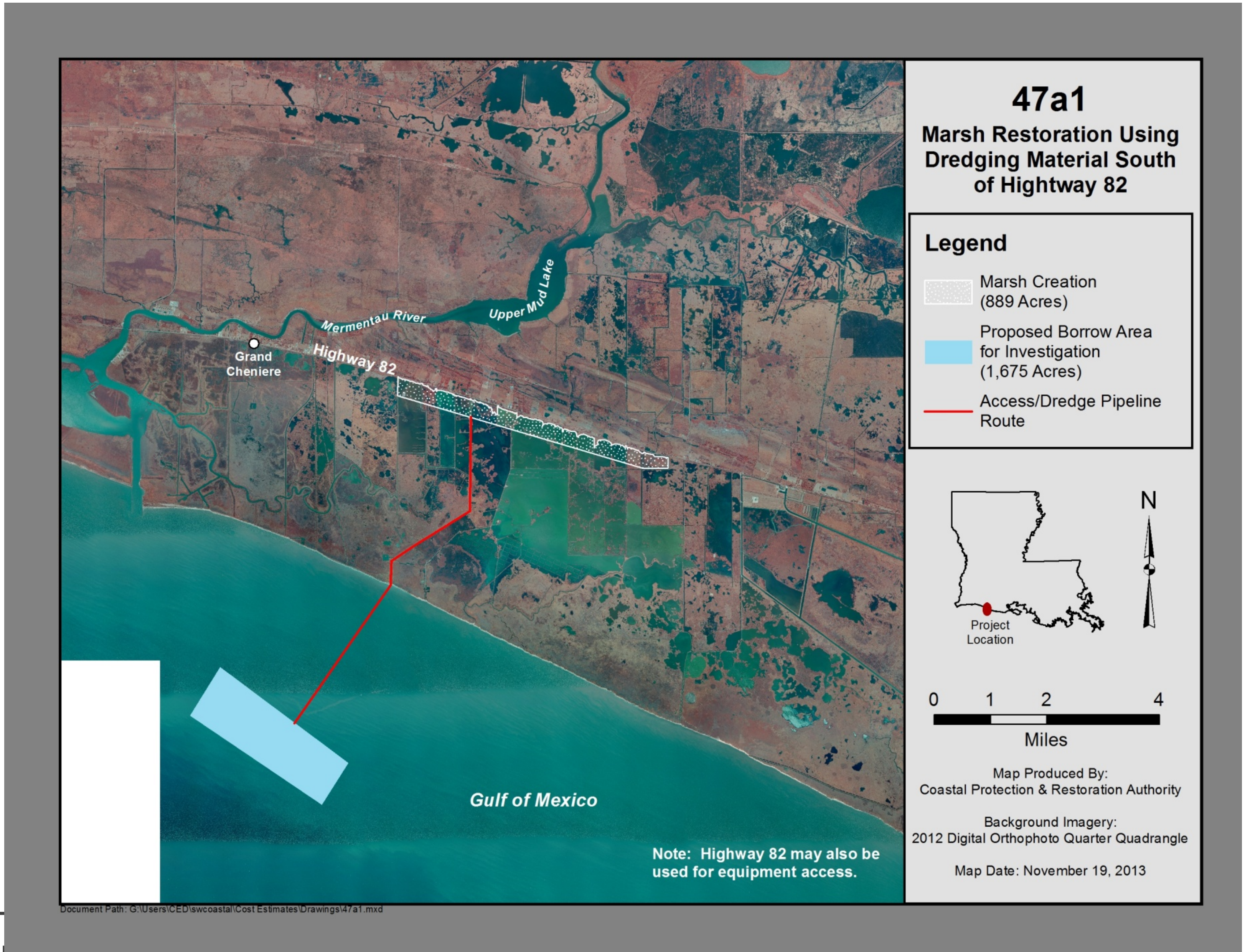
47a1
Marsh Restoration Using Dredging Material South of Hightway 82
Legend
Marsh Creation (889 Acres)
Proposed Borrow Area for Investigation (1,675 Acres)
Access/Dredge Pipeline Route
Mermentau River
Upper Mud Lake
Grand Cheniere
Highway 82
Gulf of Mexico
Note: Highway 82 may also be used for equipment access.
Project Location
N
0 1 2 4
Miles
Map Produced By:
Coastal Protection & Restoration Authority
Background Imagery:
2012 Digital Orthophoto Quarter Quadrangle
Map Date: November 19, 2013
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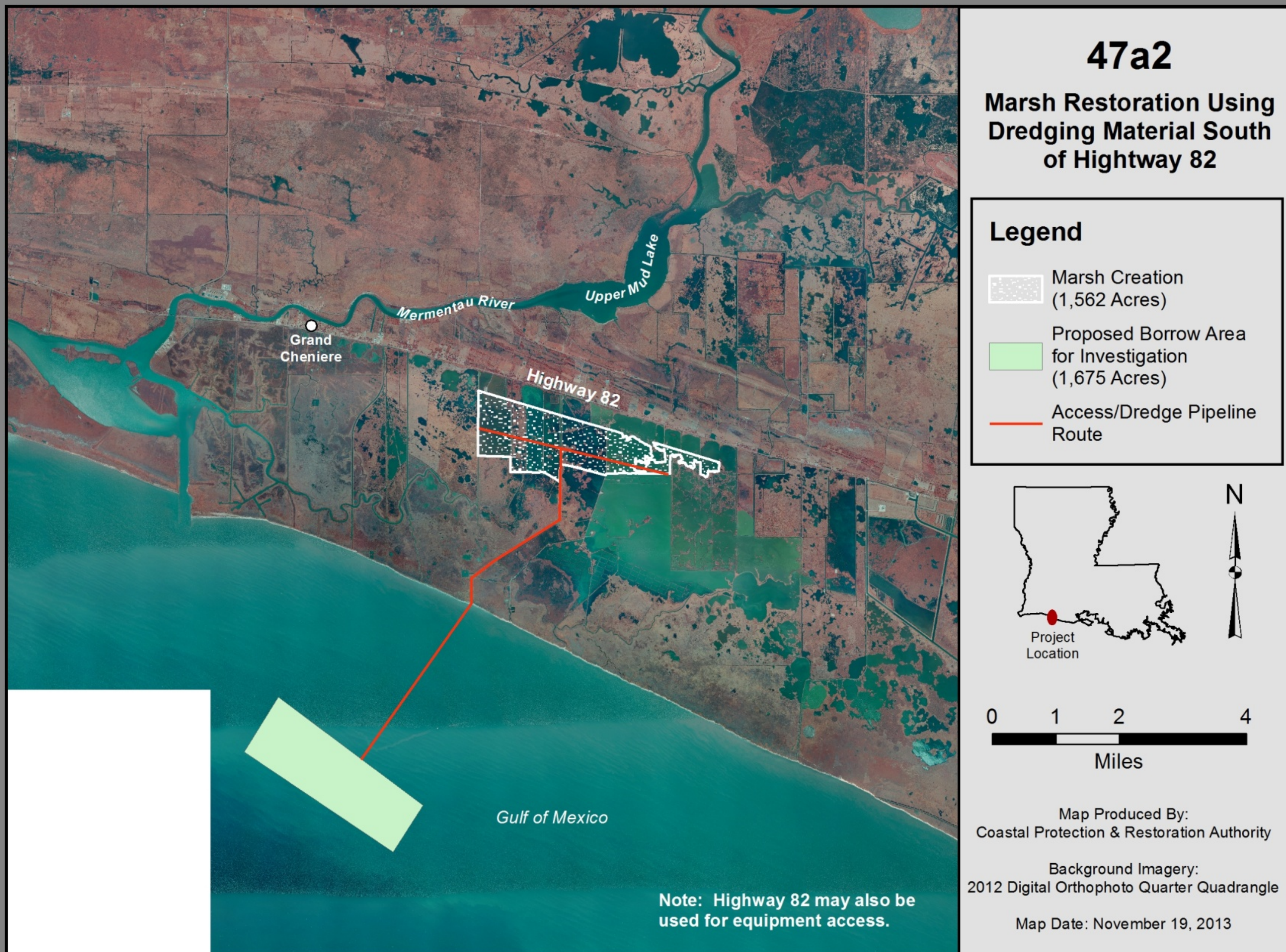

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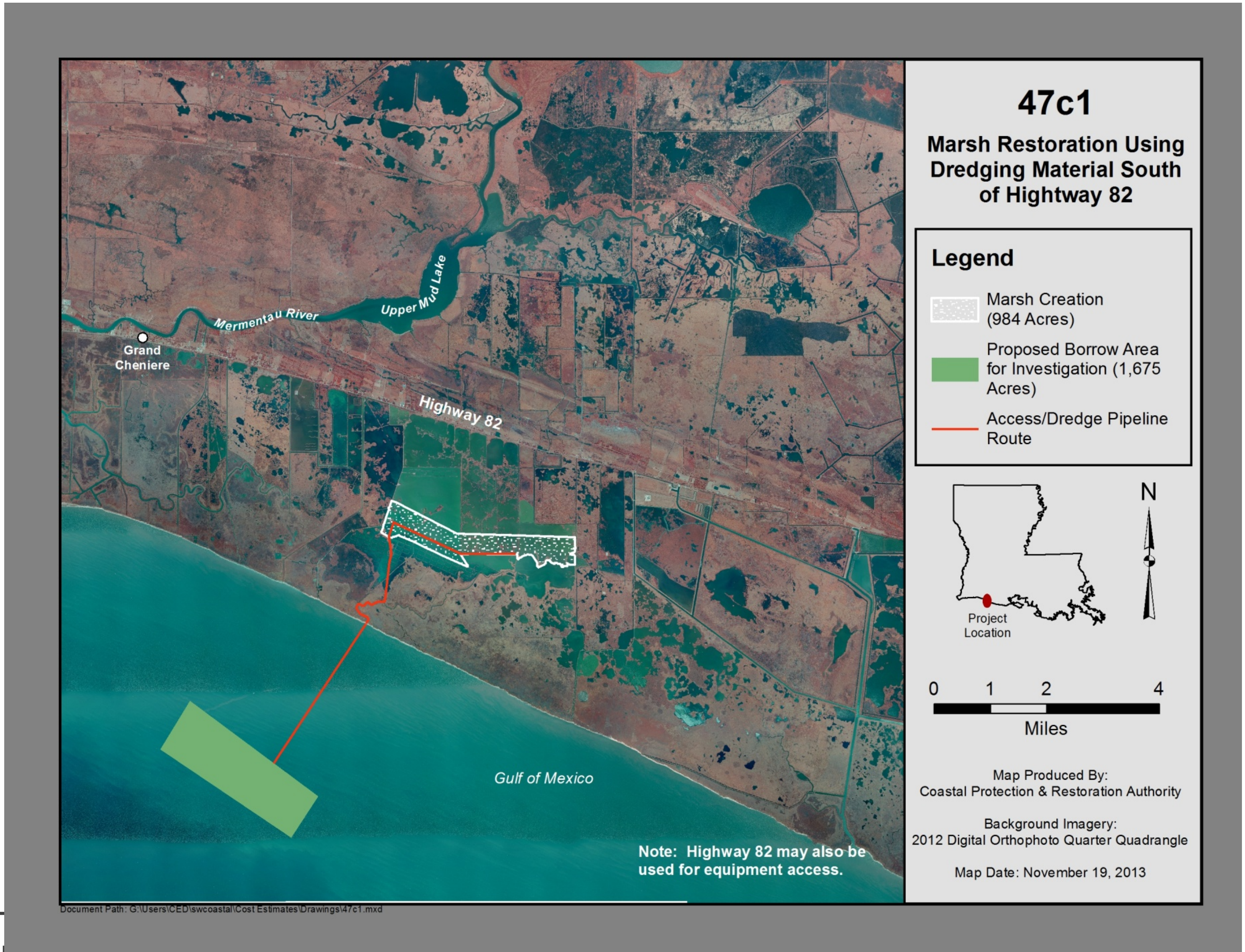
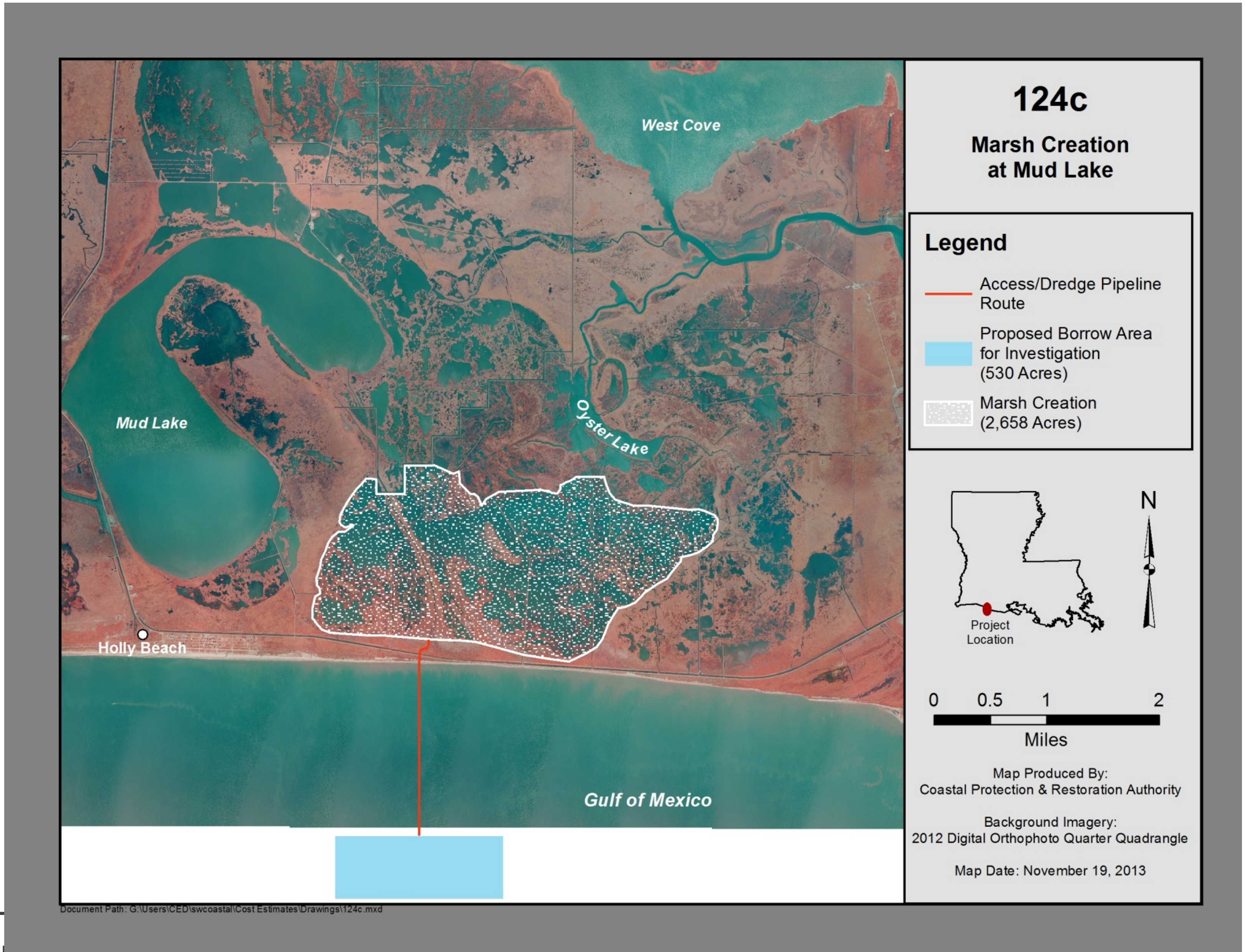

47c1
Marsh Restoration Using Dredging Material South of Hightway 82
Legend
Marsh Creation (984 Acres)
Proposed Borrow Area for Investigation (1,675 Acres)
Access/Dredge Pipeline Route
Project Location
N
0 1 2 4
Miles
Map Produced By:
Coastal Protection & Restoration Authority
Background Imagery:
2012 Digital Orthophoto Quarter Quadrangle
Map Date: November 19, 2013
Upper Mud Lake
Mermentau River
Grand Cheniere
Highway 82
Gulf of Mexico
Note: Highway 82 may also be used for equipment access.
Document Path: G:\Users\CED\swcoastal\Cost Estimates\Drawings\47c1.mxd


124c
Marsh Creation
at Mud Lake
Legend
Access/Dredge Pipeline Route
Proposed Borrow Area for Investigation (530 Acres)
Marsh Creation (2,658 Acres)
West Cove
Mud Lake
Oyster Lake
Holly Beach
Gulf of Mexico
Project Location
N
0 0.5 1 2
Miles
Map Produced By:
Coastal Protection & Restoration Authority
Background Imagery:
2012 Digital Orthophoto Quarter Quadrangle
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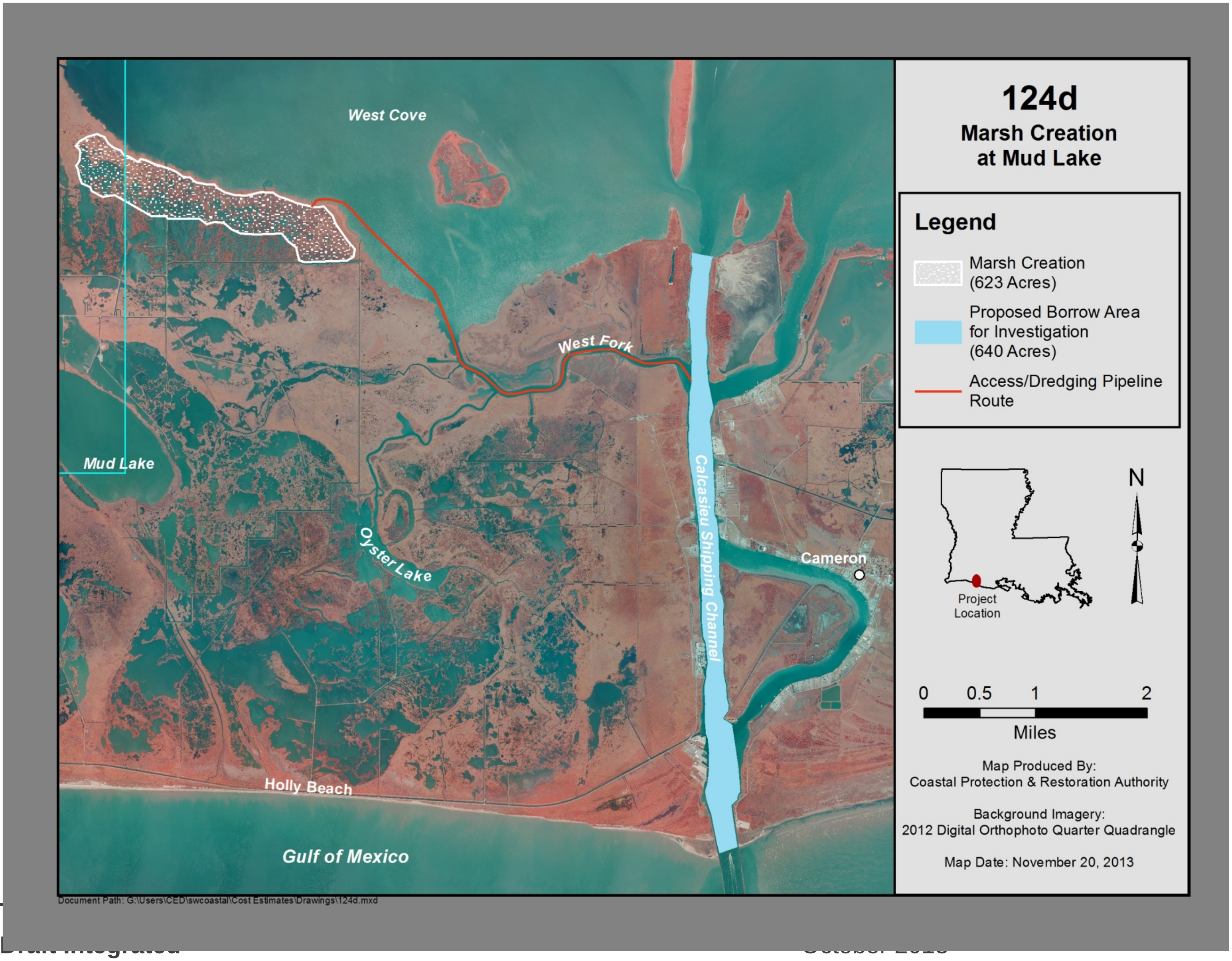
West Cove
West Fork
Mud Lake
Oyster Lake
Calcasieu Shipping Channel
Cameron
Holly Beach
Gulf of Mexico
124d
Marsh Creation
at Mud Lake
Legend
Marsh Creation
(623 Acres)
Proposed Borrow Area
for Investigation
(640 Acres)
Access/Dredging Pipeline
Route
Project
Location
N
0
0.5
1
2
Miles
Map Produced By:
Coastal Protection & Restoration Authority
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2012 Digital Orthophoto Quarter Quadrangle
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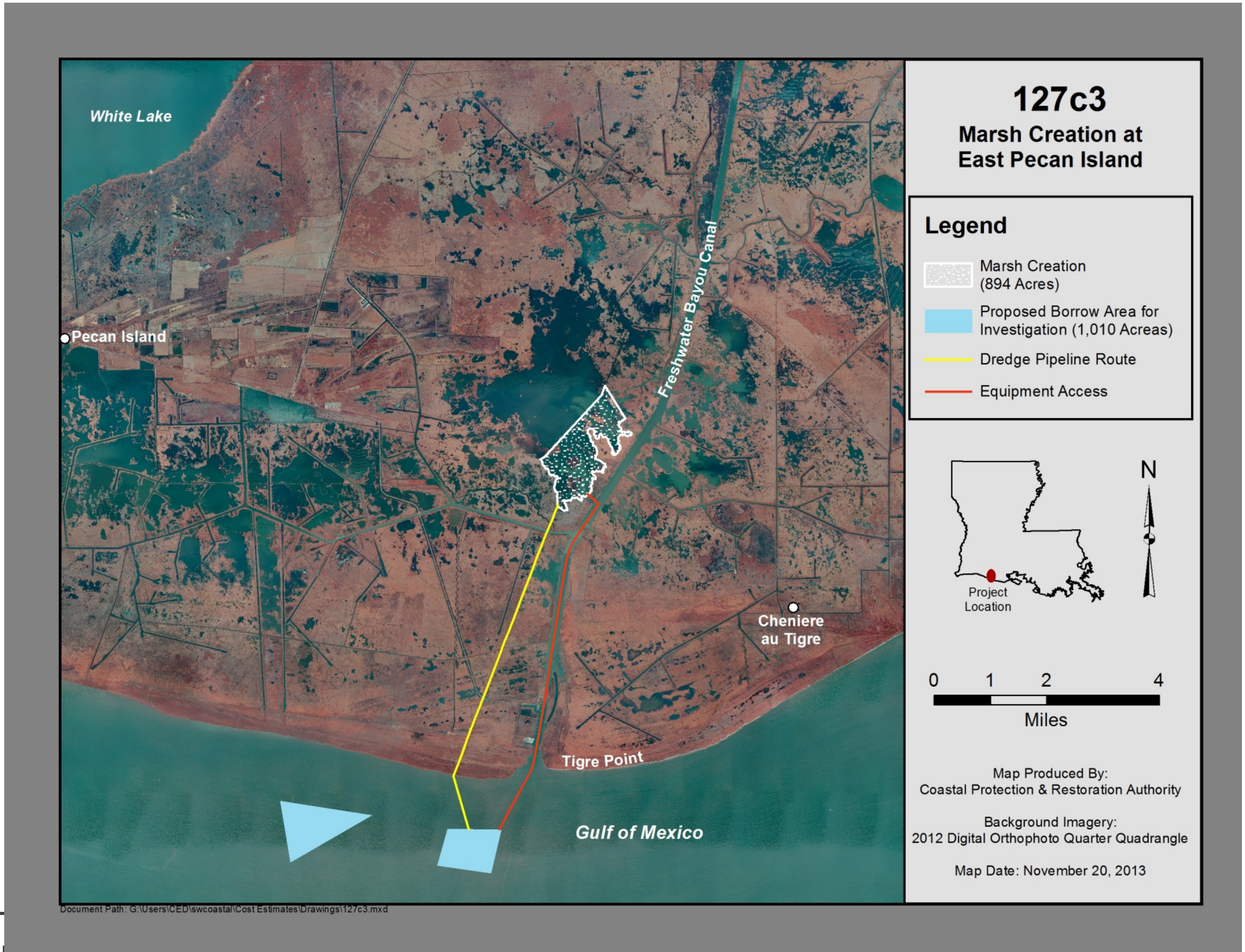
127c3
Marsh Creation at
East Pecan Island
Legend
Marsh Creation
(894 Acres)
Proposed Borrow Area for
Investigation (1,010 Acreas)
Dredge Pipeline Route
Equipment Access
N
Project
Location
0 1 2 4
Miles
Map Produced By:
Coastal Protection & Restoration Authority
Background Imagery:
2012 Digital Orthophoto Quarter Quadrangle
Map Date: November 20, 2013
White Lake
Pecan Island
Freshwater Bayou Canal
Cheniere
au Tigre
Tigre Point
Gulf of Mexico
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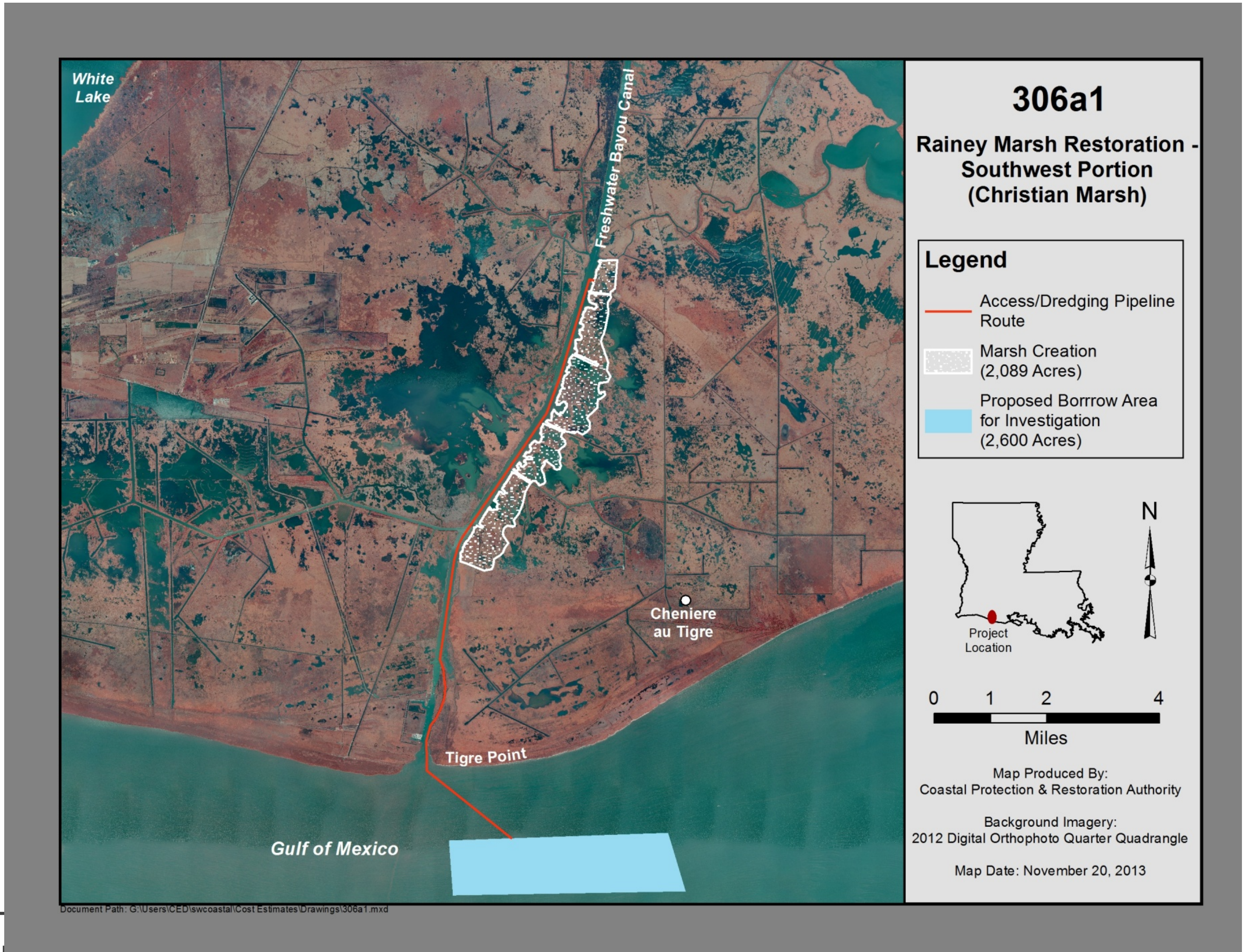
306a1
Rainey Marsh Restoration - Southwest Portion (Christian Marsh)
Legend
Access/Dredging Pipeline Route
Marsh Creation (2,089 Acres)
Proposed Borrow Area for Investigation (2,600 Acres)
Project Location
N
0 1 2 4
Miles
Map Produced By:
Coastal Protection & Restoration Authority
Background Imagery:
2012 Digital Orthophoto Quarter Quadrangle
Map Date: November 20, 2013
White Lake
Freshwater Bayou Canal
Cheniere au Tigre
Tigre Point
Gulf of Mexico
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SOUTHWEST COASTAL LOUISIANA
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ANNEX W

Hypertemporal Subunit Chage rate and Map

Gaining Subunits

<u>(001) Black Bayou</u>: 1984 to 2010 change rate = +35.1 ac/yr or +0.165%/yr

<u>(003) Brown's Lake</u>: 1984 to 2010 change rate = +6.12 ac/yr or +0.083%/yr

<u>(005) Calcasieu Ship Channel North</u>: 1984 to 2010 change rate = +6.78 ac/yr or +0.032%/yr
This gain rate is likely due to the disposal of dredge material. Assume that this practice continues but no new land is built due to the lack of room for expansion. Hold 2004 acreage constant?

<u>(006) Calcasieu Ship Channel South</u>: 1984 to 2010 change rate = +2.79 ac/yr or +0.056%/yr

<u>(009) Cameron Creole Front Ridge</u>: 1984 to 2010 change rate = +2.41 ac/yr or +0.024%/yr
This unit is mostly upland.

<u>(011) Deer-Rabbit Islands</u>: 1984 to 2010 change rate = +11.1 ac/yr or +0.242%/yr

<u>(012) E. Black Lake</u>: 1984 to 2010 change rate = +6.39 ac/yr or +0.038%/yr
This gain is likely due to a 2007 beneficial project. Using this gain rate would assume that marsh creation would continue in this unit as part of beneficial use projects. However, we cannot assume that future marsh creation will continue in this subunit. Possibly use the CWPPRA loss rate or the 1984 to 2004 rate?

<u>(015) E. Second Bayou</u>: 1984 to 2010 change rate = +17.6 ac/yr or +0.172%/yr

<u>(018) Grand Lake Ridge</u>: 1984 to 2010 change rate = +3.0 ac/yr or +0.044%/yr
This unit is mostly upland.

<u>(019) Gray Canal</u>: 1984 to 2010 change rate = +44.4 ac/yr or +0.255%/yr

<u>(022) Jimmy Savoie Rd</u>: 1984 to 2010 change rate = +2.24 ac/yr or +0.062%/yr
This unit is mostly upland.

<u>(026) Martin Beach Ship Canal Shore</u>: 1984 to 2010 change rate = +22.4 ac/yr or +0.15%/yr
Area gaining due to Holly Beach Breakwaters and accretion on east side of Sabine jetty?

<u>(029) N. Browns Lake</u>: 1984 to 2010 change rate = +88.6 ac/yr or +0.376%/yr
Gain may be partially due to marsh creation from the first cycles (2002, 2007, and 2010) of the CS-28 project. However, looking at the scatter plot (attached), area may have been gaining otherwise. Management?

<u>(031) Northern Prairie Terraces</u>: 1984 to 2010 change rate = +2.43 ac/yr or +0.055%/yr
This unit is mostly upland.

<u>(032) Phoenix Lake</u>: 1984 to 2010 change rate = +45.0 ac/yr or +0.476%/yr

<u>(033) S. Black Bayou Oilfield</u>: 1984 to 2010 change rate = +1.24 ac/yr or +0.019%/yr

<u>(039) Sabine River North</u>: 1984 to 2010 change rate = +0.85 ac/yr or +0.012%/yr

<u>(042) Southern Prairie Terraces</u>: 1985 to 2009 change rate = +1.80 ac/yr or +0.092%/yr
This unit is mostly upland.

<u>(044) Starks Bayou</u>: 1984 to 2010 change rate = +3.65 ac/yr or +0.082%/yr

<u>(045) Sweet Lake Canals</u>: 1984 to 2010 change rate = +5.15 ac/yr or +0.021%/yr

<u>(049) W. Johnson's Bayou</u>: 1984 to 2010 change rate = +0.34 ac/yr or +0.007%/yr

<u>(050) W. Second Bayou</u>: 1984 to 2010 change rate = +33.0 ac/yr or +0.373%/yr

<u>(051) West Cove Canal</u>: 1984 to 2010 change rate = +51.1 ac/yr or +0.844%/yr
This gain may be due to Section 204/1135 beneficial use projects in 1992, 1996, and 1999. It is unclear whether the subunit was gaining or losing prior to these projects. We cannot assume that there will be future marsh creation in the area. So, hold acreage constant or apply CWPPRA loss rate (-0.29%/yr or -9.2 ac/yr)?

<u>(054) Chenier Perdue Ridge</u>: 1984 to 2010 change rate = +18.5 ac/yr or +0.151%/yr
This subunit includes some upland.

<u>(063) Grand/White Lake Landbridge</u>: 1984 to 2010 change rate = +26.4 ac/yr or +0.116%/yr

<u>(067) Lake Benoit</u>: 1984 to 2010 change rate = +16.8 ac/yr or +0.032%/yr

<u>(075) Pumpkin Ridge</u>: 1984 to 2010 change rate = +2.58 ac/yr or +0.012%/yr

<u>(079) S. Lake Misere/Lacassine</u> 1984 to 2010 change rate = +10.9 ac/yr or +0.034%/yr

<u>(080) S. Pecan Island Shoreline</u>: 1984 to 2010 change rate = +33.4 ac/yr or +0.434%/yr
This gain rate is likely due to the disposal of dredge material. Assume that if this practice continues no new land is built due to the lack of room for expansion into the Gulf, therefore assume no change rate (0 ac/yr) and the 2004 acreage is held constant throughout the study period.

<u>(083) W. Big Burn</u>: 1984 to 2010 change rate = +89.7 ac/yr or +0.52%/yr

<u>(090) E. Cote Blanche Wetlands</u>: 1984 to 2010 change rate = +13.5 ac/yr or +0.024%/yr

<u>(095) Rainey Marsh</u>: 1984 to 2010 change rate = +3.06 ac/yr or +0.010%/yr

<u>(102) W. Cote Blanche Wetlands</u>: 1984 to 2010 change rate = +8.90 ac/yr or +0.033%/yr

Subunits that may be managed and/or impounded? - hold 2004 acreages constant ala Barras et al LCA Study?

(034) S. Browns Lake: 1984 to 2010 change rate = +58.9 ac/yr or +0.841%/yr
Sabine Refuge's Unit 1A/1B.

(037) Sabine Pool #3: 1984 to 2010 change rate = +48.1 ac/yr or +0.183%/yr

(056) Cut Around Bayou: 1984 to 2010 change rate = -83.9 ac/yr or -0.402%/yr
Water levels appear to be actively managed in much of this subunit. ????

(057) E. Lacassine NWR: 1984 to 2010 change rate = -11.3 ac/yr or -0.067%/yr

(060) Eastern White Lake Wetlands: 1984 to 2010 change rate = -153 ac/yr or -0.497%/yr
White Lake Conservation Area.

(072) NE White Lake: 1984 to 2010 change rate = -92.0 ac/yr or -0.850%/yr
Unit actively managed????

(073) Northwestern White Lake Wetlands: 1984 to 2010 change rate = +24.3 ac/yr or +0.139%/yr

(076) Rockefeller: 1984 to 2010 change rate = -43.4 ac/yr or -0.056%/yr
The majority of this subunit is managed, and while loss is occurring in the unmanaged portions of the subunit most of the recent "loss" appears to be located in the managed areas.

(081) S. White Lake: 1984 to 2010 change rate = -148 ac/yr or -0.67%/yr
Unit actively managed????

(082) Southwestern White Lake Wetlands: 1984 to 2010 change rate = +31.8 ac/yr or +0.61%/yr

(085) W. Lacassine NWR: 1984 to 2010 change rate = -89.3 ac/yr or -0.531%/yr

(096) S. Marsh Island: 1984 to 2010 change rate = +4.86 ac/yr or +0.064%/yr

Losing Subunits

(002) Boudreaux Lake: 1984 to 2010 change rate = -10.9 ac/yr or -0.060%/yr

(004) Calcasieu Lake – West Cove: 1984 to 2010 change rate = -3.75 ac/yr or -0.041%/yr

(008) Cameron Creole Back Ridge: 1984 to 2010 change rate = -22.5 ac/yr or -0.24%/yr
This unit includes upland, but there are enough wetland acres in this unit to lose over study period.

(010) Clear Marais: 1984 to 2010 change rate = -12.1 ac/yr or -0.125%/yr

(014) E. Johnson's Bayou: 1984 to 2010 change rate = -25.0 ac/yr or -0.217%/yr

(016) East Pass: 1984 to 2010 change rate = -2.21 ac/yr or -0.031%/yr

(017) Ellis Moss Rd: 1984 to 2010 change rate = -0.30 ac/yr or -0.04%/yr

(020) Gum Cove: 1984 to 2010 change rate = -9.39 ac/yr or -0.144%/yr
This unit is mostly upland. Uncertain whether there are enough wetland acres in unit to lose over study period. The "loss" could be the result of flooded fields. In this case, perhaps hold 2004 acreages constant???

(021) Hackberry Ridge: 1984 to 2010 change rate = -1.66 ac/yr or -0.018%/yr
This unit is mostly upland, but there seems to be enough wetland acres in this unit to los over the study period.

(023) Lambert Lake: 1984 to 2010 change rate = -156 ac/yr or -0.89%/yr

(024) Madame Johnson Bayou: 1984 to 2010 change rate = -4.34 ac/yr or -0.026%/yr

(025) Magnolia: 1984 to 2010 change rate = -212 ac/yr or -1.01%/yr

(027) Mud Bayou: 1984 to 2010 change rate = -4.38 ac/yr or -0.054%/yr

(028) Mud Lake: 1984 to 2010 change rate = -34.6 ac/yr or -0.213%/yr

(030) Northeast Sabine: 1984 to 2010 change rate = -50.7 ac/yr or -0.455%/yr

(036) Sabine Pass: 1984 to 2010 change rate = -11.3 ac/yr or -0.069%/yr

(038) Sabine Ridges: 1984 to 2010 change rate = -0.87 ac/yr or -0.009%/yr
This unit is mostly upland, but there are enough wetland acres in this unit to lose over the study period.

(040) South Fork Black Bayou: 1984 to 2010 change rate = -0.06 ac/yr or -0.001%/yr

(041) Southeast Sabine: 1984 to 2010 change rate = -18.6 ac/yr or -0.244%/yr

(043) Southwest Sabine: 1984 to 2010 change rate = -75.7 ac/yr or -0.545%/yr

(046) Sweet/Willow Lakes: 1984 to 2010 change rate = -38.0 ac/yr or -0.256%/yr

(047) W. Black Lake: 1984 to 2010 change rate = -35.6 ac/yr or -0.360%/yr

(048) W. Calcasieu Lake Dredge: 1984 to 2010 change rate = -23.4 ac/yr or -0.174%/yr

(052) Willow Bayou: 1984 to 2010 change rate = -8.80 ac/yr or -0.086%/yr

(053) Willow Bayou Canal/Greens Lake: 1984 to 2010 change rate = -6.41 ac/yr or -0.021%/yr

(055) Creole Hwy: 1984 to 2010 change rate = -0.62 ac/yr or -0.024%/yr
This unit is mostly upland, but there are enough wetland acres in this unit to lose over the study period.

(058) E. Big Burn: 1984 to 2010 change rate = -5.67 ac/yr or -0.045%/yr

(059) East Biscuit Island: 1984 to 2010 change rate = -18.0 ac/yr or -0.136%/yr

(061) Grand Chenier Ridge: 1984 to 2010 change rate = -2.61 ac/yr or -0.031%/yr
This unit is mostly upland, but there are enough wetland acres in this unit to lose over the study period.

(062) Grand Lake: 1984 to 2010 change rate = -27.0 ac/yr or -0.051%/yr

(064) Grophes Island: 1984 to 2010 change rate = -35.0 ac/yr or -0.230%/yr

(065) Hog Bayou/Oak Grove Shoreline: 1984 to 2010 change rate = -81.5 ac/yr or -0.587%/yr

(066) Hog Bayou/Oak Grove/Lower Mud Lake: 1984 to 2010 change rate = -45.9 ac/yr or -0.123%/yr

(068) Lake Misere: 1984 to 2010 change rate = -4.78 ac/yr or -0.112%/yr

(069) Little Prairie: 1984 to 2010 change rate = -8.09 ac/yr or -0.057%/yr

(070) Lulu Canal: 1984 to 2010 change rate = -36.9 ac/yr or -0.450%/yr

(074) Pecan Island Ridges: 1984 to 2010 change rate = -42.8 ac/yr or -0.463%/yr
This unit includes upland, but there are enough wetland acres in this unit to lose over the study period.

(077) Rockefeller E./S. Pecan Island: 1984 to 2010 change rate = -165 ac/yr or -0.346%/yr

(078) Rockefeller Shoreline: 1984 to 2010 change rate = -69.5 ac/yr or -1.12%/yr

(084) W. Freshwater Bayou/N. Pecan Island: 1984 to 2010 change rate = -111 ac/yr or -0.308%/yr

(086) White Lake: 1984 to 2010 change rate = -21.1 ac/yr or -0.035%/yr

(087) Willow Island: 1984 to 2010 change rate = -20.3 ac/yr or -0.166%/yr

(088) Big Woods: 1984 to 2010 change rate = -7.32 ac/yr or -0.057%/yr

(089) E. Cote Blanche Bay: 1984 to 2010 change rate = -27.4 ac/yr or -0.041%/yr

(091) E. Freshwater Bayou/Cheniere Au Tigre Bayou: 1984 to 2010 change rate = -85.9 ac/yr or -0.254%/yr

(092) E. Marsh Island: 1984 to 2010 change rate = -30.8 ac/yr or -0.075%/yr

(093) Intracoastal City/NW Vermilion Bay: 1984 to 2010 change rate = -3.08 ac/yr or -0.009%/yr

(094) Live Oak Rd: 1984 to 2010 change rate = -2.82 ac/yr or -0.098%/yr

(097) Southwest Pass Nearshore: 1984 to 2010 change rate = -35.7 ac/yr or -0.209%/yr

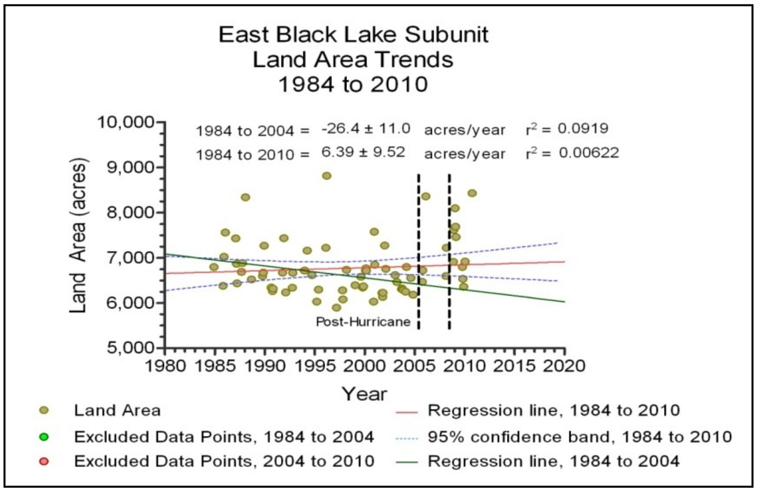
(099) Vermilion Bay: 1984 to 2010 change rate = -35.1 ac/yr or -0.027%/yr

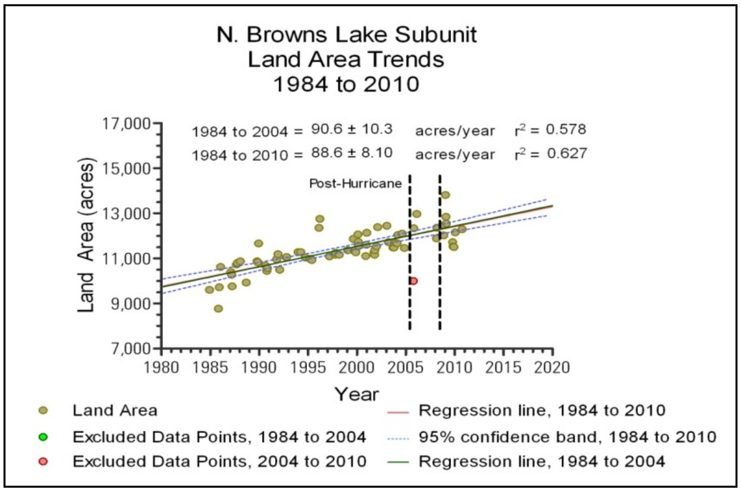
(100) Vermilion Bay Marsh: 1984 to 2010 change rate = -27.7 ac/yr or -0.073%/yr

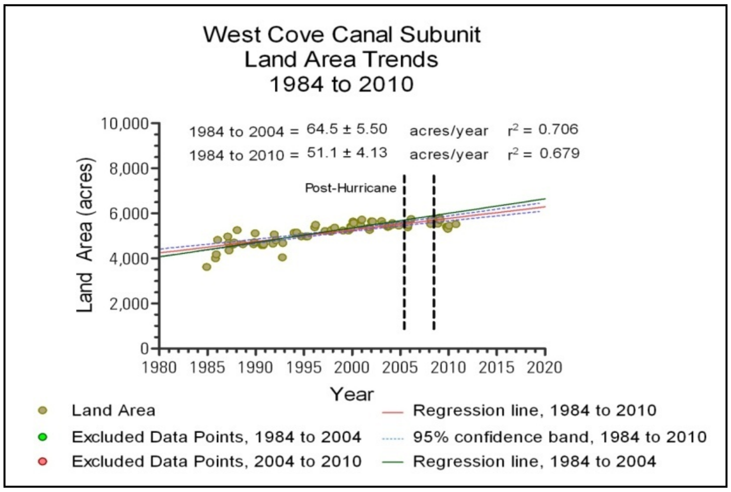
(101) W. Cote Blanche Bay: 1984 to 2010 change rate = -46.4 ac/yr or -0.046%/yr

(103) W. Marsh Island: 1984 to 2010 change rate = -11.4 ac/yr or -0.061%/yr

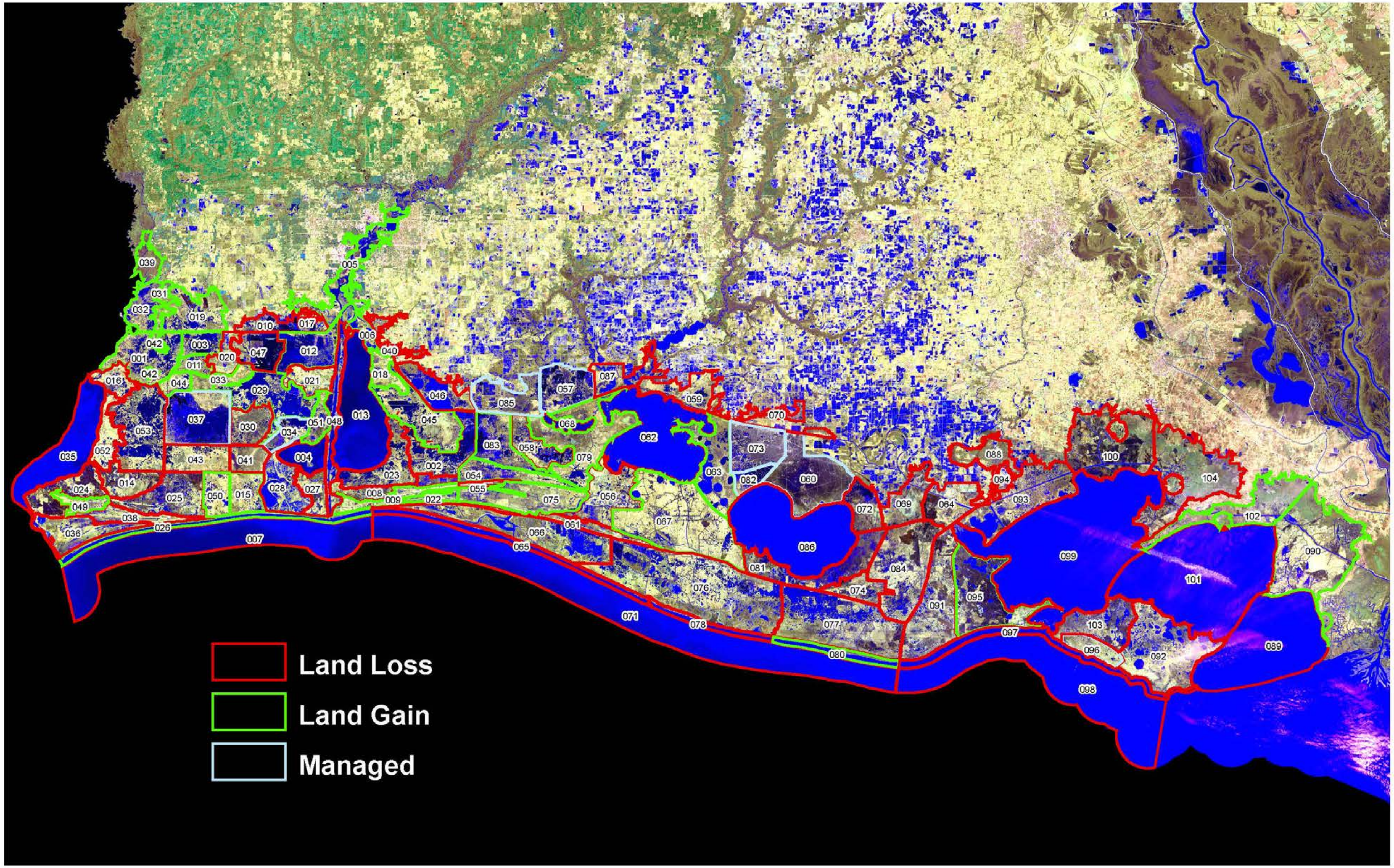
(104) Weeks Bay: 1984 to 2010 change rate = -3.19 ac/yr or -0.007%/yr







Subunits with recent marsh creation


Land Loss
Land Gain
Managed

PLAN FORMULATION APPENDIX

1.0 INTRODUCTION

This appendix provides supplemental plan formulation information for the Southwest Coastal Louisiana feasibility study. It supplements the information in Chapter 2 of the main report and includes tables used in the initial and intermediate development, screening, and evaluation of management measures, features, and alternative plans. The formulation process from the development of the NED and NER focused arrays through the identification of the NED and NER Tentatively Selected Plans is fully documented in Chapter 2 of the Main Report.

Universe of NED & NER Features: The initial set of concepts for consideration under the Southwest Coastal feasibility study was inventoried from multiple sources as shown in figure 1. Since concepts were pulled from multiple sources, some concepts did not meet the definition of a management measure, and in some cases the same concept or measure was repeated more than once (for example if it appeared in both the State Master Plan and the LACPR report) so duplicates had to be removed. Only measures that met the following criteria were carried forward into the initial array of features:

- Meets the definition of a feature ("a project or an activity that can be implemented at a specific geographic site to address one or more planning objectives");
- Not part of the future without project condition;
- Addresses one or more of the Southwest Coastal planning objectives;
- Doesn't violate any of the Southwest Coastal planning constraints.

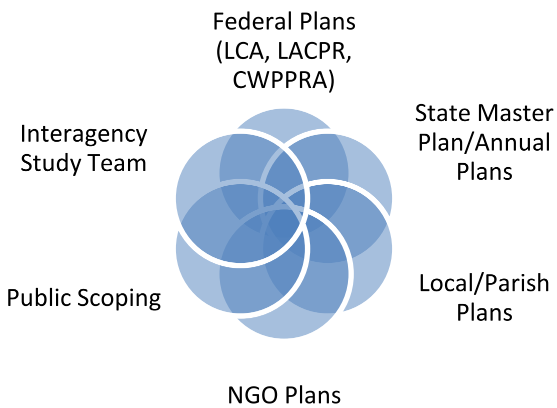


Figure 1. Sources of ideas to solve problems in the Southwest Coastal area.

After sorting through approximately 300 concepts or measures, approximately 100 were found to be unique and viable measures.

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
1	N/A	Freshwater Introduction from Sabine River to Sabine National Wildlife Refuge	Draft SMP 4-19	N/A	No	Does not address any planning objectives. CRMS data indicate the area is relatively healthy and not in need of salinity/hydrologic control.
2	N/A	Salinity control structures along the east shoreline of Sabine Lake near Blue Buck Point, Sabine Island and Black Bayou	Preliminary Draft SMP	N/A	No	Does not address any planning objectives. Modeling performed for CWPPRA project CS-32: East Sabine Lake Hydrologic Restoration indicated limited benefit from proposed structures.
3	3a1, 3c	Beneficial Use of Dredged Material from Calcasieu Ship Channel	SMP 4-13	7	Yes	The planning team reduced acreage of this measure to exclude historic water bodies, existing terraces, DMMP sites, etc. East of Calcasieu Lake the measure was repositioned to reinforce the lake rim in areas of recent land loss.
4	21a, 21b, 21c	Salinity control structures at Hwy 82	Preliminary Draft SMP	2	Yes	Duplicate of Measure #21.
5	5a	Gulf Shoreline Protection (Holly Beach reach)	SMP 4-10/ LACPR/ Cameron Parish	5	Yes	Per BICM data, Holly Beach has experienced high shoreline recession rates (~22.5 ft/yr). Pending beach nourishment project in the area will provide a short-term buffer between Highway 82 and the Gulf of Mexico.
	N/A	Gulf Shoreline Protection (Johnson's Bayou and Ocean View Beach reaches)	SMP 4-13/ LACPR	N/A	No	Does not address any planning objectives. BICM data indicate that shoreline recession rates are low. Johnson's Bayou reach has consistently been accreting since the 1880s. Ocean View Beach has been accreting since the 1990s with only minor erosion (~1.5 ft/yr) between the 1880s and 1990s.
6	N/A	Gulf Shoreline Protection (Hackberry Beach and Mermentau Beach reaches)	SMP 4-11/ LACPR	N/A	No	Does not address any planning objectives. BICM data indicate that shoreline recession rates are relatively low. Hackberry Beach has recently experienced periods of accretion (41.4 ft/yr from 2004-2005) or minor erosion (4.4 ft/yr from 1990s – 2005).

Table C-1, Initial NED and NER Features Compiled and Screened						
Initial ID	**Feature No.**	**Name/Description/Location**	**Source**	**Objective No.**	**Incorporated into the initial array of features?**	
	6b	Gulf Shoreline Protection (Rockefeller Refuge reach)	SMP 4-11/ LACPR/ Cameron Parish	5	Yes	Shoreline recession is consistently highest along Rockefeller Refuge. Per BICM data, Rockefeller Refuge has recently experienced the highest recession rates in the study area (a loss of 52.4 ft/yr from 1990s to 2005).
7	7	Salinity control structures in Calcasieu Ship Channel near Ferry/at the Gulf of Mexico	Preliminary Draft SMP	2	Yes	
8	3a1, 3c	Beneficial uses of dredged material program: utilize sediment and dedicated dredging for marsh enhancement and construction of terraces near Calcasieu Lake	Preliminary Draft SMP	7	Yes	Duplicate of Measure #3.
9	N/A	Salinity control structures at points on east side of Calcasieu Lake	Preliminary Draft SMP	N/A	No	Salinity control structures already exist on the eastern shore of Calcasieu Lake.
10	N/A	Maximize freshwater inflow to tributaries of the Mermentau from outside sources	Preliminary Draft SMP	N/A	No	Does not address any planning objectives.
11	N/A	Maximize freshwater inflow to Mermentau from outside sources	Preliminary Draft SMP	N/A	No	Does not address any planning objectives.
12	12a-d	Stabilize Grand Lake Shoreline	SMP 4-6	N/A	No	Measure was investigated. Areas of existing shoreline protection (i.e. the majority of the south and southeastern shorelines) were screened out. USGS analyses of other shoreline reaches showed relatively low recession rates (<2 feet per year). Therefore, this measure was excluded from further analysis because it doesn't address an area of critical need.
13	13	Freshwater introduction/retention structure or sill on Little Pecan Bayou	Preliminary Draft SMP	2	Yes	

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
14	N/A	Freshwater introduction/retention structure or sill on Rollover Bayou	Preliminary Draft SMP	N/A	No	Part of the future without project condition. Addressed by State project ME-01 Pecan Island Freshwater Introduction.
15	N/A	Stabilize White Lake Shoreline	SMP 4-7	N/A	No	Does not address any planning objectives. The entire south shore is protected by rock dikes whereas the north shore has not experienced significant recent shoreline recession.
16	16a	Fortify and restore banks of Schooner Bayou Canal from Highway 82 to North Prong	SMP 4-15 and Vermilion Parish	N/A	No	Measure was investigated. USGS analyses of this part of Schooner Bayou showed relatively low bankline recession rates (about 1 foot per year). Therefore, this measure was excluded from further analysis because it doesn't address an area of critical need.
	16b	Fortify and restore banks of Freshwater Bayou Canal	SMP 4-15 and Vermilion Parish	5	Yes	Banklines with existing or impending rock dikes were screened out.
17	17a	Salinity control structure on Alkali Ditch	LCA PBMO/ LACPR 5-4	2	Yes	
	17b	Salinity control structure on Crab Gully		2	Yes	
	17c	Salinity control structure on Black Lake Bayou near Hackberry	LCA PBMO/ LACPR 5-3	2	Yes	
18	N/A	Build new chamber for navigation at Calcasieu Lock on GIWW and use old lock to evacuate excess water	Preliminary Draft SMP	N/A	No	Building a new lock for navigation does not meet any planning objectives. The USACE has an existing ongoing Calcasieu Lock Replacement study. Operations of existing structures will be evaluated under Measure #602.
19	16b	Stabilize banks of Freshwater Bayou	SMP 4-8	5	Yes	Duplicate of Measure #16b.

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
20	49b1	Stabilize eastern shore of Lake Calcasieu	SMP 4-16	5	Yes	Duplicate of Measure #49.
21	21a, 21b, 21c	Hydraulic Improvements in Mermentau Basin at Highways 82 and 27 (via Hydraulic Improvement Structures)	SMP 4-20	2 & 4	Yes	Note that there are structures proposed (CWPPRA project ME-20) or constructed (CIAP project at Highway 27) that overlap with this measure. Chenier Plain Hydrodynamic model will determine best locations for additional culverts to discharge excess water and control saltwater intrusion.
22	N/A	Manage watershed to reduce rapid inflows into Mermentau Sub-basin	Preliminary Draft SMP	N/A	No	This is a planning objective not a management measure.
23	N/A	Restore marsh by filling abandoned canals	Preliminary Draft SMP	N/A	No	Although restoring marsh is a planning objective, backfilling all abandoned canals without regard to their location does not meet the objective of strategically restoring marsh and is not feasible given limited sediment resources. Also, many canals that appear to be abandoned may still serve active wells or production units.
24	N/A	Utilize freshwater inflow from Atchafalaya River: Convey Atchafalaya River Water Westward via GIWW (via Rock Dike)	LACPR PU3b 1-2	N/A	No	Does not address any planning objectives. There are significant challenges in conveyance of water due to the GIWW's relatively "porous" bankline, as well as long-term implications to Atchafalaya (and Mississippi) River operations all the way to the Old River Control Structure. This measure is not feasible or cost effective at this time because of constructability and navigation issues. This measure would be better investigated under the proposed LCA Upper Atchafalaya Basin Study.
25	N/A	Improve hydrology of the old Mermentau River Channel between Mud Lake and Gulf of Mexico	Preliminary Draft SMP	N/A	No	This measure would be difficult to implement successfully considering the proximity of the more hydraulically-efficient Mermentau River Navigation Channel.

Table C-1, Initial NED and NER Features Compiled and Screened						
Initial ID	**Feature No.**	**Name/Description/Location**	**Source**	**Objective No.**	**Incorporated into the initial array of features?**	
26	26	Bankline Protection for Gulf Intracoastal Waterway (GIWW)	SMP 4-4	N/A	No	Measure was investigated. USGS analyses of the GIWW from the Sabine River to Leland Bowman Lock showed relatively low bankline recession rates (<2 feet per year for the majority of the northern bankline, and <3 feet per year for the majority of the southern bankline). Therefore, this measure was excluded from further analysis because it doesn't address an area of critical need and because of low cost-effectiveness.
27	N/A	Allow Calcasieu Lake and surrounding area to become and remain brackish to saline	Preliminary Draft SMP	N/A	No	Does not address any planning objectives.
28	N/A	Dedicated dredging from the Gulf of Mexico for marsh creation and enhancement.	Preliminary Draft SMP	N/A	No	Does not meet the definition of a management measure (doesn't meet a planning objective at a specific location). Dredging from the Gulf of Mexico will be evaluated as a potential source of material for measures.
29	N/A	Maintain Hwy 82 for marsh protection	Preliminary Draft SMP	N/A	No	Maintenance of Hwy 82 is a LADOTD responsibility.
30	16b	Fortify spoil banks on GIWW in St. Mary and Vermilion Parish, Freshwater Bayou Canal	LACPR 3-12	1 & 5	Yes	Only Freshwater Bayou portion of this proposed measure was carried forward. Duplicate of Measure #16b.
31	416, 509, 510	Restore Chenier Forests	Preliminary Draft SMP	7	Yes	Duplicate of Measures #416, 509, and 510.
32	149, 411, 412	Lake Charles & Vicinity Hurricane Protection (via Earthen Levee/Major Structure)	SMP 4-1	1	Yes	Duplicate of Measures #149, 411, and 412.
33	N/A	New levee alignment along Highway 82 (from Vinton to Abbeville)	LACPR Atlas PU4-H	N/A	No	This alignment did not pass the initial LACPR screening because of strong local opposition; high cost; environmental concerns such as wetland impacts and drainage problems (e.g. trapping saltwater after a storm).

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
						Based on LACPR Final Technical Report evaluations, this measure doesn't meet Federal of cost effectiveness or protecting the nation's environment.
34	GIWW	Abbeville to Lake Charles Hurricane Protection (via Earthen Levee)	SMP 4-2	1	Yes	Study authority requires assessing the "feasibility of constructing an armored 12-foot levee along the Gulf Intracoastal Waterway."
35	N/A	New levee alignment along the 10-ft contour (from Abbeville to Texas border)	LACPR Atlas PU4-C	N/A	No	This alignment did not pass the initial LACPR screening because of long length (high life-cycle costs); environmental concerns such as wetland impacts and drainage problems (e.g. trapping saltwater after a storm). Based on LACPR Final Technical Report evaluations, this measure doesn't meet Federal of cost effectiveness or protecting the nation's environment.
36	N/A	Nonstructural collaboration with local, State and Federal agencies for application of all nonstructural measures	LACPR Atlas	N/A	No	Doesn't meet the definition of a management measure, but will be identified as a multi-agency collaboration opportunity in the report.
37	601	Nonstructural incentive program to elevate above ABFE/BFE to + mean sea level for new construction and reconstruction/relocation in collaboration with other agencies	LACPR Atlas	1	Yes	Will be considered under Measure #601.
38	601	Nonstructural permanent evacuation/relocation of residential assets along Hwy LA-82 for Risk Reduction and Ecosystem Restoration	LACPR Atlas	1	Yes	Will be considered under Measure #601
39	N/A	Nonstructural technical assistance/information/workshops on implementation of measures	LACPR Atlas	N/A	No	Doesn't meet the definition of a management measure, but will be identified as a multi-agency collaboration opportunity in the report.

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
40	601	Nonstructural ringwalls/berms surrounding private property	LACPR Atlas	1	Yes	Will be considered under Measure #601
41	601	Nonstructural flood proofing critical facilities and critical economic assets	LACPR Atlas	1	Yes	Will be considered under Measure #601
42	149, 411, 412	Lake Charles and Vicinity Hurricane Protection	SMP 4-1	1	Yes	Duplicate of Measures #149, 411, and 412.
43	N/A	Abbeville to Lake Charles Hurricane Protection	SMP 4-2	N/A	No	Doesn't meet Federal objective of cost effectiveness based on LACPR Final Technical Report evaluations. Also, high environmental mitigation costs.
44	TBD	Raise and Maintain Highways 82 and 27	SMP 4-3	1	No	To be evaluated with ADCIRC modeling to determine if risk reduction measures can be formulated (e.g. raising low parts of the highway, rock armor in select areas, etc). Maintenance of Highways 82 and 27 is a LADOTD responsibility.
45	N/A	Restore the Mermentau Lakes Basin Integrity	SMP 4-5	N/A	No	This is a goal not a measure. See Objectives 2, 3, and 4.
46	7	Salinity Control Structure at Calcasieu Pass	SMP 4-9	2	Yes	Duplicate of Measure #7.
47	47a, 47c, 47f, 47h	Marsh Restoration Using Dredged Material South of Highway 82	SMP 4-12	7	Yes	The planning team reduced acreage of this measure to exclude areas with existing or planned terraces, areas that Rockefeller Refuge uses for duck research, etc.
48	48	Salinity Control Structure at Sabine Pass	SMP 4-14	2	Yes	Changed measure to be a sill or rock dike closure between the Sabine Navigation Channel and the marsh in Cameron Parish just north of highway 82. However, the ship channel is open to Sabine Lake at the north end, so the benefits of the sill probably will not be as effective as if the system was isolated from the ship channel. In fact, the sill could exacerbate issues on the north end by

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
						increases in differential stage levels within the lake.
49	49b1	Stabilize Calcasieu Lake Shoreline	SMP 4-16/ Cameron Parish	5	Yes	Only 49b1 portion of this measure (i.e., shoreline in front of the Cameron-Creole Watershed) was carried forward because USGS analyses of other shoreline reaches showed relatively low recession rates (about 2 feet per year).
50	N/A	Stabilize Sabine Lake Shoreline	SMP 4-17	N/A	No	USGS analyses of the Sabine Lake shoreline showed relatively low recession rates. Therefore, this measure was excluded from further analysis because it doesn't address an area of critical need.
51	N/A	Mermentau Basin Watershed Management Plan to Retain Freshwater Resources	SMP 4-18	N/A	No	Does not meet the definition of a measure; however, measures consistent with this plan may be formulated pending the results of the Chenier Plain Hydrodynamic model.
52	N/A	Chenier Plain Freshwater and Sediment Management and Reallocation	LACPR 5-17	N/A	No	Does not meet the definition of a measure. The LCA "Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study" has not been funded; however, some ecosystem restoration concepts are being evaluated as part of the SW Coastal feasibility study.
53	GIWW	To evaluate the GIWW alignments in Planning Units 3b and 4	LACPR Atlas	1	Yes	Duplicate of Measure #34. Authority requires assessing the "feasibility of constructing an armored 12-foot levee along the Gulf Intracoastal Waterway."
54	149, 411, 412	Hurricane surge protection for Lake Charles metropolitan area and Vinton using ring levees	Preliminary Draft SMP	1	Yes	Duplicate of Measures #149, 411, and 412.
55	141, 142, 143, 144,	Hurricane surge protection from Vermilion River to GIWW/Calcasieu	Preliminary Draft SMP	1	Yes	Duplicate of Measures #141, 142, 143, 144, and 34.

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
	34?	River Lock				
56	TBD	Raise & Maintain Highways 82 and 27	SMP 4-3	1	No	Duplicate of Measure #44.
57	N/A	Proposed hurricane protection levee for 30-A storm surge at coastline	Preliminary Draft SMP	N/A	No	This alignment did not pass the initial LACPR screening for the same reasons as the Hwy 82 alignment: strong local opposition; high cost; environmental concerns such as wetland impacts and drainage problems (e.g. trapping saltwater after a storm). Based on LACPR Final Technical Report evaluations, this measure doesn't meet Federal of cost effectiveness or protecting the nation's environment.
58	N/A	Complete/accelerate the Chenier Plain Freshwater and Sediment Management and Allocation Reassessment study which was included in the LCA Near-Term Plan	LACPR 5-17	N/A	No	The LCA "Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study" has not been funded; however, some ecosystem restoration concepts are being evaluated as part of the SW Coastal feasibility study.
59	601	Develop a plan to elevate and/or relocate assets located outside the hurricane protection levee	SMP	1	Yes	Will be considered under Measure #601
60	N/A	Toll road on top of levee south of GIWW	Preliminary Draft SMP	N/A	No	Not water resources related. Does not address any planning objectives.
61	N/A	Hebert Canal Watershed	Preliminary Draft SMP	N/A	No	Does not meet the definition of a measure. See Measure #142 for Hebert Canal storm surge measure.
62	N/A	North Prong Salinity control flood protection for Mermentau Basin	Preliminary Draft SMP	N/A	No	Project constructed as part of "Schooner Bayou to GIWW." Part of the future without project condition.
63	N/A	Storm buffering systems	Preliminary Draft SMP	N/A	No	Does not meet the definition of a measure (no geographic area specified). Evaluated as part of the

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
						study.
64	N/A	Maintain Mermentau Basin as Fresh Water Basin	Preliminary Draft SMP	N/A	No	Stated as a planning objective, not a measure. See Objectives 2 – 4.
65	N/A	Cameron: Use old Calcasieu lock for flood control	Scoping	N/A	No	Duplicate of Measure #18. Change in lock operations will be evaluated under Measure #602.
66	N/A	Cameron: Need storm surge protection south of Route 82	Scoping	N/A	No	Storm surge risk reduction is a planning objective not a measure. Nonstructural risk reduction measures will be evaluated south of Hwy 82.
67	N/A	Cameron: Need beneficial use of dredged material to build levees/barriers	Scoping	N/A	No	Does not meet the definition of a measure. Levee construction methods will be evaluated if a structural plan is carried forward.
68	N/A	Cameron: Need to consolidate drainage boards by watershed for effective management	Scoping	N/A	No	Does not address any study planning objectives but will be identified in the report as a multi-agency collaboration opportunity.
69	N/A	Cameron: Need buffers/setbacks away from population	Scoping	N/A	No	Not a specific measure. Concept included in the study's multiple lines of defense strategy.
70	N/A	Cameron: Look at levee impacts on wetlands and the economy of the area	Scoping	N/A	No	Not a measure. Will be evaluated during the study
71	5a, 6b	Cameron: Erosion is a problem- need beach/shoreline stabilization along the Gulf	Scoping	5	Yes	Duplicate of Measures #5 and 6.
72	N/A	Cameron: Restore Kelso Bayou	Scoping	N/A	No	Stated as an objective not a measure. Hydrologic/Salinity Control Measure #17c would help restore Kelso Bayou. Marsh restoration is also proposed along Kelso Bayou by CWPPRA project CS-53.
73	3a1,	Cameron: Need marsh creation west of	Scoping	7	Yes	Several marsh creation sites are being evaluated west of

Table C-1, Initial NED and NER Features Compiled and Screened						
Initial ID	**Feature No.**	**Name/Description/Location**	**Source**	**Objective No.**	**Incorporated into the initial array of features?**	
	124a-d	the Calcasieu				Calcasieu Lake. Duplicate of Measures #3 and 124.
74	74a, 74b, 74c	Cameron: Need spillway structures at East Calcasieu Lake (A), Humble Canal (B), North of Deep Lake (C)	Scoping	2, 3, & 4	Yes	
75	75a and 75b	Cameron: Need sediment bypass at Mermentau River and Calcasieu Ship Channel	Scoping	N/A	No	Both measures were considered. CPRA performed a recon-level evaluation of a proposed CIAP project similar to 75b. The findings were: 1. Sand availability from the borrow source at the east side of the jetty is of limited volume; 2. The shoreline to the east of the jetty, which includes 4,000 feet of shoreline adjacent to the jetty, is currently subject to erosion. It is not common practice to use sand from eroding shorelines as a borrow source for beach nourishment at other places; and 3. A breach at the north end of the east jetty could occur if the width of the beach on the Gulf side is reduced due to excavation of sand, posing a problem for jetty stability and general shoreline erosion. Based on these findings, both 75a and 75b were removed from consideration in this study.
76	12, 16b, 26	Cameron: Need shoreline protection at Grand, Sweet, and Willow Lakes, and Freshwater Bayou	Scoping	5	Yes	Duplicate of Measures #12, 16, and 26. Only Freshwater Bayou portion of this measure was carried forward.
77	N/A	Cameron: Put a barrier along Calcasieu Lake	Scoping	N/A	No	Barriers already exist along the shorelines of much of Calcasieu Lake.
78	N/A	Cameron: Streamline the permitting process as related to existing structures/terraces	Scoping	N/A	No	Does not address planning objectives.
79	N/A	Cameron: There is marsh loss at Gum Cove	Scoping	N/A	No	This is a problem statement rather than a measure. Does not address any planning objectives. Gum Cove is located in a relatively stable subunit that shows a recent (1984 to 2010) land gain trend of 6 acres/year. Local

Table C-1, Initial NED and NER Features Compiled and Screened						
Initial ID	**Feature No.**	**Name/Description/Location**	**Source**	**Objective No.**	**Incorporated into the initial array of features?**	
						marsh benefits from the hydrologic restoration project CS-27.
80	N/A	Cameron: There is water retention/drainage problem in Creole, sedimentation in Creole Canal	Scoping	N/A	No	This is a problem statement rather than a measure. Will be evaluated through H&H modeling.
81	N/A	Cameron: Trees have been lost at Rutherford Beach because of erosion	Scoping	N/A	No	This is a problem statement rather than a measure. Chenier reforestation will be evaluated under Measure #510.
82	N/A	Cameron: There is rapid land loss at Grand Chenier/Johnson Bayou	Scoping	N/A	No	This is a problem statement rather than a measure. This is partially addressed by Measure #47.
83	N/A	Lake Charles: Use dredge material from Cameron Loop for levee repair	Scoping	N/A	No	Does not address any planning objective. Dredge material is more suitable for marsh restoration than levee repair.
84	TBD	Lake Charles: Make every effort to maintain Highway 82	Scoping	1	No	Duplicate of Measure #44.
85	N/A	Lake Charles: Streamline the regulatory process for existing structures	Scoping	N/A	No	Does not address any planning objectives.
86	N/A	Lake Charles: Plan to protect and restore the areas north of I-10	Scoping	N/A	No	Stated as an objective not a measure. Hurricane risk reduction Measures #149, 411, and 412 would address this objective.
87	N/A	Lake Charles: Create an artificial barrier off the coast	Scoping	N/A	No	Not specific enough to determine which planning objectives would be met.
88	N/A	Lake Charles: Restore wetlands	Scoping	N/A	No	Restoring wetlands is an opportunity that will be addressed by the study but it does not meet the definition of a measure.
89	N/A	Lake Charles: Limit the depth of the ship	Scoping	N/A	No	The Calcasieu Ship Channel is an authorized navigation channel with authorized dimensions. This measure would

Table C-1, Initial NED and NER Features Compiled and Screened						
Initial ID	**Feature No.**	**Name/Description/Location**	**Source**	**Objective No.**	**Incorporated into the initial array of features?**	
		channel				violate the constraint to avoid actions that negatively affect the ability of authorized navigation projects to continue to fulfill their purpose. Any changes to those dimensions would have to be addressed through the navigation authority.
90	N/A	Lake Charles: Use sheet pile in the Intracoastal and Calcasieu ship channel to prevent erosion	Scoping	N/A	No	Use of sheet pile is not relevant to meeting objectives. Sheet pile will be considered for use on all shoreline protection projects.
91	N/A	Lake Charles: Drainage concerns caused by levees; pumps may not be adequate.	Scoping	N/A	No	Does not meet the definition of a measure. Effects of any proposed structural measures will be evaluated.
92	N/A	Lake Charles: Repair levee east of Calcasieu Lake	Scoping	N/A	No	The Cameron/Creole levee has been repaired and is part of the future without project condition.
93	N/A	Lake Charles: Drainage boards by watershed	Scoping	N/A	No	Does not address any planning objectives.
94	N/A	Lake Charles: Need gate at Contraband Bayou and ship channel	Scoping	N/A	No	Does not address any planning objectives as a stand-alone measure. Will be considered part of Hurricane Storm Damage Risk Reduction Measure #411.
95	N/A	Abbeville: Issues goes upriver to where Atchafalaya splits; sediment delivery needs to be measured	Scoping	N/A	No	Does not meet the definition of a measure. Upriver changes may be better investigated through the proposed LCA Upper Atchafalaya Basin Study.
96	N/A	Abbeville: Worried that gates will hold water in just as it holds water out; need way for water to be let out	Scoping	N/A	No	Does not meet the definition of a measure. Effects of any proposed structural measures will be evaluated.
97	N/A	Abbeville: Implement canal speed regulations for boats	Scoping	N/A	No	Although implementing boating speed limits is consistent with study objectives, the costs/benefits would be uncertain and unquantifiable. There is difficultly in

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
						enforcing these types of regulations.
98	507, 508	Abbeville: Consider artificial reef creation; Navy ships could be used as reefs by sinking them; old oil platforms or sheet pile could be used	Scoping	5	Yes	Reef-like structures will be investigated under Measures #507 and 508.
99	99a	Barrier Shoreline Restoration: Freshwater Bayou to South Point/Marsh Island (Western section)	Scoping/ LACPR PU3b 1-10	5	Yes	Available data and information suggest shoreline recession rates are relatively low (although localized hotspots do exist) due to longshore sediment transport from Atchafalaya River. Measure #99a refined to provide protection to Cheniere Au Tigre, which is a unique natural feature that provides some degree of storm surge protection to inland areas/communities.
	N/A	Barrier Shoreline Restoration: Freshwater Bayou to South Point/Marsh Island (Marsh Island section)	Scoping/ LACPR PU3b 1-10	N/A	No	This portion of the measure was screened out because it is outside the authorized study area.
100	47a, 47c	Abbeville: Need marsh creation at Grand Chenier	Scoping	7	Yes	Duplicate of Measure #47.
101	N/A	Abbeville: Preserve fresh water marsh	Scoping	N/A	No	Preservation of freshwater marsh addressed through ecosystem restoration objectives.
102	507, 508	Abbeville: Restore reefs	Scoping	5	Yes	Salinities may be too low to sustain oyster reefs in the Acadiana Bays; however, reef-like structures will be investigated under Measures #507 and 508.
103	N/A	Abbeville: Need flood protection	Scoping	N/A	No	Flood damage reduction is a planning objective not a measure.
104	N/A	Abbeville: Use rocks to rebuild levees	Scoping	N/A	No	Construction method rather than a specific measure. The most cost efficient method of levee construction will be evaluated.

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
105	N/A	Abbeville: Levee height needs to be addressed	Scoping	N/A	No	Not a measure. Detailed hydrodynamic modeling and analysis will be used to determine levee heights.
106	N/A	Abbeville: Put material against levee wall to stop erosion due to barge traffic	Scoping	N/A	No	Construction method rather than a specific measure.
107	N/A	Abbeville: Address flooding from the Gulf	Scoping	N/A	No	Flood damage reduction is a planning objective not a measure.
108	N/A	Implement State Right of Access for Geotechnical, Environmental, Coastal planning efforts similar to Surveying	Scoping	N/A	No	Does not meet the definition of a measure.
109	N/A	Salinity control Structure at Mermentau River Navigation Channel /Salinity Control at Hog Bayou	Coast 2050	N/A	No	Does not address any planning objectives because Hog Bayou is silting in and is being short-circuited by Beach Prong.
110	16b	Freshwater Bayou Bank Protection, Belle Isle to Lock	LACPR 3b 1-8	5	Yes	Duplicate of Measure #16b.
111	N/A	Marsh Island Shoreline Protection	LACPR 3b 1-10	N/A	No	This measure is outside the authorized study area.
112	99a	Gulfshore Protection from Freshwater Bayou to Southwest Pass	LACPR 3b 1-11	5	Yes	Duplicate of Measure #99.
113	113b2	Stabilize Shoreline of Vermilion, East & West Cote Blanche Bays (via Rock Dike)	LACPR 3b 1-12	5	Yes	Shoreline reaches outside the authorized study area were screened out. USGS analyses of the remaining shoreline reaches showed relatively low recession rates along much of Vermilion Bay. Measure #113b2 along Southwest Point was carried forward due to concerns that the loss of the Point could result in increased marine influences (i.e., saltwater intrusion, tidal action) in Vermilion Bay.
114	114a	LA Highway 333/82 Hurricane	Vermilion	1	Yes	In the ADCIRC model, highway will be raised in low spots

Table C-1, Initial NED and NER Features Compiled and Screened						
Initial ID	**Feature No.**	**Name/Description/Location**	**Source**	**Objective No.**	**Incorporated into the initial array of features?**	
		Protection.	Parish			only; highway assumed to be maintained by LA DOTD.
	114b	LA Highway 330 Hurricane Protection. Armor south side of east side of LA 330.	Vermilion Parish	1	Yes	In the ADCIRC model, highway will be raised in low spots only; highway assumed to be maintained by LA DOTD.
115	N/A	Sabine Basin Watershed Management (Maximize Freshwater Inflow from Sabine River)	SMP 4-19	N/A	No	Doesn't address any planning objectives. CRMS data indicate the area is relatively healthy and not in need of salinity/hydrologic control.
116	N/A	Salinity Control Structure at Oyster Bayou	LCA PBMO/ LACPR 5-1	N/A	No	This project has already been constructed as part of local Ducks Unlimited/NAWCA restoration efforts.
117	N/A	Salinity Control Structure at Long Point Bayou	LCA PBMO/ LACPR 5-2	N/A	No	Doesn't address any planning objectives. CRMS data indicate the area is relatively healthy and not in need of salinity/hydrologic control.
118	17a	Salinity Control Structure at Alkali Ditch	LCA PBMO/ LACPR 5-4	2	Yes	Duplicate of Measure #17a
119	602	Modify existing Cameron-Creole Watershed Control Structure	LCA PBMO/ LACPR 5-5	2, 3, & 4	Yes	Change in structure operations will be considered under Measure #602.
120	N/A	East Sabine Hydrologic Restoration	LCA PBMO/ LACPR 5-8	N/A	No	Does not meet the definition of a measure.
121	21c	Freshwater Introduction at Pecan Island	LCA PBMO/ LACPR 5-9	2 & 4	Yes	Duplicate of Measure #21c.
122	21b	Freshwater Introduction at South Grand Chenier	LCA PBMO/ LACPR 5-13	2 & 4	Yes	Duplicate of Measure #21b.

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
123	N/A	Black Bayou Bypass Culverts	LCA PBMO/ LACPR 5-14	N/A	No	Addressed as part of the CWPPRA CS-29 project.
124	124a-d	Marsh Creation at Mud Lake	LACPR PU4: 1-1	7	Yes	The planning team removed the central portion of Measure #124 because it is located within the existing CWPPRA CS-20 project area.
125	47a, 47c	Marsh Creation at South Grand Chenier	LACPR PU4 1-2	7	Yes	Duplicate of Measure #47.
126	47f, 47h	Marsh Creation at South Pecan Island	LACPR PU4 1-3	7	Yes	Duplicate of Measure #47.
127	127c	Marsh Creation at East Pecan Island (Eastern portion)	LACPR PU4 1-4	7	Yes	The planning team reduced acreage of this measure to focus on an area of recent land loss near the west bank of the Freshwater Bayou Canal.
128	3a1	Marsh Creation at NW Calcasieu	LACPR 2-6	7	Yes	Duplicate of Measure #3.
129	N/A	Marsh Creation at No-Name Bayou	LACPR PU4 1-5	N/A	No	Measure screened out because it overlaps with a proposed Calcasieu Ship Channel DMMP site.
130	3c	Marsh Creation at East Calcasieu Lake	LACPR 2-7	7	Yes	Duplicate of Measure #3.
131	N/A	Marsh Creation at Black Bayou	LACPR PU4 1-8	N/A	No	Measure screened out because it did not meet screening criteria; i.e., it would not reinforce critical landscape features, it is far from a preferred borrow source, and it is in an area proposed for Sabine-Neches Waterway mitigation.
132	N/A	Marsh Creation at Gum Cove	LACPR PU4 1-9	N/A	No	Measure screened out because it did not meet screening criteria; i.e., it is far from a preferred borrow source, and it is in an area proposed for Sabine-Neches Waterway mitigation.

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
133	N/A	Marsh Creation at Cameron Meadows	LACPR PU4 1-10	N/A	No	Measure screened out because it did not meet screening criteria; i.e., it would not reinforce critical landscape features, and it is in an area of geologic instability.
134	N/A	Marsh Creation at Central Canal	LACPR PU4 1-11	N/A	No	Measure screened out because it did not meet screening criteria; i.e., it would not reinforce critical landscape features, it is far from a preferred borrow source, and it is in an area proposed for Sabine-Neches Waterway mitigation.
135	135a	Marsh Creation at Sweet Lake	LACPR PU4 1-12	7	Yes	The planning team repositioned this measure to avoid deep water areas with poor geotechnical conditions.
136	N/A	Brady Canal Area Marsh Creation	LACPR PU3b 1-15	N/A	No	This measure is outside the authorized study area.
137	3a1, 3c	Marsh Creation & Terracing northwest of Calcasieu Lake and East Calcasieu Marsh Creation	LACPR PU4 1-6 and 1-7	7	Yes	Duplicate of Measure #3.
138	N/A	Raise existing oilfield canals spoil bank alignments for storm surge	Vermilion Parish	N/A	No	Vermilion Parish would like to use dredge material from oilfield canal dredging to fortify the spoil banks rather than use the material for marsh nourishment. The purpose would be to allow for the establishment of trees and other vegetation that are more effective for multiple lines of defense, i.e., breaking of wind and waves, etc. This would violate the study constraint of avoiding actions that deprive one area of limited sediment resources to benefit projects in another area. Any such operational change is a permitting and policy issue that needs to be vetted through LDNR and USACE wetland permitting.

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
139	16b, 26	Fortify spoil banks of GIWW and Freshwater Bayou	LACPR PU 3b 3-15/ Vermilion Parish	5	Yes	Duplicate of Measures #16b and 26. Only Freshwater Bayou portion of this measure was carried forward.
140	511	Flood Control Structure at Boston Canal	Vermilion Parish	1	Yes	Duplicate of Measure #511.
141	141	Four Mile Canal Structure	Vermilion Parish	1	Yes	
142	142	Hebert Canal Watershed/storm protection	Vermilion Parish	1	Yes	
143	143	Flood Control Structure at Oaks Canal	Vermilion Parish	1	Yes	CBDG project.
144	144a-c	Protection Levee on the marsh/ upland interface	Vermilion Parish	1	Yes	Alignment needs to be smoothed. Will be modeled in ADCIRC for further screening evaluations.
145	144a-c	Bayou Tigre Watershed Flood Protection	Vermilion Parish	1	Yes	Will be considered under Measure #144.
146	146	Gueydan 100-year protection ring levee	LACPR	1	Yes	Will be evaluated with ADCIRC modeling for further screening.
147	149, 601	C-RL-100-1 (100-yr risk reduction through ring levees and nonstructural)	LACPR	1	Yes	Duplicate of Measures #149 and 601.
148	149, 601	C-RL-400-1	LACPR	1	Yes	Duplicate of Measures #149 and 601. Combined 100-yr, 400-yr, and 1000-yr LACPR alternatives into one measure since they are on the same footprint. Level of risk reduction to be determined.
149	149	Lake Charles Ring Levee	LACPR	1	Yes	LACPR Measures CL-RL-100-1, CL-RL-400-1, and C-RL-1000-1 all on same footprint. Level of risk reduction

Table C-1, Initial NED and NER Features Compiled and Screened						
Initial ID	**Feature No.**	**Name/Description/Location**	**Source**	**Objective No.**	**Incorporated into the initial array of features?**	
						to be determined. Measure #149 is an alternative to Measures 411/412.
150	GIWW	Continuous levee along the GIWW from Vermilion Bay to west of Vinton	LACPR Atlas PU4-G	1	Yes	Duplicate of Measure #34. Study authority requires assessing the "feasibility of constructing an armored 12-foot levee along the Gulf Intracoastal Waterway."
151	149, 411, 412, 146, 409, 114, 144	Large ring levees around Vinton/Lake Charles and Gueydan/Kaplan/Abbeville	LACPR Atlas PU4-RL-2	1	Yes	Ring levees will be modeling with ADCIRC for further screening.
152	149, 411, 412, 146, 409, 114, 144	Small ring levees around Vinton, Lake Charles, Gueydan, and Kaplan	LACPR Atlas PU4-RL	1	Yes	Ring levees will be modeling with ADCIRC for further screening.
153	N/A	Continuous levee following Highway 82	LACPR Atlas PU4-H	N/A	No	Duplicate of Measure #33.
154	N/A	Levees along the 10-foot contour	LACPR Atlas PU4-C	N/A	No	Duplicate of Measure #35.
155	GIWW, 149, 411, 412	100-year levee along the GIWW and 500-year ring levee around Vinton/Lake Charles	LACPR Atlas PU4-State	1	Yes	Duplicate of Measures #149, 411, and 412.
156	N/A	Continuous levee along the GIWW from Morgan City to Vermilion Bay	LACPR Atlas PU3b-G-1	N/A	No	This measure is outside the authorized study area.
157	N/A	Continuous levee along the GIWW from Morgan City to Abbeville	LACPR Atlas PU3b-G-2	N/A	No	This measure is outside the authorized study area.
158	N/A	Continuous levee from Franklin to Abbeville inland of the GIWW	LACPR Atlas PU3b-FA	N/A	No	This measure is outside the authorized study area.

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
159	N/A	Continuous levee from Franklin to Abbeville from preliminary draft of State Master Plan	LACPR Atlas PU3b-FA-State	N/A	No	This measure is outside the authorized study area.
160	601	Permanent Evacuation	LACPR Atlas	1	Yes	Will be considered under Measure #601.
161	601	Relocation of Residential Assets along Hwy LA 82	LACPR Atlas	1	Yes	Duplicate of Measure #38. Will be considered under Measure #601.
162	601	Buyout	LACPR Atlas	1	Yes	Duplicate of Measure #38. Will be considered under Measure #601.
163	601	Wet/Dry flood Proofing of Structures	LACPR Atlas	1	Yes	Duplicate of Measure #41. Will be considered under Measure #601.
164	601	Raising in Place	LACPR Atlas	1	Yes	Duplicate of Measure #59. Will be considered under Measure #601.
165	601	Permanent Evacuation	LACPR Atlas	1	Yes	Duplicate of Measure #38. Will be considered under Measure #601.
166	601	Relocation of Residential Assets along Hwy LA 82	LACPR Atlas	1	Yes	Duplicate of Measure #38. Will be considered under Measure #601.
167	601	Buyout	LACPR Atlas	1	Yes	Duplicate of Measure #38. Will be considered under Measure #601.
168	601	Wet/Dry flood Proofing of Structures	LACPR Atlas	1	Yes	Duplicate of Measure #41. Will be considered under Measure #601.
169	601	Raising in Place	LACPR Atlas	1	Yes	Duplicate of Measure #59. Will be considered under Measure #601.
170	N/A	Cameron - Estuarine Species Management	Cameron Parish	N/A	No	Does not meet the definition of a measure.

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
171	N/A	Cameron - Beneficial Use of Dredged Material	Cameron Parish	N/A	No	Does not meet the definition of a measure. Marsh creation sites have been identified in Cameron Parish that could beneficially use dredged material.
172	N/A	Cameron - Water Level Management	Cameron Parish	N/A	No	Does not meet the definition of a measure. The Chenier Plain Hydrodynamic model will be used to evaluate methods of water level management.
173	N/A	Cameron - Sediment Management	Cameron Parish	N/A	No	Does not meet the definition of a measure. Sediment management will be evaluated as part of this study.
174	N/A	Cameron - Salinity Control Structures	Cameron Parish	N/A	No	Does not meet the definition of a measure (no location specified).The Chenier Plain Hydrodynamic model will be used to evaluate placement of potential Salinity Control Structures. See Measures #48, 407, 17a, 17b, 17c, 7, 74a, 74b, 74c, 21a, 21b, 21c, 13, and 603.
175	N/A	Cameron - Locks replacement and management	Cameron Parish	N/A	No	Does not address any planning objectives. The Chenier Plain Hydrodynamic model will be used to evaluate the need to replace or manage locks in Cameron Parish. Will be considered under Measure #602.
176	5a, 6b, 49b1	Cameron - Shoreline stabilization	Cameron Parish	7	Yes	Shoreline stabilization measures are being considered in Cameron Parish. See Measures #5a, 6b, and 49.
177	N/A	Cameron - Flood relief structure	Cameron Parish	N/A	No	Does not meet the definition of a measure. H&H modeling will determine placement of flood control structures.
178	N/A	NRCS Cooperative River Basin studies	NRCS	N/A	No	Does not meet objectives. Reports are outdated (over 15 years old) and the measures are too small and specific to individual landowners to comprehensively address study area problems. Better addressed by NRCS programs.
300	114, 144, 141, 142,	Abbeville & Vicinity Hurricane Protection	SMP 3b-1	1	Yes	Will establish benefit-cost ratio using initial ADCIRC

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
	143, 511	(via Earthen Levee/Major Structure)				results.
301	16b	Bankline Stabilization of Freshwater Bayou from Belle Isle Bayou to Freshwater Bayou Canal Lock (via Rock Dike)	SMP 3b-7	5	Yes	Duplicate of Measure #16b.
302	N/A	Increase Sediment Transport Down Wax Lake Outlet (via Channel Construction)	SMP 3b-8	N/A	No	This measure is outside the authorized study area.
303	N/A	Southwest Pass Shoreline Stabilization (via Rock Dike)	SMP 3b-9a	N/A	No	Measure was investigated. USGS analyses showed relatively low shoreline recession rates (<2 feet per year). Therefore, this measure was excluded from further analysis because it doesn't address an area of critical need.
304	304a, 304b	Southwest Pass Sills	SMP 3b-9	5	Yes	Measures #304a and 304b are dependent on each other.
305	26	Bankline Protection for Gulf Intracoastal Waterway (GIWW) (via Rock Dike)	SMP 3b-11	N/A	No	Duplicate of Measure #26.
306	306a, 306b	Rainey Marsh Restoration	SMP 3b-12	7	Yes	There has been little recent land loss in the original location of this measure. Therefore, the measure was repositioned to the area just east of Freshwater Bayou Canal, where there is a greater need for marsh restoration to reinforce the bankline.
307	N/A	Marsh Restoration Using Dredged Material at Weeks Bay	SMP 3b-14	N/A	No	This measure is outside the authorized study area.
308	26, 16b	Fortify Spoil Banks of GIWW & Freshwater Bayou	SMP 3b-19	5	Yes	Duplicate of Measures #16b and 26. Only Freshwater Bayou portion of this measure was carried forward.
400	N/A	South Marsh Island (Restore to ~1978 marsh extent with marsh creation (500	MLODS	N/A	No	This measure is outside the authorized study area.

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
		acres)				
401	N/A	Outer Atchafalaya Bay (Restore structural oyster reefs at appropriate isohaline conditions)	MLODS/ SMP 3b-6	N/A	No	This measure is outside the authorized study area.
402	N/A	Wax Lake Outlet (Maintain status quo of active delta)	MLODS/ SMP 3b-8	N/A	No	This measure is outside the authorized study area.
403	N/A	GIWW - Hwy 317 to Hwy 82 (Outfall management to convey freshwater east of Hwy 82)	MLODS/ SMP 3b-13	N/A	No	Duplicate of Measure #24.
404	N/A	Sabine R. to Sabine National WR	MLODS/Draft SMP PU4-16	N/A	No	Duplicate of Measure #1.
405	N/A	GIWW (Outfall management to convey freshwater east of Hwy 82)	MLODS/Draft SMP PU4-17	N/A	No	Duplicate of Measure #24.
406	N/A	Red River/Bayou Beouf (Diversion to convey freshwater through the upper Mermentau Basin and into the lower basin)	MLODS	N/A	No	Does not address any planning objectives. Better addressed through the proposed LCA Upper Atchafalaya Basin Study.
407	407	Structure on GIWW at Gum Cove Ridge	MLODS	2	Yes	Purpose is to restore the function of the ridge that hydrologically separated the Sabine and Calcasieu basins.
408	21b, 21c	South of White & Grand Lakes (Flap-gate culverts)	MLODS	2, 3, & 4	Yes	Duplicate of Measure # 21.
409	409	Kaplan 100 year ring levee	MLODS/ LACPR	1	Yes	Will be evaluated with ADCIRC modeling for further screening. Expected to be screened out based on damages vs. levee costs.

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
410	146	Gueydan 100 year ring levee protection	MLODS/ LACPR	1	Yes	Duplicate of Measure #146.
411	411	Greater Lake Charles region: east side of Calcasieu (New levee alignment 500 year protection provided by the flood protection system)	MLODS/SMP	1	Yes	1% annual depth of flooding may be maximum feasible level of protection. Will be modeled in ADCIRC for further screening evaluation. Measure #94 from hydrologic/ salinity control measures is considered part of this measure. Measures #411 (east) and 412 (west) are meant to be considered as a system for providing risk reduction for the Lake Charles area for storm surge. Measures #411/412 are an alternative to Measure #149.
412	412	Greater Lake Charles region: west side of Calcasieu (New levee alignment 500 year protection provided by the flood protection system)	MLODS/SMP	1	Yes	See comment for Measure #411 above.
413	N/A	White Lake-Grand Lake Land Bridge (Restore & maintain landbridge with marsh creation and shoreline protection)	MLODS	N/A	No	Measure screened out because it did not meet screening criteria. Furthermore, the Grand-White Lakes Landbridge Protection (ME-19) CWPPRA project is part of the future without project condition.
414	416	Grand Chenier ridges (Restore ridges and upland forests on prominent ridges)	MLODS/ Preliminary Draft SMP	6	Yes	Duplicate of Measure #416.
415	510a, 510b	Hackberry & Blue Buck Ridges (Restore ridges and upland forests on prominent ridges)	MLODS/ Preliminary Draft SMP	6	Yes	Duplicate of Measure #510.
416	416	Grand Chenier Ridges (Restore ridges and upland forests on prominent ridges)	MLODS/ Preliminary Draft SMP	6	Yes	
500	N/A	Create marsh at Weeks Bay	LACPR PU3b 3-10	N/A	No	Duplicate of #307.

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
501	306a, 306b	Restore marsh at Marsh Island south shoreline and Rainey Marsh via dedicated dredging	LACPR PU3b 1-17 and 3-8	7	Yes	Marsh Island portion excluded because it is outside the authorized study area. Rainey marsh portion of this measure is a duplicate of Measure #306.
502	N/A	Increase sediment transport from Atchafalaya River down Wax Lake Outlet (via Major Structure)	LACPR PU3b 2-4	N/A	No	Duplicate of #302.
503	N/A	Historic Reef from Point Chevreuil to Marsh Island	Coast 2050	N/A	No	This measure is outside the authorized study area.
504	N/A	Historic Reef from Point Au Fer to Marsh Island		N/A	No	This measure is outside the authorized study area.
505	N/A	Improve hydrology of the old Mermentau River Channel between Mud Lake and Gulf of Mexico. (via Channel Restoration)		N/A	No	Duplicate of Measure # 25.
506	N/A	Restore marsh by filling abandoned canals	Preliminary Draft SMP	N/A	No	Duplicate of Measure #23.
507	507	Feature from Dead Cypress Point (Near Cypremort Point) to Near Bayou Michael (NW Corner of Marsh Island) (to Replace Historic Reefs)	Planning Team	5	Yes	Purpose of the measure is to reduce wave fetch and thus shoreline erosion along Vermilion Bay. Proof of concept in early phase 2a using three historic storms (Audrey, Rita & Ike) before proceeding further. LDWF doesn't think oysters will thrive in this location, therefore feature described as a submerged sill rather than reef restoration.
508	508	Feature from Marone Point or Point No Point to Lake Point (Marsh Island) (to Replace Historic Reefs)	Planning Team	5	Yes	See comment for #507 above.
509	509a,c,d	Restore/Sustain Chenier ridges and upland forests on prominent ridges in	MLODS/ Preliminary	6	Yes	

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
		Vermilion Parish	Draft SMP			
510	510a,b,d	Chenier Ridges in Cameron Parish (Restore/Sustain ridges and upland forests on prominent ridges	MLODS/ Preliminary Draft SMP	6	Yes	
511	511	Boston Canal Structure	Planning Team	1	Yes	CBDG project.
512	17a	Alkali Ditch	LCA PBMO/ LACPR 5-4	2	Yes	Duplicate of Measure #17a.
513	TBD	Erath/Delcambre and Vicinity (Vermilion Parish)	LACPR	1	Yes	For comparison with Measure #144. Added measure to highlight protection along/near the upland/marsh interface. Base condition modeling results needed to determine risk. LACPR identified two basic demonstration projects in Delcambre. They are relocation/buyout of existing residential and some commercial structures and flood proofing of existing critical facilities such as schools, water treatment facilities, police and fire stations, and city halls, as well as some commercial structures in the downtown areas considered critical to the community such as grocery stores and pharmacies.
600	16b	Freshwater Bayou Rock Armor	Stakeholder	7	Yes	The majority of this is a duplicate of Measure #16b. The one portion that does not overlap with 16b showed relatively low shoreline recession rates (about 3 feet/year).
601	601	Placeholder for nonstructural measures	LACPR	1	Yes	Implementation of nonstructural measures requires a multi-agency approach, involving the Federal Emergency Management Agency (FEMA), the National Oceanic & Atmospheric Association, the National Weather Service, U.S. Department of Transportation, the United States Housing and Urban Development Administration the U.S.

Table C-1, Initial NED and NER Features Compiled and Screened

Initial ID	Feature No.	Name/Description/Location	Source	Objective No.	Incorporated into the initial array of features?	
						Army Corps of Engineers, the Coastal Protection and Restoration Authority, the Governor's Office of Homeland Security and Emergency Preparedness and numerous other Federal, State, and local agencies.
602	602	Operational changes to existing structures	Planning Team	2, 3, & 4	Yes	Measures to be formulated pending results of Chenier Plain Hydrodynamic modeling.
603	603	Control structure at Tom's Bayou	Planning Team	2	Yes	
604	604	Preservation of Sabine Historic Oyster Reefs	Planning Team	1	Yes	Storm surge effects to be modeled in ADCIRC both with and without the oyster reef in the channel.

Following the initial screening features were grouped into NED and NER analysis categories and separated to undertake parallel processes for screening/plan formulation in each category. The features were also separated into Measure groups within each category.

NED PLAN FORMULATION

NED Goal: Provide hurricane and storm damage risk reduction and reduce flooding induced by storm surge.

Problems	Opportunities	Objectives	Measures
Flooding from tidal surge and waves associated with tropical storms	Raise or remove buildings out of the floodplain. Block surge with levees and floodgates.	Objective 1. Reduce the risk of economic losses from flooding caused by hurricanes and storm surges.	Structural (levees, floodgates, floodwalls, pumps) or Non-Structural (raise or buyout property)

The NED analysis category was comprised of two primary measure groups Structural and Non-structural. Following the initial screening forty-six remaining features were identified that would provide hurricane and storm damage risk reduction to the area. Twenty of them were nonstructural in nature. The evaluation of non-structural viability was considered generically across the entire study area as part of the NED array. The team determined that specific application of non-structural methods would be defined in the feasibility design phase subject to the justification of a programmatic non-structural plan.

The remaining 26 features presented in Table C-2 below were structural risk reduction measures and received preliminary individual evaluation in the initial NED array.

Table C-2, Initial Array of NED Structural Risk Reduction Features

No.	ID/ Feature #	Description	Name	Basin	Source
1	1	Armored 12-ft earthen levee along the GIWW		Calcasieu-Sabine, Mermentau	Southwest Coastal Louisiana Reconnaissance Report
2	34	Abbeville to Lake Charles Hurricane Protection		Calcasieu-Sabine, Mermentau	State Master Plan
3	35	New levee alignment along the 10-ft contour (from Abbeville to Texas border)		Calcasieu-Sabine, Mermentau	
4	56	Raising and maintaining Highways 82 and 27 in Cameron Parish		Calcasieu-Sabine	State Master Plan
5	57	Proposed hurricane protection levee for 30-			

		A storm surge at coastline.			
6	65	Cameron: Use old Calcasieu Lock for flood control.			
7	138	Raise existing oilfield canals spoil bank alignments for storm surge			
8	114a	LA Highway 333/82 Hurricane Protection	N/A	Mermentau	Vermilion Parish
9	114b	LA Highway 330 Hurricane Protection	N/A	Mermentau	Vermilion Parish
10	141	Four Mile Canal Structure (V3)	N/A	Mermentau	Vermilion Parish Plan
11	142	Hebert Canal Watershed/storm protection (V5)	N/A	Mermentau	Vermilion Parish Plan
12	143	Flood Control Structure at Oaks Canal (V8)	N/A	Mermentau	Vermilion Parish Plan
13	144a	Extension of Protection Levee on the marsh/upland interface (V6) to GIWW West of Forked Island	Protection Levee on the marsh/ upland interface	Mermentau	Vermilion Parish Plan
14	144b	Protection Levee on the marsh/upland interface (V6)			
15	144c	Extension of Protection Levee on the marsh/upland interface (V6) to Delcambre Canal			
16	146	Gueydan 100 yr ring levee protection PU4_fl_1000_3	Gueydan ring levee	Mermentau	LACPR
17	149a	C-RL-1000-1 Lake Charles Ring Levee/CL-RL-100-1/CL-RL-400-1 (on same footprint)	Lake Charles ring levee	Calcasieu-Sabine	LACPR
18	150	Continuous levee along the GIWW from Vermilion Bay to west of Vinton		Calcasieu-Sabine, Mermentau	
19	155	100-year levee along the GIWW and 500-year ring levee around Vinton/Lake Charles.		Calcasieu-Sabine	
20	156	Continuous levee along the GIWW from Morgan City to Abbeville.		Calcasieu-Sabine, Mermentau, Teche-Vermilion	
21	159	Continuous levee from Franklin to Abbeville.			Draft State Master Plan
22	409	Kaplan 100 yr ring levee	Kaplan ring levee	Mermentau	MLODS/ LACPR

23	411	Greater Lake Charles region (New levee alignment 500 year protection provided by the flood protection system)	Lake Charles ring levee	Calcasieu-Sabine	MLODS/State Master Plan
24	412				
25	511	Boston Canal	N/A	Mermentau	Planning Team
26	513	Delcambre, Erath and vicinity levee alignment		Mermentau	LACPR

Data and Assumptions Applied to NED Plan Evaluation

Stage-Probability Curves Data and Assumptions:

- Blended rainfall flooding from the HEC-RAS model with surge flooding from the ADCIRC model. Therefore, damages could be from surge and/or rainfall flooding.
- Surge elevations are still water only (no waves).
- No surge results were available for the 1-yr to 25-yr frequencies because ADCIRC typically does not compute below the 50-yr threshold.
- To indicate whether the subunits is surge and/or rainfall dominated, hydraulics has designated subunits by "zone" as follows:
    - North-0 results are 100% HEC-RAS.
    - North-1 is HEC-RAS below the 100-year, the greater of HEC-RAS or ADCIRC at the 100-year, and ADCIRC above the 100-year.
    - North-2 is adjusted HEC-RAS at 100-year and below, with ADCIRC above the 100-year. From this point the magnitude of the adjustment is the smallest. Adjustments were ADDED to HEC-RAS values to simulate ADCIRC runs that are not calculated. The difference between 100-year events is the maximum adjustment and linearly decreases to zero at the 1-year event.
    - South-0 to South-2 are calculated the same as North-2, but the magnitude of adjustment keeps getting bigger with each successive group.

Cost Data and Assumptions:

- "Low" scenario cost calculated using $21M/mile armored; $19M/mile un-armored (grass only).
    - The unarmored cost is based on indexing the LACPR estimates to current levels assuming the existing ground elevation is +5 for a 12' levee elevation of +17 with contingency, the levee $/mile would be about $15.5M for the levee only. It would be around $18.6M if you include E&D and S&A. Rounded to $19M/mile.
    - Added $2 million/mile for additional armoring to the study authority measure.
    - Similar to the Westshore Lake Pontchartrain study levee costs.
- "High" cost calculated using $32M/mile armored; $29M/mile un-armored (grass only).
    - High costs based on 50% increase over Low costs rounded up to nearest million.
    - High costs are still lower than for some other studies (e.g. Morganza to the Gulf) but those costs were not used because of different soil conditions/geographic location (e.g. Morganza levees were in wetland/open water areas close to the Gulf vs. Southwest Coastal levees along the banks of the GIWW).

Damage/Benefit Data and Assumptions:

- Benefits assume a 100-yr levee in place.

- With-project damages for the 1-yr through 10-yr event and the 500-yr event (see highlighted cells in table 1) are assumed to be the same as the without-project values (no benefits for those events) for the following reasons:
  - 1-yr through 10-yr are rainfall events and those damages would remain even with the levee/pumps in place (assuming pumps only to alleviate induced flooding caused by levee in place, NOT to eliminate rainfall flooding that existed prior to the levee project).
  - The 500-yr event is assumed to overtop the 100-yr levee.
- With-project damages for the 25-yr to 200-yr event are assumed to be reduced to zero. The 200-yr event was included because Morganza 100-yr levee was shown to reduce damages up to the 200-yr event.

Screening of the NED Initial Array

Analysis of the initial array was conducted as described in Table C-3. Data generated by the structural inventory was assigned to the hydrologic units that would be protected by each structural plan. The annual damages were modeled, resulting in annual damages. Aggregated subunit damages avoided were then considered to be project benefits and used to estimate the project cost that could be supported for each plan. Costs were estimated based on previous project costs per distance measurement, with estimated pumping costs included. Benefits and costs were compared to determine the potential for benefit cost ratios that exceeded 1, and would therefore be justified.

Early modeling output that overlaid Expected Annual Damages (EAD) for structure inventory and sub unit damages was used in combination with screening results to form the intermediate array.

Table C-3, Summary of Initial Ring Levee Screening Steps and Results

What	Why	How (Methods/Assumptions)	Results
Adjusted structure inventory…	…to address repetitive damages and rebuild assumptions.	Similar to Morganza method, raised structures in the database that are below the existing (2012) 10-yr floodplain elevation to an elevation above the 100-yr floodplain.	Of the approximately 52,000 structures in the inventory, 3,881 were elevated above the 2012 100-yr floodplain.
Modeled annual damages…	…to determine without-project damages for existing (2012) conditions.	Ran HEC-FDA model by subunit (reach).	Total of $113M annual damages for the entire study area (90 subunits).
Screened subunits….	…to ensure only relevant subunits/data used for screening structural measures and to reduce unnecessary calculations.	Ignored subunits (1) with zero structures/damages (2) south of proposed levees or (3) north of proposed levees but dominated by rainfall flooding.	Of the 90 original subunits, only 40 used for screening because: 22 are wetland areas containing no structures; 22 are south of the GIWW and; 6 were north of proposed levees but dominated by rainfall damages.
Calculated existing annual benefits…	…for subunits behind levees to determine the existing benefits of proposed levee.	Used an Excel spreadsheet, data from Step 2, and a set of simplifying assumptions.	Varies by subunit. In $1000s in the Gueydan and Kaplan areas, almost $9M in an Abbeville subunit, and over $25M in one of the Lake Charles subunits.

What	Why	How (Methods/Assumptions)	Results
Aggregated subunit data…	…to estimate total annual benefits of each proposed levee measure.	Using maps and Excel spreadsheets.	Varies by ring levee. From thousands (Gueydan & Kaplan) to $35M for Lake Charles levees to over $87M (north of GIWW). See table C-2.
Adjusted annual benefits…	…to account for higher damages in the future due to RSLR and estimate equivalent annual benefits over the period of analysis.	Increased annual benefits by 50% based on trends from Morganza to the Gulf project.	From thousands (Gueydan & Kaplan) to $52M for Lake Charles levees to over $131M (north of GIWW). See table C-2.
Estimated total benefits…	…to determine the order of magnitude of project that could be justified.	Multiplied annual benefits by 20, which is approximately 1 over the interest and amortization factor based on the current interest rate and a 50-yr period of analysis.	From <$1M (Kaplan) to $1B (Lake Charles) to $2.6B (GIWW). See table C-2.
Estimated levee costs…	…for use in preliminary benefit-cost ratio calculations.	Estimated levee costs for low and high cost scenarios. See cost estimate assumptions.	From over $100M for a small ring levee to $2.6 to $3.9 Billion for the armored GIWW levee. See table C-2.
Estimated pumping costs…	…to account for costs of pumps to reduce interior induced flooding causes by levees.	Levee measures will likely require pumping to remove induced rainfall flooding. Pumping costs based on LACPR data.	From several $1M for the smallest ring levees to several $100M for the largest ring levees to over $800M for the GIWW alignment. See table C-2.
Summed levee and pumping costs…	…to get total costs for comparison to total benefits.	Estimated total costs for low and high cost scenarios.	From over $100M for a small ring levee to $3.4 to $4.7 Billion for the armored GIWW levee. See table C-2.
Compare benefits to costs…	…to determine which alternatives to include in the final array.	Excel spreadsheet. If both Low & High C > B, screen the measure out. If B > than Low C, carry measure forward (even if B < High C). If the High C > B > Low C, consider reformulating the measure before running ADCIRC to achieve B > C.	**Screened out** the armored 12-ft levee along the GIWW. Removed Gueydan and Kaplan from the comprehensive ring levee plan. See table C-2.

- B = Benefits; C = Costs; BCR = Benefit-Cost Ratio

Intermediate Array of NED Alternatives: After combining overlapping features; screening out features with large negative environmental impacts; and identifying ineffective/incomplete features such as highway raisings and lock and flood control structures, 13 features and sub-feature variations were carried forward.

The intermediate array of alternatives for evaluation was as follows:

- Armored 12-ft Levee along the GIWW (Recon Alt S-1) – Carried forward from initial array for evaluation.
- Gueydan ring levee (Feature 146) - Carried forward from initial array for evaluation.

- Kaplan ring levee (Feature 409) - Carried forward from initial array for evaluation.

- Lake Charles ring levees variations - Incremental variations on the Lake Charles ring levee carried forward from initial array for evaluation were evaluated including:
  - Lake Charles ring levee (Feature 149) - southern (east and west)
  - Lake Charles ring levee (Feature 149) - southern/eastern ring only
  - Lake Charles ring levee (Feature 149) - southern/western ring only
  - Lake Charles ring levee (Feature 411/412) - northern (east and west)
  - Lake Charles ring levee (Feature 411/412) - northern/east ring only
  - Lake Charles ring levee (Feature 411/412) - northern/west ring only

- Abbeville ring levee variations – Alternative variations on the Abbeville ring levee carried forward from initial array for evaluation were evaluated including:
  - Abbeville Marsh/Upland Interface (Feature 144b) – Adopted by the Vermilion Parish Policy Jury in their official Hurricane Protection/Restoration Plan in 2009. The Plan addresses features that would reduce storm surge by creating a multiple lines of defense. One of those features is a "Protection Levee on the Marsh/Upland Interface." The area of the marsh/upland interface, south of Louisiana Highway 330 follows the alignment of existing agricultural levees. The plan proposes to raise the height of those agricultural levees.
  - Abbeville ring levee along LA Hwy 330 (Feature 114b)
  - Abbeville ring levee along GIWW – carried forward from Recon Study.
  - Abbeville ring levee (shortened variation of feature carried forward from initial array for evaluation) – Excludes Erath and Delcambre

The evaluation of the intermediate array, presented in Table C-4, identified two plans on the east side of Lake Charles and one plan in the vicinity of Abbeville as viable options for further consideration. In considering other social and economic factors the PDT determined that it would be appropriate to retain plans that addressed the west side of Lake Charles for the final evaluation. Additionally the team opted to retain only the favorable plan that optimized net benefits for East Lake Charles. The evaluation also revealed, in the consideration of a plan focused specifically on community of Abbeville as compared to a larger plan, that a majority of the benefits seemed to be associated with the communities of Delcambre and Erath. As a result, the team also decided to iteratively restore an plan based on feature number 513, Delcambre, Erath and vicinity levee alignment, and retain all three plans for final evaluation.

Table C-4. Evaluation Data for Structural Plans.

Name (feature ID)	Levee Length (miles)	Existing Condition Adjusted EAD	Existing Condition Benefits based on Adjusted EAD	Future RSLR Benefits/ Existing Damages increased by 50%	Best Estimate Benefits x 20	"Low Cost Scenario" Levee + Pumps	"High Cost Scenario" Levee + Pumps	Are best estimate benefits x 20 greater than "Low" costs?	Are best estimate benefits x 20 greater than "High" costs?
1-Armored 12-ft Levee along the GIWW	122	$87M	<$87M	$131M	$2.6B	$3.4B	$4.7B	No	No
149a-Lake Charles RL - southern (east and west)	45	$52M	$35M	$52M	$1.0B	$1.3B	$1.8B	No	No
149a-Lake Charles RL - southern/eastern ring only	22.5	$42M	$31M	$46M	$929M	$576M	$801M	Yes	Yes
149a-Lake Charles RL - southern/western ring only	22.5	$10M	$4	$6M	$119M	$725M	$950M	No	No
411/412-Lake Charles RL - northern (east and west)	45	$41M	$29M	$43M	$866M	$1.2B	$1.7B	No	No
411/412-Lake Charles RL - northern/east ring only	22.5	$33M	$26M	$38M	$767M	$509M	$734M	Yes	Yes

Name (feature ID)	Levee Length (miles)	Existing Condition Adjusted EAD	Existing Condition Benefits based on Adjusted EAD	Future RSLR Benefits/ Existing Damages increased by 50%	Best Estimate Benefits x 20	"Low Cost Scenario" Levee + Pumps	"High Cost Scenario" Levee + Pumps	Are best estimate benefits x 20 greater than "Low" costs?	Are best estimate benefits x 20 greater than "High" costs?
411/412-Lake Charles RL - northern/west ring only	22.5	$8M	$3M	$5M	$99M	$706M	$931M	No	No
144b-Abbeville Marsh/Upland Interface	33	$20M	$16M	$24M	$484M	$990M	$1.3B	No	No
Abbeville RL along GIWW (from Recon)	30	$23M	$18M	$27M	$548M	$933M	$1.2B	No	No
114b-Abbeville RL along LA Hwy 330	13	$15M	$11M	$17M	$336M	$275M	$405M	Yes	No
Abbeville RL (shortened variation)	6.5	$4M	$4M	$6M	$121M	$151M	$216M	No	No
146-Gueydan Ring Levee	6	$546K	$386K	$579K	$12M	$120M	$180M	No	No
409-Kaplan Ring Levee	11	$32K	$32K	$48K	$960K	$215M	$325M	No	No

Evaluation of Nonstructural Measures

The study has evaluated nonstructural measures that include structure elevation, dry flood proofing, wet flood proofing, berms and small walls, structure relocations, acquisition, building restrictions, and code enforcement. A detailed explanation of some of these measures is provided below.

Structure elevation is a common and widely applied nonstructural measure in the region and in the nation. Structure elevation is primarily focused on residential structures and implemented by private sector contractors, many of which have many years of experience. The technology used to implement structure elevation will be contingent upon the nature of the structure (foundation type, number of stories, exterior composition) and the nature of the soils, which is an important consideration in coastal Louisiana. Moreover, contractors typically specialize in one, or possibly more, structure elevation technology.

Dry flood proofing is a method of preventing flood water from entering the structure through the application of impermeable materials to the perimeter of the building and the placement of barriers at entrances. This approach is generally applied to nonresidential structures since the nature of the construction is more amenable to this type of retrofitting. While technically applicable to residential structures, the National Flood Insurance Program gives no credit to residential property owners for this method of flood mitigation for the purpose of determining flood insurance premiums, therefore leaving structure elevation as their primary financial incentive. Materials technology and techniques of application often vary, but the nature and scope of this approach to reducing flood risk is generally consistent from structure to structure. Dry flood proofing is effective for flood depths not greater than three feet above the adjacent ground.

In contrast, wet flood proofing consists of physically modifying the structure, except for its foundation, and the relocation of damageable items such that the interaction of the structure and flood water will result in less economic damage. The techniques applied for wet flood proofing can vary widely, is customized for each structure, and can only be determined by site inspection. Like dry flood proofing, there is a limit to its effectiveness, generally three feet of flood depth, although opportunities for performance of greater than three feet often are available depending upon individual circumstances.

Berms and small walls are engineered features with a footprint that closely approximates the perimeter of the structure being protected. What distinguishes this feature from local levees or ring levees is that they do not alter the hydrology of the flood plain and have no significant environmental impacts. Heights of these features range generally from 3 to 6 feet.

Structure relocation consists of the physical conveyance of a structure from its current location to another vacant parcel that has significantly reduced flood risk. The technology involved is reasonably straightforward, but not all structures are candidates for this type of measure as the footprint of the structure itself must be able to accommodate the capacity of the equipment needed to conduct the haul.

Acquisition as a nonstructural measure is more accurately described as acquisition of the structure and demolition of the structure. The implementation of property acquisition will be described in the Real Estate Plan. To complete this nonstructural measure, the structure thus acquired would be demolished to remove the asset from the flood plain and thereby entirely

eliminate flood risk. The degree of engineering planning needed to execute demolition is limited and the techniques required to implement include the deployment of conventional, specialized, mobile construction equipment.

Although all of the nonstructural measures described above were are viable options for implementation and were considered, the evaluation of nonstructural measures included only those that relate to structure elevation, dry flood proofing, and acquisition. Subsequent investigations of nonstructural measures at a higher level of detail in future studies will include the full range of nonstructural measures as presented earlier.

Implementation Considerations

Implementation of structure elevation is expected to be performed by private contractors consistent with the requirements outlined in the Real Estate Plan. Parish or community ordinances (building codes) articulate specific engineering requirements necessary to issue a permit for structure elevation and a certificate of occupancy once the elevation is completed. These ordinances must conform to the minimum flood plain management requirements as contained in Chapter 44 of the Code of Federal Regulations (44 CFR Part 60) as a condition of participation in the National Flood Insurance Program. Among those requirements is an elevation certificate issued by a licensed public engineer, and associated inspections by public officials related to the enforcement of electrical, plumbing, and other codes as utilities are reestablished.

In the implementation of structure elevation as a Federal project, the role of the non-Federal sponsor would include the review of plans and specifications provided by the private sector contractor as a condition of the flood mitigation agreement between the Corps, the non-Federal sponsor, and the property owner. The objective of the review of the plans and specifications is to ensure that they comply with existing engineering standards and regulatory guidance as presented in local ordinances, the Louisiana State Building Code, and 44 CFR Part 60.

For flood proofing measures, the review of plans and specifications by the non-Federal sponsor relies upon existing Corps guidance that is found in Engineering Pamphlet 1165-2-314 - Flood Proofing (15 December 1995). This guidance provides detailed considerations to be applied to the definition, classification, design, performance, and evaluation of dry flood proofing techniques. The guidance is primarily directed to flood proofing measures that are expected to perform under conditions of riverine flooding. Special consideration of the coastal storm flooding characteristics as they apply to flood proofing measures in the Southwest Coastal study area will be developed.

The implementation of the types of other nonstructural measures are expected to follow a protocol similar to those described for structure raising and acquisition. The Corps would provide specific engineering criteria to the non-Federal sponsor that would be used as the standard against which the plans and specifications of the measures would be evaluated.

Focused Array of NED Alternatives

Based on the PDT's assessment of the evaluation of the intermediate array six structural plans were identified for the focused array and more detailed analysis. The PDT also determined from initial evaluations that a programmatic non-structural risk reduction plan was viable. Based on the screening conclusions, the focused array of action alternative plans includes the following:

0. No action
1. Lake Charles ring levee ("Eastbank" Feature 149)
   - southern/eastern ring only
2. Lake Charles ring levee ("Westbank Sulphur South" Feature 149)
   - southern/western ring only
3. Lake Charles ring levee ("Westbank Sulphur Extended" Feature 411/412)
   - northern/west ring only
4. Abbeville ring levee along LA Hwy 330 ("Abbeville to Delcambre" Feature 114b)
5. Delcambre, Erath and vicinity levee alignment (Feature 513)
6. Abbeville levee (shortened variation)
7. Nonstructural Plan (Nonstructural Justified Reaches)
8. Nonstructural Plan (Nonstructural 100-Year Floodplain)

Completion of the NED Formulation Process

The comparison of the focused array, Final array, and identification of the Tentatively Selected Plan is fully documented in Chapter 2 of Main report.

NER PLAN FORMULATION

NER Goal: Provide ecosystem restoration to achieve ecosystem sustainability.

Problems	Opportunities	Objectives	Measures
Increased flood durations in wetlands (resulting in wetland loss)	Add or modify water control and/or drainage structures.	Objective 2. Improve hydrologic connectivity of wetlands to prevent scouring and loss of wetland soils and reduce storm surge-deposited saltwater residency time. Objective 3. Reduce flooding in non-flotant fresh and intermediate marshes during the vegetation growing season (March – September).	Hydrologic and salinity control structures or operational changes.
Erosion of channel banks and shorelines (resulting in wetland loss)	Stabilize navigation channel banks, lake rims, and coastal shorelines.	Objective 4. Reduce erosion of canal banks and shorelines in critical areas to protect adjacent wetlands.	Marsh Bank and shoreline stabilization features (breakwaters, riprap, dunes vegetative plantings, artificial reefs)
Deforestation and mining of chenier ridges and oyster beds.	Stop sand mining and restore chenier and oyster habitat.	Objective 5. Restore critical geomorphologic features, such as marshes and cheniers, to maintain their function as wildlife habitat and as protective barriers to inland areas.	Replant chenier ridges with native trees. Re-seed oyster beds.
Wetland loss	Restore wetland habitat.	Objectives 2 – 5 listed above.	Marsh creation, terracing, plantings.

Features were initially assembled from these existing studies:

1. LACPR Planning Unit 4 Coastal Restoration Plan
2. 2007 State Master Plan Coastal Restoration Plan

These plans were dissected into individual features and features were added from other sources (parish plans, NEPA scoping, interagency PDT). NER measures are categorized by Measure type and by basin in the following set of tables.

Table C-5, Hydrologic and Salinity Control Measures

Basin	ID	Feature Name
Calcasieu-Sabine Basin	7	Salinity control structures in Calcasieu Ship Channel near Ferry/at the Gulf of Mexico
	48	Salinity Control Structure at Sabine Pass
	407	Structure on GIWW at Gum Cove Ridge
	17a	Salinity control structure on Alkali Ditch
	17b	Salinity control structure on Crab Gully
	17c	Salinity control structure on Black Lake Bayou near Hackberry (Kelso Bayou)
	74a	Need spillway structures at East Calcasieu Lake
Mermentau Basin	74b	Need spillway structures at Humble Canal
	74c	Need spillway structures North of Deep Lake
	13	Freshwater introduction/retention structure or sill on Little Pecan Bayou
	21a	Hydraulic Improvements in Mermentau Basin at Highways 82 and 27: East of Calcasieu Lake (Big Burn)
	21b	Hydraulic Improvements in Mermentau Basin at Highways 82 and 27: South of Grand Lake (Little Pecan Bayou Hydrologic Restoration)
	21c	Hydraulic Improvements in Mermentau Basin at Highways 82 and 27: South of White Lake (South Pecan Freshwater Introduction)
Teche-Ver.	304a	Southwest Pass Sills - Southwest portion
	304b	Southwest Pass Sills – Northeast portion
	507	Reef like feature from Dead Cypress Point (Near Cypremort Point) to NW corner of Marsh Island
	508	Reef like feature from Maroon Point to Lake Point (Marsh Island)
	603	Control structure at Tom's Bayou
All	602	Operational changes to existing structures (not on map)

The initial set of chenier measures included all cheniers and elevated features identified by the Providence Engineering, Chenier and Natural Ridges Study (2009) and are presented in the table below.

Table C-6, Preservation/Restoration of Unique Natural Features (Oyster Reefs & Chenier Ridges) Measures

Basin	Subunit	ID	Feature Name/Description
Calcasieu-Sabine	Sabine Lake	604	**Preservation of Sabine Historic Oyster Reefs**
	038 – Sabine Ridges	510a	**Blue Buck Ridge** - Eight tracts totaling approximately 524 acres were identified.
		510b	**Hackberry Ridge** - Three tracts totaling approximately 149 acres were identified. The western two miles (including the 63 acre tract) of this measure have been identified by the Louisiana Natural Heritage Program as "Remnant Chenier Forest", but appear to have been damaged by recent hurricanes.
	009 – Cameron-Creole Front Ridge	510d	**Front Ridge** - In general, the eastern 3 miles of this measure do not encompass large swaths of suitable elevation. Of the remainder, eleven tracts totaling approximately 459 acres were identified.
Mermentau	061- Grand Chenier Ridge	416	**Grand Chenier Ridge** - In general, the eastern 6 miles of this measure do not encompass large swaths of suitable elevation. Of the remainder, nine tracts totaling approximately 252 acres were identified.
Teche-Vermilion	091 – East Freshwater Bayou/Cheniere au Tigre Bayou	509c	**Bill Ridge** - Three tracts were indentified that encompass approximately 9 acres of the northern ridge, and roughly 7 and 6 acres of the southern ridge. The middle section of the southern ridge was excluded due to insufficient elevation.
		509d	**Cheniere Au Tigre** - The majority of this chenier is currently forested with the exception of an 8 acre tract on the western end. The eastern part of the measure along the Gulf shoreline was screened out due to concerns about the sustainability of tree plantings in these exposed areas.

Table C-7, Marsh Restoration Measures

Basin	ID	Feature Description	Project Area
Calcasieu-Sabine	3a1	Black Lake marsh restoration	597 ac
	3c1	Cameron-Creole marsh restoration	2,147 ac
	3c2		1,137 ac
	3c3		1,322 ac
	3c4		1,016 ac
	3c5		3,389 ac
	124a	Mud Lake marsh restoration	1,102 ac
	124b		341 ac
	124c		2,658 ac
	124d		623 ac
	135a	Sweet/Willow Lake marsh restoration	1,620 ac
Mermentau	127c1	Marsh restoration at East Pecan Island on west side of Freshwater Bayou	1,176 ac
	127c2		1,300 ac
	127c3		894 ac
	47a1	Terracing south of Highway 82	889 ac
	47a2		1,562 ac
	47c1		984 ac
	47c2		1,199 ac
	47f	Terracing south of Highway 82	809 ac
	47h	Terracing south of Highway 82	1,520 ac
Teche-Vermilion	306a1	Rainey Marsh Restoration	2,089 ac
	306a2		2,476 ac
	306b1		1,245 ac
	306b2		1,371 ac
	306b3		2,233 ac

Table C-8, Shoreline/Bankline Stabilization Measures

Basin	ID	Feature Description	Project Length
Calcasieu -Sabine	49b1	Shoreline protection for Calcasieu Lake/ Cameron-Creole levee	77,253 lf
	5a	Holly Beach shoreline	39,445 lf
Mermentau	6b1	Gulf shoreline of Rockefeller NWR	58,707 lf
	6b2		42,805 lf
	6b3		37,911 lf
	16b (west)	Freshwater Bayou – unprotected portions of west bank	48,123 lf
Teche-Vermilion	16b (east)	Freshwater Bayou –unprotected portions on east bank	72,817 lf
	99a	Gulf shoreline protection in front of Cheniere Au Tigre ridge	9,235 lf
	113b2	Vermilion Bay shoreline: Southwest section	42,473 lf

Initial Screening of NER Measures

NER features were next screened by measure type across the entire study area.

Chenier Reforestation Measure Screening - To identify the most critical/strategic cheniers or segments of cheniers to reforest, the implementability and sustainability of the project was considered. Areas were deemed unsuitable for reforestation and were screened out for the following reasons:

- Low elevation. Unsuitable due to poor soil drainage and potential exposure to high salinities.
- Shoreline erosion. Areas exposed to high rates of shoreline erosion unsustainable.
- Forested areas. Areas with existing canopy cover would not benefit from reforestation.
- Developed areas. The presence of roads, homes, utilities, or oil and gas infrastructure, etc. restricts reforestation efforts.

Pecan Island Ridge (Measure 509a) was screened out because Pecan Island ridge is densely developed with no large (>5 acres) tracts available for reforestation. Mulberry Ridge (509b) and Belle Isle Ridge (509e) was screened out because elevations are less than +5 feet NAVD 88 and are unsuitable for reforestation to achieve long-term sustainability. Hackberry Beach Ridge (510c) was screened out because the only area with sufficient elevation is immediately adjacent to the beach, and tree plantings would not be sustainable in that location.

Cheniers carried forward included Grand Chenier Ridge (Measure 416), Bill Ridge (Measure 509c), Cheniere au Tigre Ridge (509d), Blue Buck Ridge (510a), Hackberry Ridge (510b), and Front Ridge (510d). These sites were further divided into 35 reforestation tracts totaling approximately 1,413 acres.

Hydrologic & Salinity Control Measure Screening – Modeling performed for the 2012 State Master Plan showed that some H&S control features had only modest or little benefits (see figure C-1). Measures benefiting less than 500 acres were screened out. Some H&S control measures work together. See table C-9 below

Table C-9, Hydrologic & Salinity Control Measure Screening Summary

ID	Feature Name	Conclusions
7	Salinity control structures in Calcasieu Ship Channel near Ferry/at the Gulf of Mexico	These measures work as a unit for exterior perimeter control and preclude the need for Alkali Ditch/Crab Gully/Kelso Bayou, GIWW at Gum Cove Ridge (407), and East Calcasieu Lake (74a).
48	Salinity Control Structure at Sabine Pass	
407	Structure on GIWW at Gum Cove Ridge	
17a	Salinity control structure on Alkali Ditch	These three measures work as a unit (do 17a, 17b, and 17c together).
17b	Salinity control structure on Crab Gully	
17c	Salinity control structure on Black Lake Bayou near Hackberry (Kelso Bayou)	
74a	Need spillway structures at East Calcasieu Lake	
74b	Need spillway structures at Humble Canal	Screened out <500 acres (see figure C-1)
74c	Need spillway structures North of Deep Lake	Screened out <500 acres (see figure C-1)
13	Freshwater introduction/retention structure or sill on Little Pecan Bayou	
21a	Hydraulic Improvements in Mermentau Basin at Highways 82 and 27: East of Calcasieu Lake (Big Burn)	Screened out because structure already constructed there under the CWPPRA authority.
21b	Hydraulic Improvements in Mermentau Basin at Highways 82 and 27: South of Grand Lake (Little Pecan Bayou Hydrologic Restoration)	Screened out <500 acres (see figure C-1)
21c	Hydraulic Improvements in Mermentau Basin at Highways 82 and 27: South of White Lake (South Pecan Freshwater Introduction)	Screened out <500 acres (see figure C-1)
304a	Southwest Pass Sills - Southwest portion	Screened out <500 acres (see figure C-1)
304b	Southwest Pass Sills – Northeast portion	Screened out <500 acres (see figure C-1)
507	Reef like feature from Dead Cypress Point (Near Cypremort Point) to NW corner of Marsh Island	Screened out because (1) the Louisiana State Master Plan showed only modest benefits for these measures (2) the measures are outside the study area (3) these measures may be constructed with Oil Spill Restoration dollars.
508	Reef like feature from Maroon Point to Lake Point (Marsh Island)	Screened out for same reasons as 507 above.
603	Control structure at Tom's Bayou	Screened out <500 acres (see figure C-1)
602	Operational changes to existing structures (not on map)	Still a possible measure.

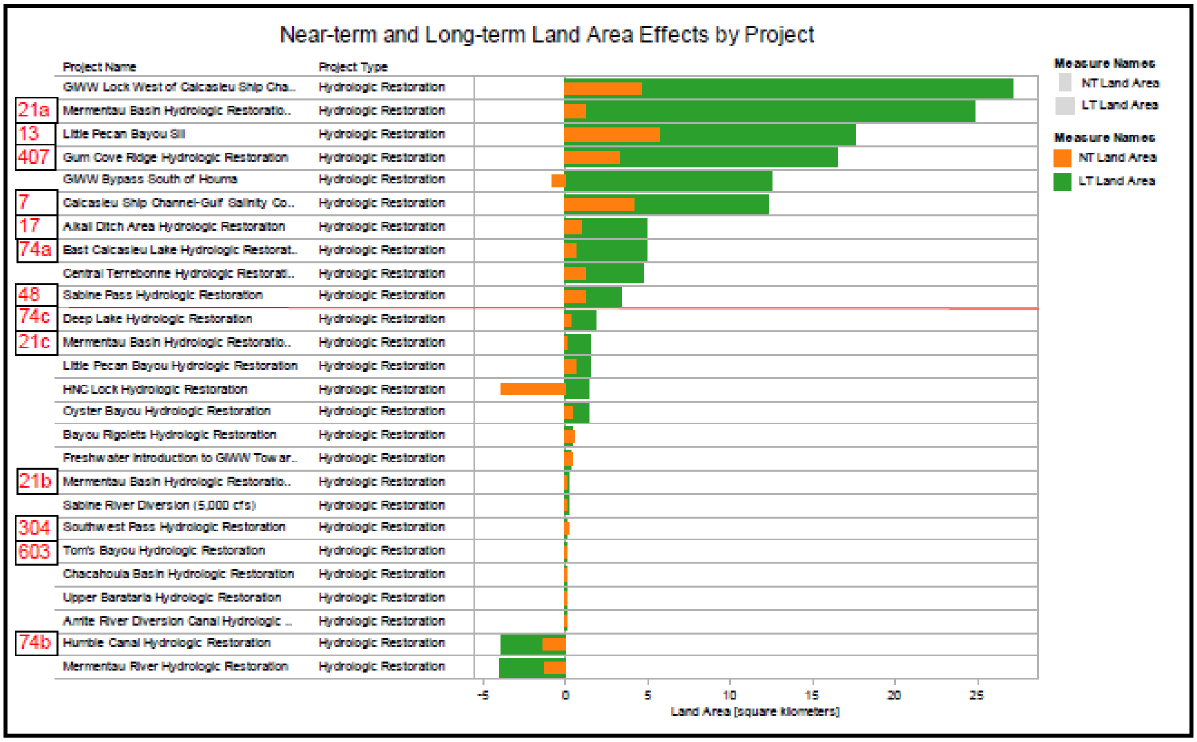


Figure C-1. State Master Plan Modeling Results used for H&S measure screening.

Marsh Restoration Measure Screening – Started with proposed marsh restoration for eight geographic locations across the study area. Divided these large marsh restoration areas into 29 individual measures/sites ranging in size from hundreds of acres to thousands of acres, totaling over 40,000 acres (refer to table NER1 for more details). Five measures/sites were screened out for the following reasons:

- Two of the Black Lake sites (Measures 3a2 and 3a3) were screened out because the areas are already permitted for use by a liquid natural gas company (SEMPRA).
- The Commissary Point site (Measure 3d) was screened out because it was found to be the least efficient marsh restoration measure. Its cost per net acre is over five times that of the most efficient marsh restoration measure. The measure is located in Subunit 45, which is gaining at a rate of +0.021%/year. It was gaining prior to Hurricane Rita at a rate 0.396%/year so the hurricane did have an impact, just not enough to convert the area to a loss trend. Based on this information, it appears that the marsh in this area will rebound on its own.
- One of the two Sweet/Willow Lake sites (Measure 135b) was dropped because of sustainability issues. The depth near 135b is likely greater than 2 feet. Terracing projects in this area have failed in the past because of high subsidence rates.

Table C-10, Marsh Restoration Measure attributes and Screening Summary.

Site	ID	Total Acres*	First Cost ($Million) **	Effective-ness: Net Acres***	Efficiency: Cost/Net Acre	In or out?	Comments and/or Screening Rationale
Black Lake	3a1	597	$20.4	545	$37,431	In	Based on the recent Black Lake project, cost estimate may be too low if the area is deeper than estimated. Potential synergy with any proposed hydro/salinity control measures that would prevent saltwater intrusion in the area. Synergy with other beneficial use projects in the Black Lake area.
	3a2	1,465	$40.5	1,271	$31,865	**Out**	Measures 3a2 and 3a3 were screened out because the areas are already permitted for use by LNG company (SEMPRA).
	3a3	490	$15.3	465	$32,903	**Out**	
Cameron-Creole	3c1	2,147	$43.7	1,333	$32,783	In	The Calcasieu Lake rim is considered a critical landscape feature. These marsh creation measures help preserve the outer lake rim and have synergy with proposed shoreline stabilization measure 49b1 which helps preserve the inner lake rim and hydrologic/salinity control levee. These measures are also located within or adjacent to the Cameron Prairie National Wildlife Refuge.
	3c2	1,137	$31.8	808	$39,356	In	
	3c3	1,322	$36.9	999	$36,937	In	
	3c4	1,016	$28.3	771	$36,706	In	
	3c5	3,389	$80.8	2,412	$33,499	In	

Site	ID	Total Acres*	First Cost ($Million) **	Effective-ness: Net Acres***	Efficiency: Cost/Net Acre	In or out?	Comments and/or Screening Rationale
Commissary Point	3d	399	$13.0	73	$178,082	**Out**	Measure 3d is the least efficient marsh restoration measure. Its cost per net acre is over five times that of the most efficient marsh restoration measure. The measure is located in Subunit 45, which is gaining at a rate of +0.021%/year. It was gaining prior to Hurricane Rita at a rate 0.396%/year so the hurricane did have an impact, just not enough to convert the area to a loss trend. Based on this information, it appears that the marsh in this area will rebound on its own.
S. of Hwy 82	47a1	889	$41.9	827	$50,665	In	Measure 47h may be built with CGBG funds. Measures 47f and h were reclassified as marsh creation, and then subsequently dropped because we decided to select marsh creation measures that would best reinforce critical landscape features, with particular emphasis on areas that are exposed to saltwater, tidal and wave action because it is critical to introduce new sediment to these areas to increase wetland sustainability. 47f and h are not exposed to high salinities as much as the other marsh creation areas selected.
	47a2	1,562	$67.2	1,362	$49,339	In	
	47c1	984	$45.3	930	$48,710	In	
	47c2	1,199	$58.2	1,176	$49,490	In	
	47f	809	$38.7	789	$49,049	**Out**	
	47h	1,520	$58.4	516	$113,178	**Out**	
Mud Lake	124a	1,102	$35.8	820	$43,659	In	These measures are all relatively efficient with the exception of measure 124d; however, 124d is critical because it reinforces the West Cove lake rim which is a critical landscape feature. Most of measure 124d is located either within or adjacent to the Sabine NWR. Measure 124a is also part of the Sabine National Wildlife Refuge and is adjacent to Hwy 27. Measure 124c is adjacent to Hwy 27 and would have synergy with measure 5a.
	124b	341	$12.4	248	$50,000	In	
	124c	2,658	$71.6	1,778	$40,270	In	
	124d	623	$13.8	159	$86,792	In	

Site	ID	Total Acres*	First Cost ($Million) **	Effective-ness: Net Acres***	Efficiency: Cost/Net Acre	In or out?	Comments and/or Screening Rationale
Pecan Island	127c 1	1,176	$41.7	648	$64,352	In	The 127 measures are critical to preventing further degradation to the wetlands to the west of Freshwater Bayou. They would also have synergy with existing and proposed Freshwater Bayou stabilization measures.
	127c 2	1,300	$61.2	1,182	$51,777	In	
	127c 3	894	$28.4	370	$76,757	In	
Sweet/	135a	1,620	$28.0	663	$42,232	**Out**	Not in a critical area for marsh creation (i.e. salinities are relatively low in this location).
	135b	2,146	$71.5	1,699	$42,084	**Out**	Measure 135b was dropped because of sustainability issues. The depth near 135b is likely greater than 2 feet. Terracing projects in this area have failed in the past because of high subsidence rates.
Rainey Marsh	306a 1	2,089	$52.2	631	$82,726	In	Measures 306b1-3 were screened out because the portion of Freshwater Bayou bank that is adjacent to them is relatively solid and protected by rock.
	306a 2	2,476	$74.7	1,309	$57,066	In	
	306b 1	1,245	$35.5	408	$87,010	**Out**	
	306b 2	1,371	$40.3	574	$70,209	**Out**	
	306b 3	2,233	$52.0	623	$83,467	**Out**	

*Total wetland acres to be constructed by proposed measure.
** Rounded to nearest 100,000.
***Net acres over the period of analysis. Land change rates used to calculate net acres based on USGS hyper-temporal analysis.

Shoreline Protection Measure Screening – Approximately 1.9 million linear feet (or 360 miles) of bank and shoreline stabilization measures were evaluated. Of the approximately 30 bank/shoreline features evaluated, 20 were screened out for the following reasons:

- All four of the Grand Lake features (features 12a – 12d) were screened out. Two of the features produced zero benefits. The other two features were not very effective or efficient (cost/net acre 2 to 4 times the average).
- Schooner Bayou (feature 16a) was not very effective or efficient (cost/net acre 4 to 5 times the average).
- It was not cost effective to rock the entire length of the GIWW (feature 26). Shoreline stabilization may be considered as part of measures located adjacent to the GIWW (e.g. Marsh Restoration features 3a1) if required by field conditions.
- Although West Cove is an important lake rim because of its proximity to Hwy 27 and the Sabine National Wildlife Refuge, the 49a features are not very cost efficient or effective in terms of net acres. The area most at risk in the future without project condition can be more cost effectively protected by marsh restoration feature 124d.
- The Lake Calcasieu features were dropped because there were either not effective (49b1 benefited limited to levee protection) or not efficient (49b2 cost/net acre 3 times the average).
- Four of the five Vermilion Bay features were screened because of low effectiveness/efficiency. For example, feature 113a2 was screened out because shoreline loss rates are low (2.6 ft/yr) resulting in low efficiency. Although over 100 net acres could be preserved, a shoreline stabilization feature would not be effective in reducing interior wetland loss.
- All of the Southwest Past (303's) and Freshwater Bayou (606's) measures were screened because they were not effective or efficient.

Table C-11, Bank/Shoreline Protection Feature Attributes and Screening Summary.

Site	ID	Total Length (feet)	Cost ($Million)	Effective-ness: Net Acres	Efficiency: Cost/Net Acre	In or out?	Comments and/or Screening Rationale
Holly Beach	5a	39,445	$43.0	870	$49,409	In	Critical protection for Holly Beach community and Hwy 27. Synergy with marsh measure 124c.
Rocke-feller	6b1	58,707	$80.6	3,395	$23,726	In	Critical protection for the Rockefeller Wildlife Refuge. Synergy with CWPPRA project ME-18. Soil/foundation concerns are currently being analyzed through demonstration projects.
	6b2	42,805	$58.9	2,638	$22,316	In	
	6b3	37,911	$52.3	1,640	$31,864	In	

Site	ID	Total Length (feet)	Cost ($Million)	Effective-ness: Net Acres	Efficiency: Cost/Net Acre	In or out?	Comments and/or Screening Rationale
Grand Lake	12a	11,491	$5.9	0	N/A	**Out**	Measures 12a and 12b don't meet objectives because they produce zero benefits.
	12b	1,240	$3.3	0	N/A	**Out**	
	12c	13,138	$6.2	29	$214,916	**Out**	Not effective – the combined benefits of 12c and 12d are less than 100 net acres. Not efficient – Cost/net acre 2 to 4 times the average.
	12d	45,248	$21.4	59	$362,497	**Out**	
Schooner Bayou	16a	20,317	$14.2	29	$488,244	**Out**	Not effective – less than 30 net acres. Not efficient - Cost/net acre 4 to 5 times the average.
Freshwater Bayou	16b-west	~ 150,000	$16.5	181	$91,160	In	Freshwater Bayou and surrounding marshes are critical landscape features. From an indirect benefits perspective, on the east bank there is a greater area of potentially vulnerable wetlands behind the southern part as compared to the northern part.
	16b-east (N)		$13.0	121	$107,438	In	
	16b-east (S)		$32.5	450	$72,222	In	
GIWW	26	960,079	$488.0	1,958	$249,212	**Out**	Not cost effective to rock the entire length of the GIWW. Shoreline stabilization may be considered as part of measures located adjacent to the GIWW (e.g. Marsh Measure 3a1) if required by field conditions.
West Cove	49a1	33,839	$18.4	87	$211,874	**Out**	Although West Cove is an important lake rim because of its proximity to Hwy 27 and the Sabine National Wildlife Refuge, the 49a measures are not very cost effective or effective in terms of net acres. The area most at risk in the future without project condition can be more cost effectively protected by marsh restoration measure 124d.
	49a2	36,701	$20.0	107	$186,534	**Out**	
Lake Calcasieu	49b1	82,282	$41.4	402	$102,934	**Out**	Benefits mostly limited to levee protection.
	49b2	151,249	$31.0	90	$344,714	**Out**	Not effective or efficient.

Site	ID	Total Length (feet)	Cost ($Million)	Effective-ness: Net Acres	Efficiency: Cost/Net Acre	In or out?	Comments and/or Screening Rationale
Cheniere au Tigre	99a	9,235	$7.2	86	$83,359	In	Part of the Cheniere au Tigre State Park. Despite producing less than 100 net acres, measure retained because Cheniere au Tigre is a critical landscape feature and shoreline stabilization is critical to protecting the Cheniere au Tigre reforestation measure.
Vermilion Bay	113a1	16,085	$11.6	46	$252,671	**Out**	Not efficient or effective.
	113a2	65,728	$46.1	185	$249,027	**Out**	Screened out because shoreline loss rates are low (2.6 ft/yr) resulting in low efficiency. Although over 100 net acres could be preserved, shoreline stabilization measure would not be effective in reducing interior wetland loss.
	113a3	N/A	N/A	N/A	N/A	**Out**	Measure was reformulated to remove sections located outside of the study area. The remaining portions within the study area were found to be stable.
	113b1	52,845	$37.1	288	$128,940	**Out**	Below average efficiency.
	113b2	42,473	$29.8	282	$105,630	In	Measure may be shortened to improve efficiency and protect the most vulnerable portion of the marsh.
Southwest Pass	303a1	6,953	$4.1	15	$275,526	**Out**	Not effective or efficient.
	303a2	31,434	$17.2	79	$217,643	**Out**	
	303b1	9,288	$5.4	18	$299,819	**Out**	
	303b2	17,353	$9.7	55	$175,864	**Out**	
Freshwater Bayou	600a	1,980	$2.0	14	$146,346	**Out**	Not effective or efficient.
	600b	4,165	$3.9	14	$276,155	**Out**	
	600c	5,241	$4.8	10	$481,053	**Out**	

Completion of the NER Formulation Process

The combination of the remaining features to develop a focused array of NER alternatives is described in Chapter 2, Plan Formulation, of the Main Report. Also fully documented in Chapter 2 is the comparison of the NER focused array, selection of the final array of alternative plans, and the identification of the NER Tentatively Selected Plan.

Contents

PART 1: BACKGROUND INFORMATION FOR EVALUATION OF NATIONAL ECONOMIC DEVELOPMENT (NED) ALTERNATIVES.

INTRODUCTION

General. This Appendix presents an economic evaluation of the six hurricane and storm surge risk reduction structural alternatives, two nonstructural alternatives, in addition to the no-action alternative that were considered for the Southwest Coastal Louisiana Feasibility Study, which includes Calcasieu, Cameron and Vermilion Parishes in the state of Louisiana. It was prepared in accordance with Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, and ER 1105-2-101, Planning Guidance, Risk Analysis for Flood Damage Reduction Studies. The National Economic Development Procedures Manual for Flood Risk Management and Coastal Storm Risk Management, prepared by the Water Resources Support Center, Institute for Water Resources, was also used as a reference, along with the Users Manual for the Hydrologic Engineering Center Flood Damage Analysis Model (HEC-FDA).

Parts 1, 2, and 3 of this economic appendix consists of a description of the methodology used to determine National Economic Development (NED) damages under existing and future conditions and projects costs. The evaluation reports damages and costs at October 2012 price levels. The year 2025 was identified as the base year for each of the alternatives as the basis for plan comparison. Six structural, two nonstructural, in addition to the no-action, alternatives were screened to arrive at the tentatively selected plan (TSP).

NED Benefit Categories Considered. The NED procedure manuals for coastal and urban areas recognize four primary categories of benefits for flood risk management measures: inundation reduction, intensification, location, and employment benefits. The majority of the benefits attributable to a project alternative generally result from the reduction of actual or potential damages caused by inundation. Inundation reduction, which is the only category of NED benefits addressed in this evaluation, includes the reduction of physical damages to structures, contents, and vehicles.

Physical Flood Damage Reduction. Physical flood damage reduction benefits include the decrease in potential damages to residential and commercial structures, their contents, and the privately owned vehicles associated with these structures. Damages included in the appendix considered both existing and future conditions. Projections of the future development expected in the study area during the 50 year period of analysis were included as part of the future without-project condition analysis.

Office of Management and Budget survey forms were used to collect information on the value and placement of contents in the industrial facilities located in the study area. The information from these surveys was used to develop the physical flood damage and benefits for these industrial properties.

Emergency Cost Reduction Benefits. Emergency costs are those costs incurred by the community during and immediately following a major storm or hurricane. They include the costs of emergency measures, such as evacuation and reoccupation activities conducted by local governments and homeowners, repair of streets, highways, and railroad tracks, and the subsequent cleanup and restoration of private, commercial, and public properties. In this evaluation, only the emergency cost reduction benefits associated with debris removal and cleanup and the reduction of damages to major and secondary highways and streets was considered. Emergency costs will be evaluated for the TSP in the draft feasibility report.

Regional Economic Development (RED). The RED account will be addressed in a separate appendix following the selection of a TSP to evaluate the project alternatives. If the economic activity lost in the flooded region can be transferred to another area or region in the national economy, then these losses are not included in the NED account. However, the impacts on the employment, income, and output of the regional economy are considered part of the RED account. The input-output macroeconomic model RECONS will be used to address the impacts of the construction spending only associated with the TSP, since only this alternative provides detailed cost information necessary to prepare a complete and accurate analysis.

DESCRIPTION OF THE STUDY AREA

Geographic Location. Located in southwest Louisiana the study area includes three parishes: Calcasieu, Cameron, and Vermillion. The Southwest Coastal evaluation area was divided into 81 unique hydrologic reaches. To enable an economic analysis of the project alternatives through the use of the HEC-FDA certified model, the area was further refined to include 90 reaches. It is bounded to the west by the Sabine River, which forms the Texas-Louisiana border, to the east by the border of Vermilion and Iberia parishes, and to the south by the Gulf of Mexico. The study area contains marshlands, agricultural lands, a wildlife refuge, and coastal communities that are not protected by any Federal levee system. Communities located within the study area include Lake Charles, Vinton, and Sulphur in Calcasieu Parish, Hackberry and Holly Beach in Cameron Parish, and Erath and Abbeville in Vermilion Parish. The area is subject to rainfall, tidal flooding and storm surge from tropical storms and hurricanes, which result in structural, agricultural, and environmental damages.

A map depicting the locations of the 90 hydrologic reaches within the study area is shown in the main report.

Land Use. The total number of acres of developed, agricultural, and undeveloped land in the study area is shown in Table 1. As shown in the Table, approximately 3 percent of the total acres in the study area are currently developed. Since there are approximately

834,414 acres of agricultural land and 1,312,216 acres of undeveloped land, there is sufficient land available to accommodate the projected residential and non-residential development through the year 2075 without impacting the wetlands in the area. This projected future development is expected to be located on parcels that tend to be on relatively higher ground and are the least exposed to flood risk.

SOCIOECONOMIC SETTING

Population and Number of Households. Table 2 displays the population in each of the parishes for the years 1970, 1980, 1990, 2000, and 2010 as well as projections for the year 2020 and the year 2080. Population projections are based on the Moody's County Forecast Database, which has population projections to the year 2038. Moody's projections were extended using a linear trend by New Orleans District based on historical data. As shown in Table 2, Calcasieu and Vermillion Parishes experienced a steady increase in population between 1970 and 2010. Cameron Parish experienced a decline in population following Hurricane Rita in 2005.

Table 3 displays the estimated population within the inventoried study area for the year 2010 and the projected population for the years 2025 and 2075. The 2010 estimates are based on an inventory of residential and non-residential properties assembled in 2010 by field survey teams. The number of inventoried residential structures was then multiplied by 2.7, the average number of persons per household in the study area in 2012. The annual compounded growth rate in population in the study area between 2010 and 2080 is expected to be 0.41 percent and 0.32 percent between 2020 and 2080.

Table 4 shows the total number of households in each parish for the years 1970, 1980, 1990, 2000, and 2010 and projections for the years 2020 and 2080. The projected number of households was based on the Moody's County Forecast Database and extended from the year 2038 to the year 2080 based on a linear growth rate using historical data.

Calcasieu and Vermillion experienced a steady increase in the total number of households between 1970 and 2010, which paralleled the growth in population. The number of households in Cameron decreased between 2000 and 2010 largely due to Hurricane Rita in 2005.

Income. Table 5 shows the per capita personal income levels for each parish for the years 1990, 2000, 2005, 2010 and 2011, the year with the latest available data. As shown in the table, the three parishes experienced a steady increase in per capita income between 1990 and 2011.

Employment. Table 6 shows the total employment by parish for the years 1970, 1980, 1990, 2000, 2010, and projections for the years 2020 and 2080. The employment projections were based on historical data and extended from the year 2011 to the year 2080 using linear extrapolation.

In all portions of the study area, growth is highly dependent upon the major employment sectors. With the exception of the city of Lake Charles in Calcasieu Parish, most of the land in the study area is sparsely populated. However, the area is rich in natural resources and industrial infrastructure. The economy of the coastal communities is centered on fishing, shrimping, and offshore oil services. The agricultural land located 30 to 40 miles inland is used for rice, sugar cane, and livestock production. The northern-most portion of the study area is heavily forested and supports a substantial timber industry. Lake Charles, which is the population center of the region, is the home of large oil refineries, petro-chemical plants, a deep-water port, McNeese State University, and casinos along the lakefront area.

Compliance with Policy Guidance Letter (PGL) 25 and Executive Order (EO) 11988. Given continued growth in employment, it is expected that development will continue to occur in the study area with or without the storm surge risk reduction system, and will not conflict with PGL 25 and EO 11988, which state that the primary objective of a flood risk reduction project is to protect existing development, rather than to make undeveloped land available for more valuable uses. However, the overall growth rate is anticipated to be the same with or without the project in place. Thus, the project will not induce development, but would rather reduce the risk of the population being displaced after a major storm event.

RECENT FLOOD HISTORY

Tropical Flood Events. While the three parishes have periodically experienced localized flooding from excessive rainfall events, the primary cause of the flood events that have taken place in the three-parish study area has been the tidal surges from hurricanes and tropical storms. During the past 25 years, coastal Louisiana was impacted by eight major tropical events: Hurricane Juan (1985), Hurricane Andrew (1992), Tropical Storm Isidore and Hurricane Lili (2002), Hurricanes Katrina and Rita (2005), and Hurricanes Gustav and Ike (2008). However, the major storms that affected this study area are Hurricane Rita (2005) and Hurricane Ike (2008).

Table 7 provides a summary of the total Federal Emergency Management Agency (FEMA) disaster assistance paid to all Louisiana policyholders as a result of these tropical events. The table includes the number of paid losses, the total amount paid, and the average amount paid on each loss. The total and average paid losses have been converted to reflect 2012 price levels. The table excludes losses that were not covered by flood insurance.

The following is a summary of the two major tropical events and their effects on the three-parish area.

Hurricane Rita. The most significant flood event to affect the Southwest Coastal area since Hurricane Audrey in 1957 was Hurricane Rita. Hurricane Rita made landfall along the Texas-Louisiana border on September 24, 2005, as a Category 3 storm with winds in excess of 120 miles per hour. A storm surge of approximately 15 - 20 feet affected the coastal region from Port Arthur, Texas to Terrebonne Parish, Louisiana. The flooding extended north to Lake Charles, where the downtown and residential areas around the lake were covered with 3 to 6 feet of flooding. With estimated losses of approximately $3 billion, Hurricane Rita became one of the most costly natural disasters in U.S. history. Approximately 55,000 housing units in Calcasieu, Cameron, and Vermilion parishes incurred flood damages as a result of this hurricane.

Approximately 2,000 square miles of farmland and marshes throughout the coastal area were inundated. According to the LSU AgCenter, agricultural losses totaled approximately $490 million. The agricultural resources impacted by the storm include sugarcane, cotton, rice, soybeans, timber, pecans, citrus, and livestock. The losses to aquaculture (crawfish, alligators, and turtles), fisheries (shrimp, oysters, and menhaden), and wildlife and recreational resources totaled approximately $100 million.

Hurricane Ike. On September 12 and 13, the Louisiana coastal region incurred flood damages as Hurricane Ike moved along the Louisiana coast. The area receiving the most widespread flooding from storm surge occurred in Southwest Louisiana, which includes the parishes of Cameron, Calcasieu, and Vermilion.

The hardest hit area was coastal Cameron Parish where almost all 2,900 homes and businesses in the area were impacted by the storm surge. Even though the area was spared a direct hit from the storm, floodwaters extended 30 miles inland to just south of the City of Lake Charles. Hundreds of residents were rescued by search and rescue teams from the Louisiana Department of Wildlife and Fisheries in conjunction with the Louisiana National Guard and the U.S. Coast Guard. The LSU AgCenter estimated that potential lost revenues and damages to the infrastructure of the agriculture, forestry, and fisheries industries in Louisiana resulting from the two hurricanes totaled approximately $959 million. The storm surge primarily affected the cattle, rice, soybeans, and sugarcane.

FEMA Flood Claims. According to FEMA data, flood claims for the three parishes in the study area that were paid between 1978 and December 2012 totaled $421 million: $ 132 million in Calcasieu, $173 million in Cameron, and $115 million in Vermillion. Table 8 shows the insurance payments between 1978 and December 2012 for each of the parishes in the study area. These claims are associated with flood events due to rainfall, riverine overflow, and storm surge. Structural alternatives that were considered only address flooding due to storm surge.

SCOPE OF THE STUDY

Problem Description. The study area, which is characterized by low, flat terrain, is highly susceptible to flooding from the tidal surges associated with hurricanes and tropical storms due to its close proximity to the Gulf of Mexico. The apparent subsidence that is taking place along the coast of Louisiana and an increase in relative sea level rise is expected to increase the potential for coastal flooding in the future. As the level of the ground sinks relative to the levels of the Gulf of Mexico, the depth of potential flooding in the future will increase. This additional problem will be addressed more fully in the feasibility phase of the study. The largest population centers are Lake Charles in Calcasieu Parish and Abbeville in Vermilion Parish.

This study will focus on the development of a hurricane and storm surge risk reduction plan for the area. The ultimate goal is to create a system that will provide risk reduction from surges associated with a hurricane or tropical storm event.

Six structural alternatives and two nonstructural alternative were considered in this analysis.

Project Alternatives. The project alternatives are described in the main report.

PART 2: ECONOMIC AND ENGINEERING INPUTS TO THE HEC-FDA MODEL

HEC-FDA MODEL

Model Overview. The Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) Version 1.2.5b Corps-certified model was used to calculate the without project damages and benefits for the Southwest Coastal LA evaluation. The economic and engineering inputs necessary for the model to calculate without project damages for existing conditions (2012), the project base year (2025), and the final year in the 50 year period of analysis (2075) include structure inventory, future development, contents-to-structure value ratios, vehicles, first floor elevations, and depth-damage relationships, ground elevations, and without-project stage probability relationships.

The uncertainty surrounding each of the economic and engineering variables was also entered into the model. Either a normal probability distribution, with a mean value and a standard deviation, or a triangular probability distribution, with a most likely, a maximum and a minimum value, was entered into the model to quantify the uncertainty associated with the key economic variables. A normal probability distribution was entered into the model to quantify the uncertainty surrounding the ground elevations. The number of years that stages were recorded at a given gage was entered for each study area reach to quantify the hydrologic uncertainty or error surrounding the stage-probability relationships.

ECONOMIC INPUTS TO THE HEC-FDA MODEL

Structure Inventory. Field surveys were completed in 2010 to develop a residential and non-residential structure inventory for the economic analysis. Based on the structural information collected during the field surveys, the Marshall and Swift Valuation Service was used to calculate a depreciated replacement cost for all residential and non-residential structures in the 90 reaches. The inventoried structures were classified as one of 14 structure types: residential one-story with slab or pier foundation, residential two-story with slab or pier foundation, mobile home, eating and recreation, grocery and gas station, multi-family residence, professional building, public and semi-public building, repairs and home use establishment, retail and personal services building, and warehouse, and contractor services building. Table 9 shows the number of structures by structure category and the total number of vehicles associated with the residential structures for existing conditions (2012) for the study area. The value of the land was not included in the analysis. Table 10 shows the number of structures in each structure category and the average depreciated replacement values for (2012 price level) existing conditions.

Future Development Inventory. Projections were made of the future residential and non-residential development to take place in the Southwest Coastal, LA Feasibility study area under without-project conditions. Based on a pattern of historical development, a total of 3,750 residential and 396 non-residential structures were placed on the undeveloped land within the reaches as part of the structure inventory for the year 2025. An additional 14,994 residential and 1,580 non-residential structures were added to the inventory for the year 2025 to obtain the structure inventory for the year 2075. Table 11 shows the projected number of structures in each structure category for the future years 2025 and 2075, respectively

The development projected to occur in each reach between the year 2012 and the year 2025 was placed at an elevation equal to the stage associated with the 2075 without-project one percent annual chance exceedance (1% ACE) (100-year) event, unless the ground elevation was higher. The projected development occurring after the year 2025 was placed at an elevation equal to the stage associated with the without-project 1% ACE (100-year) event for the year 2075, unless the ground elevation was higher. The values for the projected residential and non-residential structures were assigned using the average value calculated for each structure category based on the 2010 existing development.

Residential and Non-Residential Content-to-Structure Value Ratios (CSVR). On-site interviews were conducted with the owners of a sample of 30 structures distributed among the three residential content categories, and ten owners of each of the eight non-residential content categories (80 non-residential structures). As shown in Table 12, a

CSVR was computed for each residential and non-residential structure in the sample based on the total depreciated content value developed from the surveys. An average CSVR for each of the five residential structure categories and nine commercial structure classifications was calculated as the average of the individual structure CSVRs.

Vehicle Inventory. Based on 2000 Census block group data for the evaluation area, it was determined that there are an average of 1.64 vehicles associated with each household (owner occupied housing or rental unit). According to the Southeast Louisiana Evacuation Behavioral Report published in 2006 following Hurricanes Katrina and Rita, approximately 70 percent of privately owned vehicles are used for evacuation during storm events. The remaining 30 percent of the privately owned vehicles remain parked at the residences and are subject to flood damages. Using the Manheim Used Vehicle Value Index, which is based on over 4 million annual automobile transactions adjusted to reflect retail replacement value, each vehicle was assigned an average value of $13,411 at the 2012 price level. Since only those vehicles not used for evacuation can be included in the damage calculations, an adjusted average vehicle value of $6,598 ($13,411 x 1.64 x 0.30) was assigned to each individual residential structure record in the HEC-FDA model. If an individual structure had more than one housing unit, then the adjusted vehicle value was assigned to each housing unit in a residential or multi-family structure category.

First Floor Elevations and Elevation of Vehicles. Topographical data obtained from the Light Detection and Ranging (LIDAR) digital elevation model (DEM) using the NAVD88 (2004.65 epoch) were used to determine ground elevations. Field survey teams estimated the height of each residential and non-residential structure above the ground using hand levels. The ground elevation was added to the height of the foundation of the structure above the ground in order to determine the first floor elevation of the structure. Vehicles were assigned to the ground elevation of the adjacent residential structures.

Depth-Damage Relationships. Site-specific saltwater, long duration (approximately one week) depth-damage relationships developed by a panel of building and construction experts for Structures, Contents, and Vehicles and Content-to-Structure Value Ratios (CSVRs) in Support of the Lower Atchafalaya and Morganza to the Gulf, Louisiana, Feasibility Study were used in the economic analysis. These curves indicate the percentage of the total structure value that would be damaged at various depths of flooding. Damage percentages were determined for each one-half foot increment from one-half foot below first floor elevation to two feet above first floor, and for each one-foot increment from 2 feet to 15 feet above first floor elevation. The panel of experts developed depth-damage relationships for five residential structure categories and for three commercial structure categories. Depth-damage relationships were also developed for three residential content categories and eight commercial content categories. The depth-damage relationships for vehicles were developed based on interviews with the owners of automobile dealerships that had experienced flood damages and were used to calculate flood damages to vehicles at the various levels of flooding.

Table 13 shows the residential and non-residential depth-damage relationships developed for structures, contents, and vehicles.

Uncertainty Surrounding the Economic Inputs. The uncertainty surrounding the four key economic variables was quantified and entered into the HEC-FDA model. These economic variables included structure values, contents-to-structure value ratios, first floor elevations, and depth-damage relationships. The HEC-FDA model used the uncertainty surrounding these variables to estimate the uncertainty surrounding the stage-damage relationships developed for each reach.

Structure and Vehicle Values. In order to quantify the uncertainty surrounding the values calculated for the residential and non-residential structure inventory, several survey teams valued an identical set of structures from various evaluation areas in coastal Louisiana. The structure values calculated by each of the teams during windshield surveys were used to develop a mean value and a standard deviation for each structure in the sample. The standard deviation was then expressed as a percentage of the mean value for that structure. The average standard deviation as a percentage of the mean for the sampled structures was then used to represent the uncertainty surrounding the structure value for all the inventoried residential and non-residential structures. The average standard deviation, which was expressed as a percentage of the mean structure value, totaled 12.15 percent for residential structures and 14.28 percent for non-residential structures.

The uncertainty surrounding the values assigned to the vehicles in the inventory was determined using a triangular probability distribution function. The Manheim vehicle value, adjusted for number of vehicles per household and for the evacuation of vehicles prior to a storm event, was used as the most likely value. The average value of a new vehicle before taxes, license, and shipping charges was used as the maximum value, while the average 10-year depreciation value of a vehicle was used as the minimum value.

Content-to-Structure Value Ratios. On-site interviews were conducted with the owners of a sample of 30 structures among the three residential content categories and ten owners of each of the eight non-residential content categories (80 non-residential structures). A CSVR was computed for each residential and non-residential structure in the sample based on the total depreciated content value developed from these interviews. The mean and standard deviation values for each residential and non-residential category were entered into the HEC-FDA model. The model used a normal probability density function to describe the uncertainty surrounding the CSVR for each content category. The expected values and standard deviations are shown for each of the three residential categories and the eight non-residential categories in the final report dated May 1997 entitled *Depth-Damage Relationships for Structures, Contents, and Vehicles and Content-to-Structure Value Ratios (CSVRs) in support of the Lower Atchafalaya Reevaluation and Morganza to the Gulf, LA Feasibility Studies* .

First Floor Elevations. The topographical data used to estimate the first floor elevations assigned to the structure inventory contain two sources of uncertainty. The first source of uncertainty arises from the use of the 2009 LIDAR data, and the second source of uncertainty arises from the use of hand levels to determine the structure foundation heights above ground elevation. The error implicit in using LIDAR data to estimate the ground elevation of each of the inventoried structures is normally distributed with a mean of zero and a standard deviation of 0.297 feet. According to the Hydrologic Engineering Center training manual, and the uncertainty implicit in estimating foundation heights using hand levels from within 50 feet of the structure is normally distributed with a mean of zero and a standard deviation of 0.3 feet at the 95 percent level of confidence.

Depth-Damage Relationships. A triangular probability density function was used to determine the uncertainty surrounding the damage percentage associated with each depth of flooding. A minimum, maximum and most likely damage estimate was provided by a panel of experts for each depth of flooding. The specific range of values regarding probability distributions for the depth-damage curves can be found in the final report mentioned above.

ENGINEERING INPUTS TO THE HEC-FDA MODEL

Ground Elevations. Geospatial Engineering acquired elevation data for the Southwest Coastal, LA study area. The LIDAR data were processed and used to create a digital elevation model (DEM) with a five-foot by five-foot horizontal grid resolution. The DEM used NAVD88 2004.65 vertical datum to determine the ground elevations for each of the residential and non-residential structures in the evaluation area.

Stage-Probability Relationships. Stage-probability relationships were provided for the existing (2012) without-project condition and future without-project conditions (2025 and 2075). Water surface profiles were provided for eight annual chance exceedance (ACE) events: 99% (1-year), 20% (5-year), 10% (10-year), 4% (25-year), 2% (50-year), 1% (100-year), 0.5% (200-year), and 0.2% (500-year). The water surface profiles were based on storm surge and incorporated rainfall events. A unique water surface profile was provided for each of 81 hydrologic reaches. Due to HEC-FDA modeling requirements, some reaches were subdivided to facilitate analysis, resulting in a total of 90 hydrologic, reaches. However, the definition of each reach was based upon the relationship between water surface elevation and probability.

Uncertainty Surrounding the Engineering Inputs. The uncertainty surrounding two key engineering parameters was quantified and entered into the HEC-FDA model. These engineering variables included ground elevations and the stage-probability curves. The HEC-FDA model used the uncertainty surrounding these variables to estimate the uncertainty surrounding the elevation of the storm surges for each reach.

Ground Elevations. A topographic survey was conducted to estimate the uncertainty surrounding the use of the LIDAR data to estimate ground elevations in urbanized areas. The uncertainty surrounding the ground elevations was 0.297 feet for a residential and non-residential structure which was discussed in the first floor elevation uncertainty section of this report.

Stage-Probability Relationships. A 50-year equivalent record length was used to quantify the uncertainty surrounding the stage-probability relationships for each reach.
Based on this equivalent record length, the HEC-FDA model calculated the confidence limits surrounding the stage-probability functions.

PART 3: NATIONAL ECONOMIC DEVELOPMENT (NED) FLOOD DAMAGE AND BENEFIT CALCULATIONS

NED FLOOD DAMAGE AND BENEFIT CALCULATIONS FOR 6 STRUCTURAL ALTERNATIVES

HEC-FDA Model Calculations. The HEC-FDA model was utilized to evaluate flood damages using risk-based analysis. Damages were reported at the index location for each of the 90 reaches for which a structure inventory had been conducted. A range of possible values, with a maximum and a minimum value for each economic variable (first floor elevation, structure and content values, and depth-damage relationships), was entered into the HEC-FDA model to calculate the uncertainty or error surrounding the elevation-damage, or stage-damage, relationships. The model also used the number of years that stages were recorded at a given gage to determine the hydrologic uncertainty surrounding the stage-probability relationships.

The possible occurrences of each variable were derived through the use of Monte Carlo simulation, which used randomly selected numbers to simulate the values of the selected variables from within the established ranges and distributions. For each variable, a sampling technique was used to select from within the range of possible values. With each sample, or iteration, a different value was selected. The number of iterations performed affects the simulation execution time and the quality and accuracy of the results. This process was conducted simultaneously for each economic and hydrologic variable. The resulting mean value and probability distributions formed a comprehensive picture of all possible outcomes.

Stage-Damage Relationships with Uncertainty. The HEC-FDA model used the economic and engineering inputs to generate a stage-damage relationship for each structure category in each study area reach under existing (2012) and future (2025 and 2075) conditions. The possible occurrences of each economic variable were derived through the use of Monte Carlo simulation, a statistical technique used to randomly sample from a distribution of possible outcomes. A total of 1,000 iterations were executed by the model for the Southwest Coastal LA, Feasibility Study. The sum of all sampled values was divided by the number of samples to yield the expected value for a specific simulation. A mean and standard deviation was automatically calculated for the damages at each stage.

Stage-Probability Relationships with Uncertainty. The HEC-FDA model used an equivalent record length (50 years) for each reach to generate a stage-probability relationship with uncertainty for the without-project condition under existing (2012) and future (2025 and 2075) conditions through the use of graphical analysis. The model used the eight stage-probability events together with the equivalent record length to define the full range of the stage-probability or stage-probability functions by interpolating between the data points. Confidence bands surrounding the stages for each of the probability events were also provided.

Without-Project Expected Annual Damages. The model used Monte Carlo simulation to sample from the stage-probability curve with uncertainty. For each of the iterations within the simulation, stages were simultaneously selected for the entire range of probability events. The sum of all damage values divided by the number of iterations run by the model yielded the expected value, or mean damage value, with confidence bands for each probability event. The probability-damage relationships are integrated by weighting the damages corresponding to each magnitude of flooding (stage) by the percentage chance of exceedance (probability). From these weighted damages, the model determined the expected annual damages (EAD) with confidence bands (uncertainty). For the without-project alternative, the expected annual damages (EAD) were totaled for each reach to obtain the total without-project EAD under existing (2012) and future (2025 and 2075) conditions. Table 14 shows the Expected Annual Damages for structures, contents and vehicles for 2012, 2025 and 2075 and the percentage increase between 2012 and 2025 and 2012 and 2075. Table 15 shows the number and type of structures that are damaged by each annual chance exceedance event for the years 2025 and 2075 using the intermediate sea level rise scenario.

Without-Project Equivalent Annual Damages. The HEC-FDA model was used to calculate the without project equivalent annual damages using the FY 2013 interest rate of 3.50 percent. The results are displayed in Table 16. Also, the 3.5 percent FY 2013 Federal discount rate was used to screen alternatives.

Screening of Structural Alternatives. Utilizing existing data, current and future without-project damages and parametric costs, the alternatives were evaluated for the 0.02 percent, 0.01 percent and 0.005 percent (50 year, 100 year, and 200 year) levels of risk reduction.

Using the damage probability relationship from the HEC-FDA model for the damage reaches receiving risk reduction from each of the six structural alternatives, it was estimated that a 0.02 percent (50 year) project would eliminate damages for the 25 and 50 year events. The 0.01 percent (100 year) project would eliminate damages for the 25, 50 and 100 year events and the 0.005 percent (200 year) project would eliminate damages for the 25, 50, 100 and 200 year events. The six structural alternatives would not eliminate any damages from rainfall at the more frequent events (1 and 10 year events).

The 2025 and 2075 without project expected annual damages by reach and estimated with project damages and benefits are displayed in Table 17 and Table 18 for each of the six structural alternatives. A percentage was applied to the overall benefits by reach for each alternative to reflect the estimated percentage of the total structures in a reach that are receiving risk reduction from each structural alternative. For example, approximately 42 percent of the residential and non-residential structures in reach SA-100 lie behind the Abbeville to Delcambre levee alignment (Alternative 1). Therefore, the estimated total damages and benefits calculated for that reach are multiplied by 42 percent to determine the expected annual benefits for the Abbeville to Delcambre alternative for reach SA-100. This methodology was applied to all proposed structural alternatives.

The expected annual estimated benefits for 2025 and 2075 were converted to an equivalent annual value using the current interest rate, 3.50 percent, and a 50-year period of analysis. The total cost for the structural alternatives included the construction costs and operation and maintenance for three levels of risk reduction. Tables 19, 20 and 21 show the calculation of the estimated annual cost for the alternatives for three levels of risk reduction using the 3.50 percent interest rate and a 50-year period of analysis. Tables 22 through 39 show the estimated equivalent annual benefits, annual costs, and equivalent annual net benefits for the alternatives with varying levels of risk reduction.

The net benefit results show that none of the structural alternatives are economically justified. The results were obtained using parametric costs and adjustments to the without project damages to reflect the expected project performance. It should also be noted that mitigation costs were not included for the six structural alternatives. Addition of mitigation costs in the structural alternatives would only reduce the net benefits of alternatives that are not economically justified.

NED FLOOD DAMAGE AND BENEFIT CALCULATIONS FOR NONSTRUCTURAL ALTERNATIVE

HEC-FDA Model Calculations. The Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) Version 1.2.5b certified model was used to analyze nonstructural alternatives for the Southwest Coastal, LA feasibility evaluation. The model was used to create a module that contained all of the residential and non-residential structures, except warehouses and industrial facilities, with a first floor elevation less than or equal to the stage associated with the 0.01 annual exceedance probability, or 100-year event, for all reaches. The number of structures eligible for nonstructural measures increases over time as the stage associated with the 100-year event increases from 2025 to 2075 due to sea level rise. The specific nonstructural measures considered in this analysis include structure elevation, flood proofing, and property acquisition (only in cases when structure-raising would require elevation greater than 13 feet).

Structure Elevation. A structure elevation measure was considered for all residential structures within the 100-year floodplain of the study area. This measure involved raising residential structures to the elevation of the stage associated with the 2075 without project condition 100-year storm event. Although participation in the residential structure raising alternative is completely voluntary, the result of this analysis assumes 100 percent participation by all property owners with structures located below the elevation of the 100-year storm event. Non-residential structures are generally not suitable candidates for structure-raising and thus were only considered for flood proofing and not raising.

The cost per square foot for raising a residential structure was based on data obtained during interviews with representatives of three major metropolitan New Orleans area contracting firms that specialize in the raising of structures. Costs were derived for slab and pier foundation residential structures with both one and two stories, and also for mobile homes. Table 40 displays the costs for each of the five residential categories analyzed these include one and two story slab foundation, one and two story pier foundation and mobile home.

The cost per square foot to raise an individual structure to the required height was multiplied by the footprint square footage of each structure to compute the costs to elevate the structure. The footprint square footage for each structure was determined by applying the average square footage estimated for each residential structure category as shown in Table 41. The average was taken from the structures in the structure inventory. Costs to elevate a structure were added to a per structure temporary relocation cost to complete the total cost of the structure elevation measure. Relocation costs included packing/moving, labor, storage, hotel costs, per diem costs, kennel costs for pets, and contingencies. Relocation costs for structure elevation, for the contractor specified period of the raising, 30 days, amounts to $6,148 per structure. Administrative costs of $10,000 per structure for implementing the elevation of structures were also included in the total costs. The total costs for all raised structures were annualized over the 50-year life of the project using the Fiscal Year 2013 Federal discount rate of 3.5 percent and an October 2012 price level.

Benefits were defined as the reduction in the without-project damages that would result from structures being elevated to the 100-year stage.

Flood Proofing of Non-residential Structures. The flood proofing measures were applied to all non-residential structures except for warehouses and industrial facilities. While specific techniques may differ, flood proofing measures are generally characterized as the treatment of structure exterior with impermeable materials to prevent the entry of water. Different costs were developed to flood proof the structures based on the square footage. If the square footage was between zero and 20,000 square feet, then the total cost equaled $113,761; between 20,000 and 100,000 square feet then $268,800; and if greater than 100,000 square feet the total costs for flood proofing is $664,476. The costs were developed for the Draft Nonstructural Alternatives Feasibility Study, Donaldsonville LA to the Gulf evaluation (September 14, 2012) by contacting local contractors and applied to this study.

Benefits were defined as the reduction in the without-project damages that would result from structures being flood proofed up to 3 feet above the first floor elevation which is the maximum depth for which flood proofing would be effective. These benefits were then totaled by reach and compared to the costs of flood proofing. Economic justification was determined by combining the expected annual benefits and expected annual costs for the structural and nonstructural components and comparing. Net benefits were calculated by subtracting the combined expected annual costs from the expected annual benefits.

Acquisition of Structures. Residential structures that required elevation higher than the 13-foot limit were considered for acquisition. The costs associated with this measure included the depreciated replacement cost of the structure plus $60,000 as estimated for the Uniform Relocations Act, $30,000 for Supervision and Administration, and $70,000 for Lands. This adds an additional $160,000 to the depreciated structure value. The benefits were calculated as the damage reduced by removing the property from the 100 year flood plain for each reach. However, as the analysis will show, only 8 residential structures qualified for acquisition.

Other criteria exist that may indicate that property acquisition is a more appropriate nonstructural measures compared to structure elevation. One such criterion is that the relatively poor condition of the residential property may not lend itself to safe or effective elevation. Eligibility for acquisition under this criterion can only be made through direct inspection of the subject property, which is not possible using the benefit methodology described in this Appendix, but can be explicitly considered during project implementation. Another criterion is that, in individual instances, the cost of acquisition may be less than the cost of structure elevation. While this may the case in unique circumstances, cost data that were used to conduct the analysis have generally shown that the cost to elevate an average structure is less than the full cost to acquire it, once the cost of the land, relocation costs, and supervision and administration are concluded. While these criteria were not used in the methodology for benefit estimation, they do indicate the potential for fewer structure elevation measures and a corresponding increase in the number of acquisitions as the project is implemented.

Screening of the Nonstructural Alternatives The benefits for implementing nonstructural measures consist of the combined flood damages reduced that result from the elevation of residential structures, flood proofing of non-residential structures, and property acquisition for the study area as a whole and also by reach. The nonstructural evaluation for the study area as a whole is the "Nonstructural 100-year Floodplain" plan, and the nonstructural evaluation by reach is considered the "Nonstructural Justified Reaches" plan. For the Nonstructural 100-year Floodplain plan, equivalent annual benefits were totaled for all reaches in the study area and compared to the annual cost for implementation to yield an estimate of net benefits for the entire study area. For the alternative nonstructural plan, equivalent annual benefits were totaled by reach and compared to the annual cost for implementation by reach to yield an estimate of net benefits aggregated by reach.

Table 42 displays the total costs, annual costs, equivalent annual benefits, expect annual net benefits and the benefit to cost ratios for all individual reaches and for the total of all reaches in the study area. The cost was annualized using the FY 2013 Federal discount rate of 3.50 percent over the 50 year period of analysis. For the Nonstructural 100-year Floodplain plan, the table indicates negative annual net benefits of $64,324,000 and an associated benefit to cost ratio of 0.54.

The results by type of nonstructural measure are listed in Table 43. There were 11,272 structures with a first floor elevation below the 100 year water surface elevation in 2025 and 15,332 structures with a first floor elevation beneath the 100 year water surface elevation in 2075. These structures are eligible for a nonstructural measure as described above. There are a total of 26,604 structures with a first floor elevation lower than the 100 year water surface elevation in the 90 reaches.

For the Nonstructural Justified Reaches plan, damages, benefits, costs and net benefits were analyzed specifically at the reach level. Of the 90 reaches, eleven reaches were identified as having positive net benefits and benefit to cost ratios greater than one. The results are summarized in Table 44. Net benefits for this plan are $4,123,000 with an associated benefit to cost ratio of 1.25. The eleven nonstructural economically justified reaches constitute the Nonstructural Justified Reaches plan.

Table 45 provides details with respect to the number of structures associated with each nonstructural measure by economically justified reach.

NED TENTATIVELY SELECTED PLAN

NED Alternatives. The structural alternatives were not found to be economically justified. In addition, the Nonstructural 100-year Floodplain plan was also determined to lack economic justification. However, the nonstructural alternative for the Nonstructural Justified Reaches plan was found to be economically justified and is therefore identified as the Tentatively Selected Plan.

PART 4: NATIONAL ENVIRONMENTAL RESTORATION (NER) PLAN

Cost-effectiveness and Incremental Cost Analysis

Background. The purpose of the Southwest Coastal National Ecosystem Restoration (NER) plan is to reduce the risks associated with habitat damage via saltwater intrusion, shoreline retreat, and loss of geomorphologic infrastructure. This result would contribute towards achieving and sustaining a larger 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.

Alternatives and Nomenclature. The final array is comprised of the No-Action Plan, Plan M-4 and Plan CM-4 which consists of combinations of measures to be implemented in the Calcasieu and Mermentau Basins exclusively and in concert. Furthermore, plans that contained the salinity control gate in the Calcasieu Ship Channel in the initial array were also examined without the gate. The "C" plans are combinations of measures to be implemented in the Calcasieu Basin. The "M" plans are combinations of measures to be implemented in the Mermentau Basin. The "A" plan is the salinity control gate in the Calcasieu Ship Channel; it was analyzed as a standalone plan and as a component measure in other plans. The numbers one through six represents unique combinations of measures.

Cost-effectiveness and Incremental Cost Analysis. ER 1105-2-100 requires that the NER outputs of ecosystem restoration plans be expressed in non-monetary units. Since the combination of costs and benefits of ecosystem restoration plans cannot be expressed in a common metric, cost effectiveness and incremental cost analysis are employed as a means of comparing alternatives. A plan is cost effective if no other alternative plan provides the same level of output for less cost and if no other alternative plan provides more output for the same or less cost. The subset of cost effective plans that are superior financial investments are identified through incremental cost analysis. These "best buys" are the most efficient plans at producing the output variable, providing the greatest increase in the value of the output variable for the least increase in the value of the cost variable. The first best buy is the most efficient plan. It produces output at the lowest incremental cost per unit of output, which, for the first best buy, is equal to the lowest average cost. The next best buy is the most efficient plan for producing additional output, and each subsequent best buy can be ranked based on the same process.

Model Overview. The IWR Planning Suite is a certified decision support model used to assist with the formulation and comparison of alternative plans, primarily with environmental restoration and watershed planning studies. Specifically the model performs cost effectiveness and incremental cost analysis. The IWR Planning Suite was developed within the US Army Corps of Engineers' Investment and Management Decision Making Research Program, conducted by the Corps Institute for Water Resources (IWR).

Cost and Output. A detailed cost schedule was not available for all of the plans in this analysis, so total cost was used for each alternative in the CE/ICA. The total cost includes the cost of each alternative's component measures. Additionally, for the measures including the salinity control structures in the Calcasieu Ship Channel (Plan A), a navigation delay cost of $234,556,178 was included. The output metric used in this analysis was net average annual habitat units (AAHUs). Table 2 displays the cost and net AAHUs for each plan. The average annual cost was computed for plan CM-4 which is the TSP. Construction costs were compounded up to the base year of 2025 and O&M costs were discounted back to the base year of 2025 using the Federal discount rate for FY 2014 of 3.5%. The project costs were then annualized over a 50-year period yielding an average annual cost of $49,689,525. See Tables 48 and 49 for the cost schedules associated with the TSP and Table 7 for its average annual cost.

Results. There are ten cost-effective alternatives not including the no-action alternative. Of those, four alternatives are best buys which are displayed in Table 51. Figure 1, an output of the IWR Planning Suite shows the cost-efficiency frontier curve of the cost-effective alternatives. At each point on the curve, which represents a cost-effective plan, no other plans yielded the same or more output for the same or lower cost.

Table 52 shows the results of the incremental cost analysis. Plan M-4 is the most efficient plan, yielding the lowest average cost per unit of output. CM-4 is the next most efficient plan yielding the lowest incremental cost per unit of incremental output of all of the larger cost-effective plans. The table also shows the increase in average incremental cost from one increment of output to the next highest increment. Figure 2 shows the best buy plans in a box graph. The PDT chose plan CM-4 as the NER TSP. Plan M-4 was not selected due to its insufficiency in accomplishing the goals of the project.

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Table 1
Southwest Coastal, LA Feasibility Study
Land Use in the Study Area
(2009)

Land Class Name	Acres	Percentage of Total
Developed land	81,081	3%
Agricultural Land	834,414	32%
Undeveloped Land	1,312,216	51%
Open Water	360,736	14%
Total	2,588,446	100%

Source: National Agricultural Statistical Service

Table 2
Southwest Coastal, LA Feasibility Study
Historical and Projected Parish Population

Parish	1970	1980	1990	2000	2010	2020	2080
Calcasieu	145.6	168.3	168.3	183.5	187.5	195.0	236.7
Cameron	8.2	9.4	9.2	10.0	6.8	6.6	3.9
Vermillion	43.1	48.7	50.0	54.0	56.7	59.9	76.8
Total	197.0	226.4	227.5	247.4	251.0	261.4	317.4

Source: U.S. Census data, and Moody's County Forecast Database

Table 3
Existing Condition and Projected Population Within
Inventoried Study Area
Southwest Coastal, LA Feasibility Study
(1,000s)

Parish	2010	2025	2075
Total in Study Area	160,596	173,529	224,975

Source: U.S. Census data, and Moody's County Forecast Database
Note: Population estimates assume 2.7 residents based on average houshold size and 20 housing units within a multi family structure.

Table 4
Southwest Coastal, LA Feasibility Study
Existing Condition and Projected Households by Parish
(1,000s)

Parish	1970	1980	1990	2000	2010	2020	2080
Calcasieu	42.1	56.8	60.4	68.6	70.6	76.4	104.5
Cameron	2.3	3.0	3.2	3.6	2.5	2.5	2.3
Vermillion	12.8	16.3	17.8	19.9	21.1	23.1	33.0
Total	57.2	57.2	81.3	92.1	94.2	102.0	139.8

Source: U.S. Census data, and Moody's County Forecast Database

Table 5
Southwest Coastal, LA Feasibility Study
Per Capita Income ($1000s)

Parish	1990	2000	2005	2010	2011
Calcasieu	15,511	23,034	29,021	34,577	36,366
Cameron	13,001	18,433	20,739	33,784	35,114
Vermillion	12,343	19,130	23,091	29,873	30,998

Source: Bureau of Economic Analysis

Table 6
Southwest Coastal, LA Feasibility Study
Total Employment
(1,000s)

Parish	1970	1980	1990	2000	2010	2020	2080
Calcasieu	54.2	80.8	82.2	102.8	106.9	126.3	210.4
Cameron	3.4	5.6	5.5	5.7	4.1	5.0	5.4
Vermillion	14.4	19.3	17.7	20.3	20.9	22.7	31.1
Total	72.0	105.7	105.4	128.8	131.9	154.0	246.9

Source: Bureau of Economic Analysis for years 1980-2010 and projections extrapolated from historical data.

Table 7
Southwest Coastal, LA Feasibility Study
Flood Insurance Claims
Coastal Louisiana

Event	Month/ Year	Number of Paid Claims	Total Amount Paid ($1,000s)
Tropical Storm Juan	Oct-85	6,187	189,842
Hurricane Andrew	Aug-92	5,589	270,791
Tropical Storm Isadore	Sep-02	8,441	141,869
Hurricane Lili	Oct-02	2,563	46,049
Hurricane Katrina	Aug-05	167,099	18,556,254
Hurricane Rita	Sep-05	9,507	539,086
Hurricane Gustav	Sep-08	4,524	115,250
Hurricane Ike	Sep-08	46,137	2,712,969
Hurricane Isaac	Aug-12	7,323	376,270

Source: Federal Emergency Management Agency (FEMA)
Note: Total amount paid and average amount paid have been updated
to the Oct 2012 price level using the CPI for all urban consumers.

Table 8
Southwest Coastal, LA Feasibility Study
FEMA Flood Claims by Parish
1978-2012

Parish	Number of Claims	Total Nominal Dollar Amount ($1,000s)	Average Dollar Amount per Claim ($1,000s)
Calcasieu	5,775	131,973	23
Cameron	3,061	173,494	57
Vermillion	3,218	115,411	36
Total Study Area	12,054	420,878	35

Source: FEMA

Table 9
Southwest Coastal, LA Feasibility Study
Number of Structures Under Existing Conditions
(2012)

Reach Name	Residential	Mobile Home	Non-Residential	Vehicle	Total
Total	38,213	8,647	4,997	67,666	119,523

Table 10
Southwest Coastal, LA Feasibility Study
Residential and Non-Residential Structure Inventory
Existing Conditions (2012)
(2012 Price Level)

Structure Category	Number	Average Depreciated Replacement Value ($)
Residential		
One-Story Slab	21,045	154,900
One-Story Pier	15,065	103,850
Two-Story Slab	1,708	236,880
Two-Story Pier	395	168,000
Mobile Home	8,647	13,920
Total Residential	**46,860**	
Non-Residential		
Eating and Recreation	300	755,020
Professional	932	680,760
Public and Semi-Public	603	1,404,530
Repair and Home Use	133	563,060
Retail and Personal Services	635	817,020
Warehouse	1,565	370,640
Grocery and Gas Station	138	494,890
Multi-Family Occupancy	631	898,350
Industrial	60	100,558,900
Total Non-Residential	**4,997**	

Table 11 Southwest Coastal, LA Feasibility Study Number of Projected Residential and Non-Residential Structures	
Future Conditions (2025)	
Structure Category	Number
Residential	
One-Story Slab	1,685
One-Story Pier	1,205
Two-Story Slab	136
Two-Story Pier	32
Mobile Home	692
Total Residential	**3,750**
Non-Residential	
Eating and Recreation	24
Professional	11
Public and Semi-Public	47
Repair and Home Use	76
Retail and Personal Services	50
Warehouse	11
Grocery and Gas Station	125
Multi-Family Occupancy	52
Industrial	0
Total Non-Residential	**396**
Future Conditions (2075)	
Structure Category	Number
Residential	
One-Story Slab	6,734
One-Story Pier	4,821
Two-Story Slab	547
Two-Story Pier	125
Mobile Home	2,767
Total Residential	**14,994**
Non-Residential	
Eating and Recreation	95
Professional	43
Public and Semi-Public	193
Repair and Home Use	298
Retail and Personal Services	202
Warehouse	45
Grocery and Gas Station	501
Multi-Family Occupancy	203
Industrial	0
Total Non-Residential	**1,580**

Table 12
Southwest Coastal, LA Feasibility Study
Content-to-Structure Value Ratios (CSVR) and Standard Deviations (SD)
by Structure Category

Structure Category		(CSVR, SD)
Residential	One-story (1STY-PIER/1STY-SLAB)	(0.72,0.23)
	Two-story (2STY-PIER/2STY-SLAB)	(0.51,0.28)
	Mobile home (MOBHOM)	(1.42,0.65)
Non-Residential	Eating and Recreation (EAT)	(3.19,4.60)
	Groceries and Gas Stations (GROC)	(1.31,0.98)
	Professional Buildings (PROF)	(0.76,0.71)
	Public and Semi-Public Buildings (PUBL)	(0.84,1.06)
	Multi-Family Buildings (MULT)	(0.24,0.13)
	Repair and Home Use (REPA)	(2.33,2.00)
	Retail and Personal Services (RETA)	(1.40,1.01)
	Warehouses and Contractor Services (WARE)	(2.93,3.56)

Source: Based onDepth-Damage Relationships for Structures, Contents, and Vehicles and Content-to-Structure Value Ratios (CSVR) in Support of the Lower Atchafalaya and Morganza to the Gulf, Louisiana, Feasibility Study

Table 13
Depth-Damage Relationships for Structures, Contents and Vehicles
Southwest Coastal, LA Feasibility Study

Occupancy Type	Category Name	Damage Type	Parameter																				
1STY-PIER	Residential		Stage	-1.1	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0
		Structure	Mean %	0.0	1.1	12.2	15.2	49.4	50.1	66.7	70.2	71.2	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5
			Lower %	0.0	1.0	11.9	13.7	44.4	45.1	60.0	63.2	64.1	87.7	87.7	87.7	87.7	87.7	87.7	87.7	87.7	87.7	87.7	87.7
			Upper %	0.0	1.7	18.3	22.8	74.0	75.1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
		Contents	Mean %	0.0	0.0	0.0	0.0	95.0	95.0	95.0	95.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0
			Lower %	0.0	0.0	0.0	0.0	90.0	90.0	95.0	95.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0
			Upper %	0.0	0.0	0.0	0.0	98.0	98.0	98.0	98.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1STY-SLAB	Residential		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	1.1	1.1	23.3	23.3	37.2	41.9	45.3	92.0	92.0	92.0	92.0	92.0	92.0	92.0	92.0	92.0	92.0	92.0	92.0
			Lower %	0.0	1.0	1.0	21.0	21.0	35.5	37.7	40.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8
			Upper %	0.0	1.7	1.7	35.0	35.0	55.9	62.9	68.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
		Contents	Mean %	0.0	0.0	0.0	0.0	95.0	95.0	95.0	95.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0
			Lower %	0.0	0.0	0.0	0.0	90.0	90.0	95.0	95.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0
			Upper %	0.0	0.0	0.0	0.0	98.0	98.0	98.0	98.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2STY-PIER	Residential		Stage	-1.1	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0
		Structure	Mean %	0.0	1.4	2.2	6.4	19.0	19.0	31.9	32.6	33.3	93.4	93.4	93.4	93.4	93.4	93.4	93.6	93.6	93.6	93.6	93.6
			Lower %	0.0	1.2	2.0	5.8	17.1	17.1	28.7	29.3	30.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0
			Upper %	0.0	2.1	3.3	9.6	28.5	28.5	47.9	48.9	49.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
		Contents	Mean %	0.0	0.0	0.0	0.0	69.6	74.7	74.7	78.5	79.9	83.2	83.2	83.2	83.2	83.2	83.2	97.5	97.8	98.5	98.5	98.5
			Lower %	0.0	0.0	0.0	0.0	66.2	70.9	70.9	74.6	75.9	79.0	79.0	79.0	79.0	79.0	79.0	92.6	92.9	93.6	93.6	93.6
			Upper %	0.0	0.0	0.0	0.0	73.1	78.4	78.4	82.5	83.9	87.3	87.3	87.3	87.3	87.3	87.3	100.0	100.0	100.0	100.0	100.0
2STY-SLAB	Residential		Stage	-1.1	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0
		Structure	Mean %	0.0	1.2	1.2	16.1	16.1	26.1	27.1	28.5	80.0	80.0	80.0	80.0	80.0	80.0	80.3	80.3	80.3	83.2	83.2	83.2
			Lower %	0.0	1.1	1.1	14.5	14.5	23.5	24.4	25.7	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0
			Upper %	0.0	1.8	1.8	24.2	24.2	39.1	40.7	42.8	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
			Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Contents	Mean %	0.0	0.0	0.0	0.0	69.6	74.7	74.7	78.5	79.9	83.2	83.2	83.2	83.2	83.2	83.2	97.5	97.8	98.5	98.5	98.5
			Lower %	0.0	0.0	0.0	0.0	66.2	70.9	70.9	74.6	75.9	79.0	79.0	79.0	79.0	79.0	79.0	92.6	92.9	93.6	93.6	93.6
			Upper %	0.0	0.0	0.0	0.0	73.1	78.4	78.4	82.5	83.9	87.3	87.3	87.3	87.3	87.3	87.3	100.0	100.0	100.0	100.0	100.0
VEHICLES	AUTO		Stage	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0
		Structure	Mean %	0.0	0.0	3.7	13.0	46.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
			Lower %	0.0	0.0	2.3	12.0	44.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
			Upper %	0.0	0.0	4.7	15.0	45.3	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: For the purpose of this table stage is defined as the number of feet above or below the first floor elevation of the structure or automobile.

Table 13 (Cont)
Depth-Damage Relationships for Structures, Contents and Vehicles
Southwest Coastal, LA Feasibility Study

Occupancy Type	Category Name	Damage Type	Parameter																				
EAT	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	0.0	6.6	19.8	19.8	24.5	24.5	29.6	34.7	37.9	37.9	37.9	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3
			Lower %	0.0	0.0	6.2	18.4	18.4	22.8	22.8	26.6	31.2	34.1	34.1	34.1	57.0	57.0	57.0	57.0	57.0	57.0	57.0	57.0
			Upper %	0.0	0.0	7.6	22.8	22.8	28.2	28.2	37.0	43.4	47.4	47.4	47.4	79.2	79.2	79.2	79.2	79.2	79.2	79.2	79.2
		Contents	Mean %	0.0	0.0	0.0	41.2	45.6	73.3	74.8	92.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
			Lower %	0.0	0.0	0.0	39.2	43.3	69.6	71.1	87.8	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0
			Upper %	0.0	0.0	0.0	51.5	57.0	91.6	93.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
GROC	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	0.0	6.6	19.8	19.8	24.5	24.5	29.6	34.7	37.9	37.9	37.9	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3
			Lower %	0.0	0.0	6.2	18.4	18.4	22.8	22.8	26.6	31.2	34.1	34.1	34.1	57.0	57.0	57.0	57.0	57.0	57.0	57.0	57.0
			Upper %	0.0	0.0	7.6	22.8	22.8	28.2	28.2	37.0	43.4	47.4	47.4	47.4	79.2	79.2	79.2	79.2	79.2	79.2	79.2	79.2
		Contents	Mean %	0.0	0.0	0.0	99.1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
			Lower %	0.0	0.0	0.0	94.1	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0
			Upper %	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MOBHOM	MOBHOME		Stage	-1.1	-1.0	-0.5	0.0	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	6.4	7.3	9.9	43.4	44.7	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6
			Lower %	0.0	6.1	6.9	9.4	41.2	42.5	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7
			Upper %	0.0	8.6	9.8	13.4	58.6	60.3	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
		Contents	Mean %	0.0	0.0	0.0	95.0	96.0	97.0	98.0	99.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
			Lower %	0.0	0.0	0.0	90.0	92.0	94.0	96.0	98.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
			Upper %	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MULT	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	0.0	6.6	19.8	19.8	24.5	24.5	29.6	34.7	37.9	37.9	37.9	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3
			Lower %	0.0	0.0	6.2	18.4	18.4	22.8	22.8	26.6	31.2	34.1	34.1	34.1	57.0	57.0	57.0	57.0	57.0	57.0	57.0	57.0
			Upper %	0.0	0.0	7.6	22.8	22.8	28.2	28.2	37.0	43.4	47.4	47.4	47.4	79.2	79.2	79.2	79.2	79.2	79.2	79.2	79.2
		Contents	Mean %	0.0	0.0	0.0	20.1	26.2	33.5	42.4	49.8	51.7	51.7	51.7	51.7	51.7	51.7	71.8	85.2	100.0	100.0	100.0	100.0
			Lower %	0.0	0.0	0.0	15.8	22.4	31.2	40.5	46.6	50.3	50.3	50.3	50.3	50.3	50.3	56.4	79.6	93.5	97.1	97.1	97.1
			Upper %	0.0	0.0	0.0	22.2	28.7	35.2	46.2	51.4	53.0	53.1	54.6	54.6	54.6	54.6	79.3	89.5	100.0	100.0	100.0	100.0
PROF	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	0.0	6.6	19.8	19.8	24.5	24.5	29.6	34.7	37.9	37.9	37.9	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3
			Lower %	0.0	0.0	6.2	18.4	18.4	22.8	22.8	26.6	31.2	34.1	34.1	34.1	57.0	57.0	57.0	57.0	57.0	57.0	57.0	57.0
			Upper %	0.0	0.0	7.6	22.8	22.8	28.2	28.2	37.0	43.4	47.4	47.4	47.4	79.2	79.2	79.2	79.2	79.2	79.2	79.2	79.2
		Contents	Mean %	0.0	0.0	0.0	35.0	43.3	56.7	63.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
			Lower %	0.0	0.0	0.0	30.0	37.1	48.6	54.8	85.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
			Upper %	0.0	0.0	0.0	50.0	61.8	81.0	91.3	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: For the purpose of this table stage is defined as the number of feet above or below the first floor elevation of the structure or automobile

Table 13 (Cont)
Depth-Damage Relationships for Structures, Contents and Vehicles
Southwest Coastal, LA Feasibility Study

PUBL	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	0.0	1.1	22.3	23.7	25.8	32.7	34.4	79.1	79.1	79.1	79.1	79.1	79.1	79.1	79.1	80.5	80.5	80.5	80.5
			Lower %	0.0	0.0	1.1	20.8	22.1	24.0	29.5	31.0	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	72.4	72.4	72.4	72.4
			Upper %	0.0	0.0	1.3	25.7	27.3	29.7	39.3	43.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
		Contents	Mean %	0.0	0.0	0.0	80.0	85.0	85.7	86.6	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
			Lower %	0.0	0.0	0.0	60.0	63.8	64.3	65.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
			Upper %	0.0	0.0	0.0	88.0	93.5	94.2	95.3	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
REPA	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	0.0	1.1	22.3	23.7	25.8	32.7	34.4	79.1	79.1	79.1	79.1	79.1	79.1	79.1	79.1	80.5	80.5	80.5	80.5
			Lower %	0.0	0.0	1.1	20.8	22.1	24.0	29.5	31.0	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	72.4	72.4	72.4	72.4
			Upper %	0.0	0.0	1.3	25.7	27.3	29.7	39.3	43.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
		Contents	Mean %	0.0	0.0	0.0	33.3	34.3	34.3	69.2	70.6	72.1	80.6	83.7	83.7	83.7	83.7	83.7	83.7	83.7	83.7	83.7	83.7
			Lower %	0.0	0.0	0.0	31.7	32.6	32.6	65.7	67.1	68.5	76.6	79.6	79.6	79.6	79.6	79.6	79.6	79.6	79.6	79.6	79.6
			Upper %	0.0	0.0	0.0	41.7	42.9	42.9	86.5	88.3	90.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
RETA	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	0.0	1.1	22.3	23.7	25.8	32.7	34.4	79.1	79.1	79.1	79.1	79.1	79.1	79.1	79.1	80.5	80.5	80.5	80.5
			Lower %	0.0	0.0	1.1	20.8	22.1	24.0	29.5	31.0	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	72.4	72.4	72.4	72.4
			Upper %	0.0	0.0	1.3	25.7	27.3	29.7	39.3	43.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
		Contents	Mean %	0.0	0.0	0.0	36.6	60.5	60.5	75.4	85.1	94.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
			Lower %	0.0	0.0	0.0	34.8	57.5	57.5	71.6	80.8	89.7	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0
			Upper %	0.0	0.0	0.0	45.7	75.7	75.7	94.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
WARE	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	0.0	1.1	22.3	23.7	25.8	32.7	34.4	79.1	79.1	79.1	79.1	79.1	79.1	79.1	79.1	80.5	80.5	80.5	80.5
			Lower %	0.0	0.0	1.1	20.8	22.1	24.0	29.5	31.0	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	72.4	72.4	72.4	72.4
			Upper %	0.0	0.0	1.3	25.7	27.3	29.7	39.3	43.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
		Contents	Mean %	0.0	0.0	0.0	17.6	22.1	22.1	29.2	34.0	42.8	50.8	58.7	66.7	74.6	79.7	79.7	79.7	79.7	79.7	79.7	79.7
			Lower %	0.0	0.0	0.0	16.8	21.0	21.0	27.8	32.3	40.7	48.3	55.8	63.4	70.9	75.7	75.7	75.7	75.7	75.7	75.7	75.7
			Upper %	0.0	0.0	0.0	22.0	27.7	27.7	36.6	42.5	53.6	63.5	73.4	83.4	93.3	99.6	99.6	99.6	99.6	99.6	99.6	99.6

Note: For the purpose of this table stage is defined as the number of feet above or below the first floor elevation of the structure or automobile

Source: Based on *Depth-Damage Relationships for Structures, Contents, and Vehicles and Content-to-Structure Value Ratios (CSVRs) in Support of the Lower Atchafalaya and Morganza to the Gulf, Louisiana, Feasibility Study Final Report* dated May 1997

Table 14
Southwest Coastal, LA Feasibility Study
Expected Annual Damages (1,000's)
Structures, Contents, and Vehicles

Analysis Year	Without- Project Damages	Percent Increase from 2012
2012	$ 144,652	
2025	$ 153,191	6%
2075	$ 417,884	189%

Note: Without-project damages after adjusting the structure inventories for repetitive flood losses after the year 2012.

Table 15
Southwest Coastal, LA Feasibility Study
Number of Structures Receiving Damages By Probability Event in 2025 and 2075
Residential, Commercial, and Mobile Homes
Without-Project Condition

Annual Chance Exceedance Event (ACE)	Residential	Non-Residential	Mobile Home	Total
Base year 2025				
0.99 (1 yr)	0	37	0	37
0.20 (5 yr)	267	148	106	521
0.10 (10 yr)	2,282	373	476	3,131
0.04 (25 yr)	5,992	779	1,033	7,804
0.02 (50 yr)	9,576	1,240	1,858	12,674
0.01 (100 yr)	15,575	2,155	3,212	20,942
0.005 (200 yr)	18,050	2,590	4,334	24,974
0.002 (500 yr)	21,818	3,189	5,300	30,307
Future year 2075 Intermediate Sea Level Rise				
0.99 (1 yr)	0	37	0	37
0.20 (5 yr)	594	276	258	1,128
0.10 (10 yr)	3,231	617	821	4,669
0.04 (25 yr)	9,700	1,297	2,258	13,255
0.02 (50 yr)	22,220	2,426	5,014	29,660
0.01 (100 yr)	35,024	4,876	9,524	49,424
0.005 (200 yr)	41,728	5,660	10,329	57,717
0.002 (500 yr)	46,061	6,196	10,977	63,234

Note: The table reflects the number of structures damaged by ACE event after adjustments were made to the structure inventory for repetitive flooding.

Table 16

Southwest Coastal, LA Feasibility Study

Equivalent Annual Without Project Damages by Reach

Equivalent Annual Damage Analysis

File Help

Southwest Coastal
Equivalent Annual Damage by Damage Categories and Damage Reaches
for the Without (Without project condition) plan
(Damage in $1,000's)

Discount Rate: 3.500
Analysis Period: 50 Years
Plan was calculated with Uncertainty

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Equivalent Annual Damage or Damage Categories: AUTO	COM	MOBHOME	RES	Total Damage
SW Coastal	Stream added d	SA-001(1)	SA-001	0.07	1.82	0.03	2.40	4.31
		SA-006 (7)	SA-006	0.00	0.00	0.00	0.00	0.00
		SA-010(19)	SA-010	0.00	0.00	0.00	0.00	0.00
		SA-011(22)	SA-011	12.49	1072.55	54.71	415.50	1555.25
		SA-012(25)	SA-012	3044.94	14356.32	46.11	14243.96	31691.34
		SA-013(28)	SA-013	59.34	876.10	17.25	267.98	1220.68
		SA-014(31)	SA-014	37.62	911.28	15.58	134.45	1098.94
		SA-015 (34)	SA-015	0.00	0.00	0.00	0.00	0.00
		SA-016(37)	SA-016	0.04	0.00	0.00	8.23	8.27
		SA-017(40)	SA-017	20.75	204.57	11.61	272.97	509.90
		SA-017-RL(43)	SA-017-RL	122.12	2433.33	32.06	1581.20	4168.71
		SA-019 (46)	SA-019	0.00	0.00	0.00	0.00	0.00
		SA-021(49)	SA-021	4.62	0.00	2.37	0.48	7.48
		SA-023(52)	SA-023	11.11	4.64	8.44	25.96	50.15
		SA-030(61)	SA-030	75.69	1641.96	28.21	836.18	2582.04
		SA-031(64)	SA-031	45.70	935.70	8.22	34.97	1024.59
		SA-033(70)	SA-033	191.40	1803.59	47.39	2735.48	4777.85
		SA-033-RL(73)	SA-033-RL	0.78	97.54	0.05	14.84	113.21
		SA-033-RL(76)	SA-033-RL	32.29	195.73	8.19	289.26	525.47
		SA-034(79)	SA-034	77.99	1921.32	46.78	308.11	2354.19
		SA-036 (82)	SA-036	0.00	0.00	0.00	0.00	0.00
		SA-038(85)	SA-038	6.64	0.00	0.00	3.20	9.84
		SA-040 (91)	SA-040	0.00	0.00	0.00	0.00	0.00
		SA-046(103)	SA-046	10.93	0.00	17.60	1.31	29.84
		SA-048(106)	SA-048	1189.99	4942.83	74.14	2071.42	8278.37
		SA-054 (112)	SA-054	0.00	0.00	0.00	0.00	0.00
		SA-067(130)	SA-067	7.71	0.00	6.18	1.64	15.53
		SA-070 (133)	SA-070	0.00	0.00	0.00	0.00	0.00
		SA-070-N(136)	SA-070-N	147.12	2789.64	83.14	2265.57	5285.47
		SA-070-S(139)	SA-070-S	89.67	6055.35	14.27	488.01	6647.29
		SA-074(151)	SA-074	33.04	116.89	7.91	253.00	410.83
		SA-079(166)	SA-079	12.46	48.79	3.55	23.82	88.63
		SA-086 (173)	SA-086	0.00	0.00	0.00	0.00	0.00
		SA-087 (176)	SA-087	0.00	0.00	0.00	0.00	0.00
		SA-089(181)	SA-089	61.24	284.68	16.76	548.69	911.38
		SA-090 (184)	SA-090	0.00	0.00	0.00	0.00	0.00
		SA-091(187)	SA-091	86.53	4789.96	94.93	450.97	5422.38
		SA-092 (190)	SA-092	0.00	0.00	0.00	0.00	0.00
		SA-096(202)	SA-096	41.03	912.52	36.86	719.10	1709.51
		SA-097 (205)	SA-097	0.00	0.00	0.00	0.00	0.00
		SA-099(211)	SA-099	7774.84	13120.05	135.93	3856.84	24887.66
		SA-099-RL(214)	SA-099-RL	4450.41	3768.45	543.42	5887.80	14650.08
		SA-100(217)	SA-100	16.75	317.81	10.23	286.07	630.86
		SA-101(220)	SA-101	12.51	525.25	2.92	22.11	562.79
		SA-104 (232)	SA-104	0.00	0.00	0.00	0.00	0.00
		SA-106(238)	SA-106	1576.88	1660.41	230.79	2554.51	6022.60
		SA-107 (241)	SA-107	0.00	0.00	0.00	0.00	0.00
		SA-111(247)	SA-111	0.00	30.33	0.00	0.00	30.33
		SA-112(250)	SA-112	48.78	4466.96	33.82	478.73	5028.28
		SA-114 (256)	SA-114	0.00	0.00	0.00	0.00	0.00
		SA-115(259)	SA-115	12.18	27.29	6.23	130.99	176.69
		XA-304(271)	XA-304	12.06	55.47	3.31	56.58	127.41
		XA-304-RL(274)	XA-304-RL	270.75	2015.77	124.21	2776.14	5186.86
		XA-305(277)	XA-305	37.72	67.43	23.29	444.27	572.72
		XA-306(280)	XA-306	1902.96	9033.91	370.84	12199.32	23507.03
		XA-307(283)	XA-307	539.08	2132.70	23.46	1496.94	4192.18
		XA-310(292)	XA-310	12.14	20.24	12.73	88.45	133.55
		XA-311(295)	XA-311	80.18	2705.57	36.15	1021.61	3843.51
		XA-313(301)	XA-313	45.51	1947.79	27.98	538.84	2560.11
		XA-315(307)	XA-315	160.43	3658.24	27.77	805.63	4652.07
		XA-316(310)	XA-316	23.66	0.00	3.79	260.06	287.50
		XA-316-RL(313)	XA-316-RL	55.08	4438.96	12.45	685.65	5192.15
		XA-319(322)	XA-319	11.50	113.16	5.76	81.45	211.87
		XA-320(325)	XA-320	615.13	31.32	3.30	160.94	810.69
		XA-322(331)	XA-322	7.14	237.95	2.99	220.21	468.29
		XA-324(337)	XA-324	277.68	1.56	0.07	86.81	366.11
		XA-325 (340)	XA-325	0.00	0.00	0.00	0.00	0.00
		XA-326(343)	XA-326	10.65	29213.29	0.97	26.33	29251.25
		XA-327(346)	XA-327	10.40	104.31	0.00	8.94	123.64
		XA-329(352)	XA-329	9.35	454.28	3.13	108.55	575.31
		XA-331(358)	XA-331	9.99	0.00	0.65	6.22	16.86
		XA-336(373)	XA-336	4.05	729.91	0.02	33.13	767.11
		XA-337(376)	XA-337	191.61	5139.54	100.79	2903.47	8335.40

***** - Computations have not been completed.

+ - Something has changed and computations need to be redone.

Table 16 (cont.)

Equivalent Annual Damages by Reach

	XA-337(376)	XA-337	191.61	5139.54	100.79	2903.47	8335.40
	XA-340(385)	XA-340	1831.62	18.24	19.19	1161.47	3030.52
	XA-341(388)	XA-341	6.46	256.99	0.00	2.55	266.00
	XA-343 (394)	XA-343	0.00	0.00	0.00	0.00	0.00
	XA-344 (397)	XA-344	0.00	0.00	0.00	0.00	0.00
	XA-346(403)	XA-346	21.49	0.00	0.25	0.00	21.74
	XA-347(406)	XA-347	23.50	175.29	23.11	160.16	382.05
	XA-347-RL(409)	XA-347-RL	4.62	127.00	16.05	58.03	205.70
	XA-348 (412)	XA-348	43.41	1523.93	51.74	835.11	2454.19
	XA-348-RL(415)	XA-348-RL	27.34	449.75	44.66	84.29	606.04
	XA-349(418)	XA-349	0.00	0.18	0.00	0.00	0.18
	XA-350(421)	XA-350	0.00	1.08	0.00	0.00	1.08
	XA-351 (424)	XA-351	0.00	0.00	0.00	0.00	0.00
	XA-352 (427)	XA-352	0.00	0.00	0.00	0.00	0.00
	XA-353(430)	XA-353	1.03	105.41	0.00	1.84	108.28
	XA-354(433)	XA-354	0.30	34.79	0.00	5.86	40.95
	XA-355(436)	XA-355	5.41	15.41	1.74	417.47	440.02
	XA-356(439)	XA-356	950.09	8323.52	204.87	6006.22	15484.69
Total for stream:			26517.95	143446.64	2790.96	73958.23	246713.78

***** - Computations have not been completed.

+ - Something has changed and computations need to be redone.

*Note: The without project expected annual damages for the years 2025 and 2075 were converted to equivalent values using the FY 2013 federal discount rate, however, the expected average annual values for the final array of alternatives were converted to equivalent annual values using the FY 2014 federal discount rate of 3.50 percent.

Table 17
Southwest Coastal, LA Feasibility Study
Expected Annual Damages and Estimated Benefits for Six Structural Alternatives (2025)
($1,000s)

SWCLA Alternative 2025			50-Year Levee		100-year Levee		200-Year Levee	
	Proportion of Structures Behind Levee	Without project Damages	With project Damages	Benefits	With project Damages	Benefits	With project Damages	Benefits
Abbeville to Delcambre								
XA-305	1.00	318.2	214.4	103.7	152.0	166.1	95.0	223.1
XA-313	0.84	1,689.6	1,181.4	508.3	706.0	983.7	383.5	1,306.2
XA-356	0.99	7,783.7	6,051.5	1,732.2	4,851.5	2,932.2	3,542.7	4,241.0
SA-100	0.42	71.8	71.1	0.7	66.1	5.7	47.8	24.1
XA-306	0.99	17,164.2	9,065.2	8,099.0	6,181.9	10,982.2	4,155.5	13,008.7
SA-070-N	0.15	637.7	410.7	227.0	276.3	361.3	169.4	468.3
XA-329	0.64	297.4	239.6	57.8	159.4	138.1	92.4	205.0
Total		27,962.6	17,233.9	10,728.7	12,393.3	15,569.3	8,486.3	19,476.3
Delcambre/Erath								
XA-306	0.86	14,875.6	7,856.5	7,019.1	5,357.7	9,517.9	3,601.4	11,274.2
XA-305	1.00	318.2	214.4	103.7	152.0	166.1	95.0	223.1
XA-356	0.03	234.9	182.6	52.3	146.4	88.5	106.9	128.0
Total		15,428.7	8,253.6	7,175.1	5,656.1	9,772.6	3,803.4	11,625.3
Abbeville Ring Levee								
XA-356	0.80	6,248.9	4,858.3	1,390.6	3,894.9	2,354.0	2,844.2	3,404.7
SA-100	0.42	71.8	71.1	0.7	66.1	5.7	47.8	24.1
SA-070-N	0.15	637.7	410.7	227.0	276.3	361.3	169.4	468.3
Total		6,958.4	5,340.1	1,618.3	4,237.3	2,721.0	3,061.3	3,897.1
Lake CharlesWestbankSulfurExtended								
XA-337	0.77	2,647.7	2,535.7	112.0	2,303.4	344.3	1,709.9	937.8
XA-307	0.82	2,585.4	1,977.3	608.1	1,738.8	846.6	1,496.1	1,089.3
Total		5,233.1	4,513.0	720.1	4,042.2	1,190.9	3,206.0	2,027.1
Lake CharlesWestbankSulfurSouthExtended								
XA-337	0.99	3,418.9	3,274.3	144.6	2,974.4	444.5	2,208.0	1,211.0
XA-307	0.82	2,585.4	1,977.3	608.1	1,738.8	846.6	1,496.1	1,089.3
XA-316RL	0.71	2,062.0	2,016.4	45.5	1,911.2	150.8	1,221.4	840.6
XA-304RL	0.98	984.2	960.3	23.9	960.3	23.9	778.8	205.3
XA-355	1.00	488.3	306.1	182.2	221.3	266.9	163.0	325.2
Total		9,538.7	8,534.5	1,004.3	7,806.0	1,732.8	5,867.3	3,671.4
Lake Charles Eastbank								
SA-12	1.00	24,867.3	14,264.3	10,603.0	9,663.2	15,204.1	6,765.0	18,102.3
SA-011	0.97	158.5	150.8	7.7	122.6	35.9	79.0	79.4
SA-099RL	1.00	9,707.6	6,368.7	3,339.0	5,471.2	4,236.5	4,905.7	4,801.9
SA-099	0.73	12,427.6	10,178.3	2,249.3	9,725.7	2,701.9	9,241.4	3,186.2
XA-307	0.12	391.0	299.0	92.0	262.9	128.0	226.2	164.7
SA-106	0.23	758.4	585.3	173.1	495.6	262.8	415.0	343.4
Total		48,310.3	31,846.4	16,463.9	25,741.1	22,569.2	21,632.5	26,677.8

Table 18
Southwest Coastal, LA Feasibility Study
Expected Annual Damages and Estimated Benefits for Six Structural Alternatives (2075)
($1,000s)

SWCLA Alternative 2075			50-Year Levee		100-year Levee		200-Year Levee	
	Proportion of Structures Behind Levee	Without project Damages	With project Damages	Benefits	With project Damages	Benefits	With project Damages	Benefits
Abbeville to Delcambre								
XA-305	1.00	1,157.9	679.8	478.1	449.7	708.2	270.0	887.9
XA-313	0.84	3,891.4	1,626.6	2,264.8	1,008.4	2,883.0	627.4	3,264.1
XA-356	0.99	31,901.9	21,171.7	10,730.1	14,093.3	17,808.6	8,415.1	23,486.8
SA-100	0.42	624.8	542.9	81.9	380.6	244.2	213.0	411.8
XA-306	0.99	40,718.5	20,497.6	20,220.9	15,354.7	25,363.7	11,689.5	29,029.0
SA-070-N	0.15	1,299.1	695.6	603.6	464.6	834.6	312.2	986.9
XA-329	0.64	652.3	349.8	302.4	221.0	431.3	132.4	519.9
Total		80,245.9	44,945.9	34,681.9	31,972.3	48,273.6	21,659.6	58,586.3
Delcambre/Erath								
XA-306	0.86	35,289.3	17,764.6	17,524.8	13,307.4	21,981.9	10,130.9	25,158.5
XA-305	1.00	1,157.9	679.8	478.1	449.7	708.2	270.0	887.9
XA-356	0.03	962.8	639.0	323.8	425.4	537.5	254.0	708.9
Total		37,410.1	19,083.4	18,326.7	14,182.5	23,227.6	10,654.8	26,755.2
Abbeville Ring Levee								
XA-356	0.80	25,611.4	16,997.0	8,614.3	11,314.3	14,297.0	6,755.8	18,855.6
SA-100	0.42	624.8	542.9	81.9	380.6	244.2	213.0	411.8
SA-070-N	0.15	1,299.1	695.6	603.6	464.6	834.6	312.2	986.9
Total		27,535.3	18,235.5	9,299.8	12,159.5	15,375.8	7,281.0	20,254.3
Lake CharlesWestbankSulfurExtended								
XA-337	0.77	13,310.2	12,040.0	1,270.2	8,438.2	4,872.0	4,712.8	8,597.4
XA-307	0.82	5,321.2	3,848.7	1,472.5	2,926.3	2,394.9	2,140.9	3,180.3
Total		18,631.4	15,888.7	2,742.7	11,364.5	7,266.9	6,853.7	11,777.7
Lake CharlesWestbankSulfurSouthExtended								
XA-337	0.99	17,187.3	15,547.1	1,640.2	10,896.1	6,291.2	6,085.6	11,101.7
XA-307	0.82	5,321.2	3,848.7	1,472.5	2,926.3	2,394.9	2,140.9	3,180.3
XA-316RL	0.71	7,335.8	5,811.3	1,524.4	3,223.7	4,112.0	1,588.5	5,747.3
XA-304RL	0.98	13,233.9	11,482.9	1,751.0	9,057.8	4,176.1	4,877.8	8,356.1
XA-355	1.00	518.7	321.8	196.9	233.7	284.9	173.6	345.1
Total		43,596.8	37,011.8	6,585.0	26,337.7	17,259.2	14,866.4	28,730.4
Lake Charles Eastbank								
SA-12	1.00	51,613.4	37,470.3	14,143.1	27,636.0	23,977.4	17,721.6	33,891.8
SA-011	0.97	3,849.7	3,772.3	77.4	3,205.2	644.5	2,023.6	1,826.1
SA-099RL	1.00	26,560.4	19,085.0	7,475.4	14,684.2	11,876.2	10,620.7	15,939.7
SA-099	0.73	30,145.3	25,317.1	4,828.2	22,327.7	7,817.6	19,391.9	10,753.4
XA-307	0.12	804.7	582.0	222.7	442.5	362.2	323.7	480.9
SA-106	0.23	2,679.8	1,847.6	832.1	1,496.2	1,183.6	1,168.5	1,511.3
Total		115,653.2	88,074.3	27,578.9	69,791.8	45,861.4	51,250.0	64,403.1

Table 19
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.02 AEP for Alternative

Abbeville to Delcambre

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	28.25	1.27	35.95
2018	-6	28.25	1.23	34.73
2019	-5	117.99	1.19	140.13
2020	-4	117.99	1.15	135.39
2021	-3	117.99	1.11	130.81
2022	-2	117.99	1.07	126.39
2023	-1	89.73	1.04	92.87
2024	0	89.73	1.00	89.73
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	0.84	0.23	0.19
2068	44	0.84	0.22	0.18
2069	45	5.55	0.21	1.18
2070	46	5.55	0.21	1.14
2071	47	5.55	0.20	1.10
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		726.25		789.81

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		33.70
O&M Costs ($Millions)		0.51
Total Average Annual Costs ($Millions)		34.20

Table 19 (cont)
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.02 AEP for Alternative

Delcambre/Erath

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	15.17	1.27	19.30
2018	-6	15.17	1.23	18.64
2019	-5	52.16	1.19	61.95
2020	-4	52.16	1.15	59.85
2021	-3	52.16	1.11	57.83
2022	-2	52.16	1.07	55.87
2023	-1	36.99	1.04	38.29
2024	0	36.99	1.00	36.99
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	2.13	0.23	0.49
2068	44	2.13	0.22	0.47
2069	45	21.10	0.21	4.49
2070	46	21.10	0.21	4.34
2071	47	0.00	0.20	0.00
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		359.42		358.50

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		15.28
O&M Costs ($Millions)		0.24
Total Average Annual Costs ($Millions)		15.53

Note: Mitigation cost are not included in alternatives.

Table 19 (cont)
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.02 AEP for Alternative

Abbeville Ring Levee

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	12.91	1.27	16.42
2018	-6	12.91	1.23	15.87
2019	-5	43.45	1.19	51.61
2020	-4	43.45	1.15	49.86
2021	-3	43.45	1.11	48.18
2022	-2	43.45	1.07	46.55
2023	-1	30.54	1.04	31.61
2024	0	30.54	1.00	30.54
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	1.16	0.23	0.26
2068	44	1.16	0.22	0.26
2069	45	11.51	0.21	2.45
2070	46	11.51	0.21	2.36
2071	47	0.00	0.20	0.00
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		286.04		295.97

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		12.62
O&M Costs ($Millions)		0.28
Total Average Annual Costs ($Millions)		12.89

Table 19 (cont)
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.02 AEP for Alternative

Lake Charles Westbank Sulphur Extended

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	5.89	1.27	7.49
2018	-6	5.89	1.23	7.24
2019	-5	21.61	1.19	25.67
2020	-4	21.61	1.15	24.80
2021	-3	21.61	1.11	23.96
2022	-2	21.61	1.07	23.15
2023	-1	15.72	1.04	16.27
2024	0	15.72	1.00	15.72
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	0.60	0.23	0.14
2068	44	0.60	0.22	0.13
2069	45	5.97	0.21	1.27
2070	46	5.97	0.21	1.23
2071	47	0.00	0.20	0.00
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		142.81		147.08

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		6.27
O&M Costs ($Millions)		0.21
Total Average Annual Costs ($Millions)		6.48

Table 19 (cont)
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.02 AEP for Alternative

Lake Charles Westbank Sulphur South

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	23.87	1.27	30.37
2018	-6	23.87	1.23	29.35
2019	-5	69.47	1.19	82.51
2020	-4	69.47	1.15	79.72
2021	-3	69.47	1.11	77.02
2022	-2	69.47	1.07	74.42
2023	-1	45.60	1.04	47.19
2024	0	45.60	1.00	45.60
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	1.81	0.23	0.41
2068	44	1.81	0.22	0.40
2069	45	11.96	0.21	2.54
2070	46	11.96	0.21	2.46
2071	47	11.96	0.20	2.38
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		456.32		474.35

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		20.22
O&M Costs ($Millions)		0.44
Total Average Annual Costs ($Millions)		20.67

Table 19 (cont)
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.02 AEP for Alternative

Lake Charles Eastbank

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	72.83	1.27	92.66
2018	-6	72.83	1.23	89.52
2019	-5	124.68	1.19	148.09
2020	-4	124.68	1.15	143.08
2021	-3	124.68	1.11	138.24
2022	-2	124.68	1.07	133.56
2023	-1	51.86	1.04	53.67
2024	0	51.86	1.00	51.86
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	3.10	0.23	0.71
2068	44	3.10	0.22	0.68
2069	45	20.45	0.21	4.35
2070	46	20.45	0.21	4.20
2071	47	20.45	0.20	4.06
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		$815.63		864.67

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		36.9
O&M Costs ($Millions)		0.60
Total Average Annual Costs ($Millions)		37.5

Table 20
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.01 AEP for Alternative

Abbeville to Delcambre

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	30.53	1.27	38.84
2018	-6	30.53	1.23	37.52
2019	-5	143.21	1.19	170.09
2020	-4	143.21	1.15	164.34
2021	-3	143.21	1.11	158.78
2022	-2	143.21	1.07	153.41
2023	-1	112.69	1.04	116.63
2024	0	112.69	1.00	112.69
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	1.19	0.23	0.27
2068	44	1.19	0.22	0.26
2069	45	7.87	0.21	1.67
2070	46	7.87	0.21	1.62
2071	47	7.87	0.20	1.56
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		885.238		957.67

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		40.8
O&M Costs ($Millions)		0.565
Total Average Annual Costs ($Millions)		41.4

Note: Mitigation cost are not included in alternatives.

Table 20 (cont.)
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.01 AEP for Alternative

Delcambre/Erath

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	16.66	1.27	21.20
2018	-6	16.66	1.23	20.48
2019	-5	68.78	1.19	81.69
2020	-4	68.78	1.15	78.93
2021	-3	68.78	1.11	76.26
2022	-2	68.78	1.07	73.68
2023	-1	52.12	1.04	53.94
2024	0	52.12	1.00	52.12
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	2.66	0.23	0.61
2068	44	2.66	0.22	0.59
2069	45	17.59	0.21	3.74
2070	46	17.59	0.21	3.62
2071	47	17.59	0.20	3.49
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		470.79		470

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		20.1
O&M Costs ($Millions)		0.24
Total Average Annual Costs ($Millions)		20.3

Table 20 (cont.)
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.01 AEP for Alternative

Abbeville Ring Levee

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	13.68	1.27	17.41
2018	-6	13.68	1.23	16.82
2019	-5	52.06	1.19	61.84
2020	-4	52.06	1.15	59.74
2021	-3	52.06	1.11	57.72
2022	-2	52.06	1.07	55.77
2023	-1	38.38	1.04	39.72
2024	0	38.38	1.00	38.38
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	1.45	0.23	0.33
2068	44	1.45	0.22	0.32
2069	45	14.41	0.21	3.06
2070	46	14.41	0.21	2.96
2071	47	0.00	0.20	0.00
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		344.11		354.09

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		15.1
O&M Costs ($Millions)		0.28
Total Average Annual Costs ($Millions)		15.4

Table 20 (cont.)
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.01 AEP for Alternative

Lake Charles Westbank Sulphur Extended

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	6.52	1.27	8.29
2018	-6	6.52	1.23	8.01
2019	-5	28.59	1.19	33.96
2020	-4	28.59	1.15	32.81
2021	-3	28.59	1.11	31.70
2022	-2	28.59	1.07	30.63
2023	-1	22.08	1.04	22.85
2024	0	22.08	1.00	22.08
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	1.27	0.23	0.29
2068	44	1.27	0.22	0.28
2069	45	12.58	0.21	2.68
2070	46	12.58	0.21	2.58
2071	47	0.00	0.20	0.00
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		199.25		196

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		8.4
O&M Costs ($Millions)		0.21
Total Average Annual Costs ($Millions)		8.6

Table 20 (cont.)
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.01 AEP for Alternative

Lake Charles Westbank Sulphur South

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	25.99	1.27	33.07
2018	-6	25.99	1.23	31.95
2019	-5	93.07	1.19	110.54
2020	-4	93.07	1.15	106.80
2021	-3	93.07	1.11	103.19
2022	-2	93.07	1.07	99.70
2023	-1	67.08	1.04	69.43
2024	0	67.08	1.00	67.08
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	3.24	0.23	0.74
2068	44	3.24	0.22	0.71
2069	45	21.40	0.21	4.55
2070	46	21.40	0.21	4.40
2071	47	21.40	0.20	4.25
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		629.12		636

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		27.1
O&M Costs ($Millions)		0.44
Total Average Annual Costs ($Millions)		27.6

Table 20 (cont.)
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.01 AEP for Alternative

Lake Charles Eastbank

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	75.32	1.27	95.83
2018	-6	75.32	1.23	92.59
2019	-5	152.44	1.19	181.06
2020	-4	152.44	1.15	174.93
2021	-3	152.44	1.11	169.02
2022	-2	152.44	1.07	163.30
2023	-1	77.12	1.04	79.82
2024	0	77.12	1.00	77.12
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	4.62	0.23	1.05
2068	44	4.62	0.22	1.02
2069	45	30.49	0.21	6.48
2070	46	30.49	0.21	6.26
2071	47	30.49	0.20	6.05
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		$1,015		1,055

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		45.0
O&M Costs ($Millions)		0.6
Total Average Annual Costs ($Millions)		45.6

Table 21
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.005 AEP for Alternative

Abbeville to Delcambre

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	33.90	1.27	43.13
2018	-6	33.90	1.23	41.67
2019	-5	180.66	1.19	214.56
2020	-4	180.66	1.15	207.31
2021	-3	180.66	1.11	200.30
2022	-2	180.66	1.07	193.53
2023	-1	146.76	1.04	151.89
2024	0	146.76	1.00	146.76
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	1.56	0.23	0.35
2068	44	1.56	0.22	0.34
2069	45	10.28	0.21	2.19
2070	46	10.28	0.21	2.11
2071	47	10.28	0.20	2.04
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		$1,118		1,206

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		51.4
O&M Costs ($Millions)		0.6
Total Average Annual Costs ($Millions)		52.0

Note: Mitigation cost are not included in alternatives.

Table 21 (cont.)
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.005 AEP for Alternative

Delcambre/Erath

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	18.27	1.27	23.25
2018	-6	18.27	1.23	22.46
2019	-5	86.68	1.19	102.95
2020	-4	86.68	1.15	99.46
2021	-3	86.68	1.11	96.10
2022	-2	86.68	1.07	92.85
2023	-1	68.40	1.04	70.80
2024	0	68.40	1.00	68.40
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	3.18	0.23	0.72
2068	44	3.18	0.22	0.70
2069	45	21.02	0.21	4.47
2070	46	21.02	0.21	4.32
2071	47	21.02	0.20	4.17
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		589.49		591

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		25.2
O&M Costs ($Millions)		0.24
Total Average Annual Costs ($Millions)		25.4

Table 21 (cont.)
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.005 AEP for Alternative

Abbeville Ring Levee

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	15.10	1.27	19.21
2018	-6	15.10	1.23	18.56
2019	-5	67.81	1.19	80.54
2020	-4	67.81	1.15	77.81
2021	-3	67.81	1.11	75.18
2022	-2	67.81	1.07	72.64
2023	-1	52.71	1.04	54.55
2024	0	52.71	1.00	52.71
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	1.87	0.23	0.43
2068	44	1.87	0.22	0.41
2069	45	18.57	0.21	3.95
2070	46	18.57	0.21	3.82
2071	47	0.00	0.20	0.00
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		447.74		460

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		19.6
O&M Costs ($Millions)		0.28
Total Average Annual Costs ($Millions)		19.9

Table 21 (cont.)
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.005 AEP for Alternative

Lake Charles Westbank Sulphur Extended

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	8.17	1.27	10.40
2018	-6	8.17	1.23	10.05
2019	-5	47.02	1.19	55.85
2020	-4	47.02	1.15	53.96
2021	-3	47.02	1.11	52.13
2022	-2	47.02	1.07	50.37
2023	-1	38.85	1.04	40.21
2024	0	38.85	1.00	38.85
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	2.06	0.23	0.47
2068	44	2.06	0.22	0.45
2069	45	20.40	0.21	4.34
2070	46	20.40	0.21	4.19
2071	47	0.00	0.20	0.00
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		327.05		321

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		13.7
O&M Costs ($Millions)		0.21
Total Average Annual Costs ($Millions)		13.9

Table 21 (cont.)
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.005 AEP for Alternative

Lake Charles Westbank Sulphur South

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	29.23	1.27	37.18
2018	-6	29.23	1.23	35.93
2019	-5	129.04	1.19	153.26
2020	-4	129.04	1.15	148.07
2021	-3	129.04	1.11	143.07
2022	-2	129.04	1.07	138.23
2023	-1	99.81	1.04	103.31
2024	0	99.81	1.00	99.81
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	5.03	0.23	1.15
2068	44	5.03	0.22	1.11
2069	45	33.22	0.21	7.06
2070	46	33.22	0.21	6.83
2071	47	33.22	0.20	6.59
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		883.94		882

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		37.6
O&M Costs ($Millions)		0.44
Total Average Annual Costs ($Millions)		38.0

Table 21 (cont.)
Southwest Coastal, LA Feasibility Study
Average Annual Costs for the 0.005 AEP for Alternative

Lake Charles Eastbank

Year	Project Year	Construction Costs ($ millions)	PV Factor	Present Value of Construction Costs ($ millions)
2015	-9	0.00	1.36	0.00
2016	-8	0.00	1.32	0.00
2017	-7	78.55	1.27	99.94
2018	-6	78.55	1.23	96.56
2019	-5	188.33	1.19	223.67
2020	-4	188.33	1.15	216.11
2021	-3	188.33	1.11	208.80
2022	-2	188.33	1.07	201.74
2023	-1	109.78	1.04	113.62
2024	0	109.78	1.00	109.78
2025	1	0.00	0.97	0.00
2026	2	0.00	0.93	0.00
2027	3	0.00	0.90	0.00
2028	4	0.00	0.87	0.00
2029	5	0.00	0.84	0.00
2030	6	0.00	0.81	0.00
2031	7	0.00	0.79	0.00
2032	8	0.00	0.76	0.00
2033	9	0.00	0.73	0.00
2034	10	0.00	0.71	0.00
2035	11	0.00	0.68	0.00
2036	12	0.00	0.66	0.00
2037	13	0.00	0.64	0.00
2038	14	0.00	0.62	0.00
2039	15	0.00	0.60	0.00
2040	16	0.00	0.58	0.00
2041	17	0.00	0.56	0.00
2042	18	0.00	0.54	0.00
2043	19	0.00	0.52	0.00
2044	20	0.00	0.50	0.00
2045	21	0.00	0.49	0.00
2046	22	0.00	0.47	0.00
2047	23	0.00	0.45	0.00
2048	24	0.00	0.44	0.00
2049	25	0.00	0.42	0.00
2050	26	0.00	0.41	0.00
2051	27	0.00	0.40	0.00
2052	28	0.00	0.38	0.00
2053	29	0.00	0.37	0.00
2054	30	0.00	0.36	0.00
2055	31	0.00	0.34	0.00
2056	32	0.00	0.33	0.00
2057	33	0.00	0.32	0.00
2058	34	0.00	0.31	0.00
2059	35	0.00	0.30	0.00
2060	36	0.00	0.29	0.00
2061	37	0.00	0.28	0.00
2062	38	0.00	0.27	0.00
2063	39	0.00	0.26	0.00
2064	40	0.00	0.25	0.00
2065	41	0.00	0.24	0.00
2066	42	0.00	0.24	0.00
2067	43	5.98	0.23	1.36
2068	44	5.98	0.22	1.32
2069	45	39.48	0.21	8.40
2070	46	39.48	0.21	8.11
2071	47	39.48	0.20	7.84
2072	48	0.00	0.19	0.00
2073	49	0.00	0.19	0.00
2074	50	0.00	0.18	0.00
		1,260.36		1,297

Discount Rate	3.5%	
Amortization Factor	0.0426	
Average Annual Costs		55.3
O&M Costs ($Millions)		0.6
Total Average Annual Costs ($Millions)		55.9

Table 22
Southwest Coastal, LA Feasibility Study
0.02 AEP (50-year) Abbeville to Delcambre Alternative Total Equivalent Annual Net Benefits
(2012 Price Level; 3.50% Discount Rate)
(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	46.4	27.2	19.2
First Costs			726.3
Interest During Construction			78.1
Annual Operation & Maintenance Costs			0.51
Total Annual Costs			34.2
Benefit Cost Ratio			0.56
Equivalent Annual Net Benefits - 2025 Base Year			-14.99

Note: Mitigation is not included in the cost estimates

Table 23
Southwest Coastal, LA Feasibility Study
0.02 AEP (50-year) Delcambre/Erath Alternative Total Equivalent Annual Net Benefits
(2012 Price Level; 3.50% Discount Rate)
(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	23.2	12.1	11.1
First Costs			359.4
Interest During Construction			35.8
Annual Operation & Maintenance Costs			0.24
Total Annual Costs			15.5
Benefit Cost Ratio			0.72
Equivalent Annual Net Benefits - 2025 Base Year			-4.41

Note: Mitigation is not included in the cost estimates

Table 24

Southwest Coastal, LA Feasibility Study

0.02 AEP (50-year) Abbeville Ring Levee Total Equivalent Annual Net Benefits

(2012 Price Level; 3.50% Discount Rate) Abbeville Ring Levee

(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	14.2	11.7	2.6
First Costs			286.0
Interest During Construction			29.9
Annual Operation & Maintenance Costs			0.28
Total Annual Costs			12.9
Benefit Cost Ratio			0.20
Equivalent Annual Net Benefits - 2025 Base Year			-10.33

Note: Mitigation is not included in the cost estimates

Table 25

Southwest Coastal, LA Feasibility Study

0.02 AEP (50-year) Lake Charles Westbank Sulfur Extended Total Equivalent Annual Net Benefits

(2012 Price Level; 3.50% Discount Rate)

(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	10.0	8.5	1.4
First Costs			142.8
Interest During Construction			14.6
Annual Operation & Maintenance Costs			0.21
Total Annual Costs			6.5
Benefit Cost Ratio			0.22
Equivalent Annual Net Benefits - 2025 Base Year			-5.04

Note: Mitigation is not included in the cost estimates

Table 26

Southwest Coastal, LA Feasibility Study

0.02 AEP (50-year) Lake Charles Westbank Sulfur South Total Equivalent Annual Net Benefits

(2012 Price Level; 3.50% Discount Rate)

(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	21.6	18.6	3.0
First Costs			456.3
Interest During Construction			49.4
Annual Operation & Maintenance Costs			0.44
Total Annual Costs			20.7
Benefit Cost Ratio			0.14
Equivalent Annual Net Benefits - 2025 Base Year			-17.69

Note: Mitigation is not included in the cost estimates

Table 27

Southwest Coastal, LA Feasibility Study

0.02 AEP (50-year) Lake Charles Eastbank Total Equivalent Annual Net Benefits

(2012 Price Level; 3.50% Discount Rate)

(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	32.1	21.2	10.9
First Costs			815.6
Interest During Construction			102.6
Annual Operation & Maintenance Costs			0.60
Total Annual Costs			37.5
Benefit Cost Ratio			0.29
Equivalent Annual Net Benefits - 2025 Base Year			-26.60

Note: Mitigation is not included in the cost estimates

Table 28
Southwest Coastal, LA Feasibility Study
0.01 AEP (100-year) Abbeville to Delcambre Alternative Total Equivalent Annual Net Benefits
(2012 Price Level; 3.50% Discount Rate)
(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	46.4	19.3	27.1
First Costs			885.2
Interest During Construction			93.0
Annual Operation & Maintenance Costs			0.56
Total Annual Costs			41.4
Benefit Cost Ratio			0.66
Equivalent Annual Net Benefits - 2025 Base Year			-14.27

Note: Mitigation is not included in the cost estimates

Table 29
Southwest Coastal, LA Feasibility Study
0.01 AEP (100-year) Delcambre/Erath Alternative Total Equivalent Annual Net Benefits
(2012 Price Level; 3.50% Discount Rate)
(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	23.2	8.7	14.5
First Costs			470.8
Interest During Construction			45.6
Annual Operation & Maintenance Costs			0.24
Total Annual Costs			20.3
Benefit Cost Ratio			0.72
Equivalent Annual Net Benefits - 2025 Base Year			-5.77

Note: Mitigation is not included in the cost estimates

Table 30

Southwest Coastal, LA Feasibility Study

0.01 AEP (100-year) Abbeville Ring Levee Total Equivalent Annual Net Benefits

(2012 Price Level; 3.50% Discount Rate) Abbeville Ring Levee

(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	14.2	7.0	7.2
First Costs			344.1
Interest During Construction			35.0
Annual Operation & Maintenance Costs			0.28
Total Annual Costs			15.4
Benefit Cost Ratio			0.47
Equivalent Annual Net Benefits - 2025 Base Year			-8.18

Note: Mitigation is not included in the cost estimates

Table 31

Southwest Coastal, LA Feasibility Study

0.01 AEP (100-year) Lake Charles Westbank Sulfur Extended Total Equivalent Annual Net Benefits

(2012 Price Level; 3.50% Discount Rate)

(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	10.0	6.6	3.3
First Costs			199.3
Interest During Construction			18.8
Annual Operation & Maintenance Costs			0.21
Total Annual Costs			8.6
Benefit Cost Ratio			0.39
Equivalent Annual Net Benefits - 2025 Base Year			-5.23

Note: Mitigation is not included in the cost estimates

Table 32
Southwest Coastal, LA Feasibility Study
0.01 AEP (100-year) Lake Charles Westbank Sulfur South Total Equivalent Annual Net Benefits
(2012 Price Level; 3.50% Discount Rate)
(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	21.6	14.4	7.2
First Costs			629.1
Interest During Construction			63.3
Annual Operation & Maintenance Costs			0.44
Total Annual Costs			27.6
Benefit Cost Ratio			0.26
Equivalent Annual Net Benefits - 2025 Base Year			-20.36

Note: Mitigation is not included in the cost estimates

Table 33
Southwest Coastal, LA Feasibility Study
0.01 AEP (100-year) Lake Charles Eastbank Total Equivalent Annual Net Benefits
(2012 Price Level; 3.50% Discount Rate)
(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	72.1	41.3	30.8
First Costs			1015.4
Interest During Construction			131.1
Annual Operation & Maintenance Costs			0.60
Total Annual Costs			45.6
Benefit Cost Ratio			0.68
Equivalent Annual Net Benefits - 2025 Base Year			-14.77

Note: Mitigation is not included in the cost estimates

Table 34
Southwest Coastal, LA Feasibility Study
0.005 AEP (200-year) Abbeville to Delcambre Alternative Total Equivalent Annual Net Benefits
(2012 Price Level; 3.50% Discount Rate)
(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Category			
Residential & Commercial - Structure/Content/Vehicles	45.6	13.1	32.5
First Costs			1117.9
Interest During Construction			115.2
Annual Operation & Maintenance Costs			0.57
Total Annual Costs			52.0
B/C Ratio			0.63
Equivalent Annual Net Benefits - 2025 Base Year			-19.48

Note: Mitigation is not included in the cost estimates

Table 35
Southwest Coastal, LA Feasibility Study
0.005 AEP (200-year) Delcambre/Erath Alternative Total Equivalent Annual Net Benefits
(2012 Price Level; 3.50% Discount Rate)
(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	23.2	6.2	17.0
First Costs			589.5
Interest During Construction			56.2
Annual Operation & Maintenance Costs			0.24
Total Annual Costs			25.4
Benefit Cost Ratio			0.67
Equivalent Annual Net Benefits - 2025 Base Year			-8.45

Note: Mitigation is not included in the cost estimates

Table 36

Southwest Coastal, LA Feasibility Study

0.005 AEP (200-year) Abbeville Ring Levee Total Equivalent Annual Net Benefits

(2012 Price Level; 3.50% Discount Rate) Abbeville Ring Levee

(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	14.2	4.6	9.7
First Costs			447.7
Interest During Construction			44.4
Annual Operation & Maintenance Costs			0.28
Total Annual Costs			19.9
Benefit Cost Ratio			0.49
Equivalent Annual Net Benefits - 2025 Base Year			-10.20

Note: Mitigation is not included in the cost estimates

Table 37

Southwest Coastal, LA Feasibility Study

0.005 AEP (200-year) Lake Charles Westbank Sulfur Extended Total Equivalent Annual Net Benefits

(2012 Price Level; 3.50% Discount Rate)

(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	10.0	4.5	5.5
First Costs			327.1
Interest During Construction			29.7
Annual Operation & Maintenance Costs			0.21
Total Annual Costs			13.9
Benefit Cost Ratio			0.39
Equivalent Annual Net Benefits - 2025 Base Year			-8.43

Note: Mitigation is not included in the cost estimates

Table 38

Southwest Coastal, LA Feasibility Study

0.005 AEP (200-year) Lake Charles Westbank Sulfur South Total Equivalent Annual Net Benefits

(2012 Price Level; 3.50% Discount Rate)

(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	21.6	9.0	12.5
First Costs			883.9
Interest During Construction			84.6
Annual Operation & Maintenance Costs			0.44
Total Annual Costs			38.0
Benefit Cost Ratio			0.33
Equivalent Annual Net Benefits - 2025 Base Year			-25.50

Note: Mitigation is not included in the cost estimates

Table 39

Southwest Coastal, LA Feasibility Study

0.005 AEP (200-year) Lake Charles Eastbank Total Equivalent Annual Net Benefits

(2012 Price Level; 3.50% Discount Rate)

(Costs and Benefits $ Millions)

Item	Equiv Annual W/O Project Damages (2025-2075)	Equiv Annual With-Project Damages (2025-2075)	Equiv Annual Benefits (2025-2075)
Damage Categories			
Residential & Commercial - Structure/Content/Vehicles	32.1	14.4	17.7
First Costs			1260.4
Interest During Construction			140.3
Annual Operation & Maintenance Costs			0.60
Total Annual Costs			55.9
Benefit Cost Ratio			0.32
Equivalent Annual Net Benefits - 2025 Base Year			-38.17

Note: Mitigation is not included in the cost estimates

Table 40
Southwest Coastal, LA Feasibility Study
Cost per Square Foot of Elevating Residential Structures
(2012 Price Level)
($)

	1STY-SLAB			2STY-SLAB			1STY-PIER			2STY-PIER			MOBHOM		
Ft. Raised	Min	Most Likely	Max	Min	Most Likely	Max	Min	Most Likely	Max	Min	Most Likely	Max	Min	Most Likely	Max
1	62	70	77	70	77	85	54	62	69	61	68	76	30	34	38
2	62	70	77	70	77	85	54	62	69	61	68	76	30	34	38
3	64	71	79	71	79	86	57	64	72	63	71	78	30	34	38
4	66	74	81	76	84	91	57	64	72	63	71	78	30	34	38
5	66	74	81	76	84	91	57	64	72	63	71	78	38	42	45
6	68	75	83	78	85	93	58	66	73	65	72	80	38	42	45
7	68	75	83	78	85	93	58	66	73	65	72	80	38	42	45
8	70	78	85	80	88	96	60	67	75	66	74	81	38	42	45
9	70	78	85	80	88	96	60	67	75	66	74	81	38	42	45
10	70	78	85	80	88	96	60	67	75	66	74	81	38	42	45
11	70	78	85	80	88	96	60	67	75	66	74	81	38	42	45
12	70	78	85	80	88	96	60	67	75	66	74	81	38	42	45
13	73	80	88	85	93	101	61	69	76	68	75	83	38	42	45

Table 41
Southwest Coastal, LA Feasibility Study
Average Footprint of Structure by Category
(2012 Price Level)

Structure Category	Average Footprint (sq. ft.)
One story Pier	1,479
One story slab	2,031
Two story pier	1,328
Two story slab	1,788
Mobile home	576
Eatery	5,972
Grocery	6,362
Multi-Occupancy	38,321
Professional	6,190
Public	7,970
Repair	5,772
Retail	11,408
Warehouse	6,297

Note: Calculated from collected structure inventory.

Table 42
Southwest Coastal, LA Feasibility Study
Costs and Benefits for the Nonstructural Alternatives by Study Area Reach
(2012 Price Level; 3.50% Discount Rate)
($1000)

Reach	Total Cost (1000s)	Average Annual Cost	Equivalent Annual Benefits	Expected Annual Net Benefits	Benefit Cost Ratio
SA-001(1)	-	-	-	-	-
SA-006 (7)	-	-	-	-	-
SA-010(19)	-	-	-	-	-
SA-011(22)	12,156	518	229	(289)	0.44
SA-012(25)	715,089	30,484	18,711	(11,774)	0.61
SA-013(28)	13,751	586	225	(361)	0.38
SA-014(31)	6,443	275	206	(69)	0.75
SA-015 (34)	-	-	-	-	-
SA-016(37)	281	12	6	(6)	0.50
SA-017(40)	22,787	971	148	(823)	0.15
SA-017-RL(43)	89,862	3,831	1,898	(1,933)	0.50
SA-019 (46)	-	-	-	-	-
SA-021(49)	205	9	2	(7)	0.20
SA-023(52)	2,288	98	30	(67)	0.31
SA-030(61)	37,883	1,615	667	(948)	0.41
SA-031(64)	4,782	204	35	(169)	0.17
SA-033(70)	114,013	4,860	2,446	(2,414)	0.50
SA-033-RL(73)	1,519	65	22	(43)	0.34
SA-033-RL(76)	8,466	361	364	3	1.01
SA-034(79)	9,591	409	617	208	1.51
SA-036 (82)	-	-	-	-	-
SA-038(85)	-	-	-	-	-
SA-040 (91)	-	-	-	-	-
SA-046(103)	1,147	49	15	(33)	0.32
SA-048(106)	34,647	1,477	2,009	532	1.36
SA-054 (112)	-	-	-	-	-
SA-067(130)	1,063	45	4	(42)	0.08
SA-070 (133)	-	-	-	-	-
SA-070-N(136)	88,264	3,763	2,201	(1,562)	0.58
SA-070-S(139)	13,687	583	929	345	1.59
SA-074(151)	8,650	369	223	(146)	0.60
SA-079(166)	899	38	19	(19)	0.50
SA-086 (173)	-	-	-	-	-
SA-087 (176)	-	-	-	-	-
SA-089(181)	27,316	1,164	435	(729)	0.37
SA-090 (184)	-	-	-	-	-
SA-091(187)	12,896	550	1,352	802	2.46
SA-092 (190)	-	-	-	-	-
SA-096(202)	47,680	2,033	722	(1,310)	0.36
SA-097 (205)	-	-	-	-	-
SA-099(211)	41,393	1,765	1,686	(78)	0.96
SA-099-RL(214)	189,172	8,064	4,285	(3,780)	0.53
SA-100(217)	31,638	1,349	162	(1,187)	0.12
SA-101(220)	1,032	44	6	(38)	0.15
SA-104 (232)	-	-	-	-	-
SA-106(238)	83,079	3,542	2,419	(1,122)	0.68
SA-107 (241)	-	-	-	-	-

Table 42 (cont)
Southwest Coastal, LA Feasibility Study
Costs and Benefits for the Nonstructural Alternatives by Study Area Reach
(2012 Price Level; 3.50% Discount Rate)
($1000)

Reach	Total Cost (1000s)	Average Annual Cost	Equivalent Annual Benefits	Expected Annual Net Benefits	Benefit Cost Ratio
SA-111(247)	-	-	-	-	-
SA-112(250)	10,177	434	566	132	1.31
SA-114 (256)	-	-	-	-	-
SA-115(259)	5,084	217	119	(98)	0.55
XA-304(271)	2,345	100	64	(36)	0.64
XA-304-RL(274)	193,089	8,231	1,156	(7,076)	0.14
XA-305(277)	25,703	1,096	315	(781)	0.29
XA-306(280)	296,306	12,632	14,589	1,958	1.15
XA-307(283)	62,840	2,679	1,238	(1,441)	0.46
XA-310(292)	7,314	312	52	(260)	0.17
XA-311(295)	39,788	1,696	1,535	(161)	0.91
XA-313(301)	25,072	1,069	727	(342)	0.68
XA-315(307)	21,834	931	904	(27)	0.97
XA-316(310)	8,446	360	194	(167)	0.54
XA-316-RL(313)	59,961	2,556	911	(1,645)	0.36
XA-319(322)	6,672	284	125	(160)	0.44
XA-320(325)	6,395	273	94	(178)	0.35
XA-322(331)	17,838	760	102	(659)	0.13
XA-324(337)	1,232	53	66	13	1.26
XA-325 (340)	-	-	-	-	-
XA-326(343)	2,369	101	84	(17)	0.83
XA-327(346)	114	5	8	3	1.66
XA-329(352)	7,077	302	95	(206)	0.32
XA-331(358)	242	10	5	(5)	0.53
XA-336(373)	583	25	130	105	5.22
XA-337(376)	332,294	14,166	1,953	(12,213)	0.14
XA-340(385)	24,027	1,024	891	(133)	0.87
XA-341(388)	341	15	36	21	2.44
XA-343 (394)	-	-	-	-	-
XA-344 (397)	-	-	-	-	-
XA-346(403)	-	-	-	-	-
XA-347(406)	11,038	471	93	(378)	0.20
XA-347-RL(409)	4,396	187	45	(143)	0.24
XA-348 (412)	-	-	-	-	-
XA-348-RL(415)	9,528	406	83	(324)	0.20
XA-349(418)	-	-	-	-	-
XA-350(421)	114	5	1	(4)	0.13
XA-351 (424)	-	-	-	-	-
XA-352 (427)	-	-	-	-	-
XA-353(430)	227	10	0	(10)	0.01
XA-354(433)	121	5	5	(0)	0.95
XA-355(436)	871	37	17	(20)	0.47
XA-356(439)	453,167	19,319	6,304	(13,015)	0.33
Total	3,258,288	138,901	74,577	(64,324)	0.54

Note: Reaches not receiving damages do not contain structures within the 100 year floodplain.

Table 43
Southwest Coastal, LA Feasibility Study
Nonstructural Measures for All Reaches in Study Area (2025 and 2075)

2025			
Elevation of Structures	Flood Proofing	Acquistion	Total
10,456	810	6	11,272

2075			
Elevation of Structures	Flood Proofing	Acquistion	Total
14,090	1,240	2	15,332

Total for 2025 and 2075			
Elevation of Structures	Flood Proofing	Acquistion	Total
24,546	2,050	8	26,604

Table 44
Southwest Coastal, LA Feasibility Study
Economically Justified Reaches for the Nonstructural Alternative
Total Equivalent Annual Net Benefits
(2012 Price Level; 3.50% Discount Rate)
($1000)

Reach	Total Cost (1000s)	Average Annual Cost	Equivalent Annual Benefits	Expected Annual Net Benefits	Benefit Cost Ratio
SA-033-RL(76)	8,466	361	364	3	1.01
SA-034(79)	9,591	409	617	208	1.51
SA-048(106)	34,647	1,477	2,009	532	1.36
SA-070-S(139)	13,687	583	929	345	1.59
SA-091(187)	12,896	550	1,352	802	2.46
SA-112(250)	10,177	434	566	132	1.31
XA-306(280)	296,306	12,632	14,589	1,958	1.15
XA-324(337)	1,232	53	66	13	1.26
XA-327(346)	114	5	8	3	1.66
XA-336(373)	583	25	130	105	5.22
XA-341(388)	341	15	36	21	2.44
Total	388,040	16,542	20,665	4,123	1.25

Table 45
Southwest Coastal, LA Feasibility Study
Economically Justified Reaches for the Nonstructural Alternative
Number of Structures by Reach Addressed by Nonstructural Measure
(2012 Price Level; 3.50% Discount Rate)

Reach	Elevation of Structures	Flood Proofing	Acquistion	Total
SA-033-RL(76)	74	3	-	77
SA-034(79)	110	9	3	122
SA-048(106)	387	2	-	389
SA-070-S(139)	106	28	-	134
SA-091(187)	136	33	-	169
SA-112(250)	143	5	-	148
XA-306(280)	2,698	162	-	2,860
XA-324(337)	7	-	-	7
XA-327(346)	-	1	-	1
XA-336(373)	3	2	-	5
XA-341(388)	1	2	-	3
Total	3,665	247	3	3,915

Table 46
Southwest Coastal, LA Feasibility Study
Final Array of Alternatives for National Ecosystem Restoration

PLAN NUMBER	Alternative
A	Entry Salinity Control
C-1	Calcasieu Large Integrated Restoration
C-2	Calcasieu Moderate Integrated Restoration
C-3	Calcasieu Moderate Integrated Restoration
C-4	Calcasieu Small Integrated Restoration
C-5	Calcasieu Interior Perimeter Salinity Control
C-6	Calcasieu Marsh & Shoreline
CA-1	Calcasieu Large Integrated Restoration w/ Entry Salinity Control
CA-2	Calcasieu Moderate Integrated Restoration w/ Entry Salinity Control
CA-3	Calcasieu Moderate Integrated Restoration w/ Gum Cove & Entry Salinity Control
CA-4	Calcasieu Small Integrated Restoration w/ Entry Salinity Control
CM-1	Comprehensive Large Integrated Restoration
CM-2	Comprehensive Moderate Integrated Restoration
CM-3	Comprehensive Moderate Integrated Restoration
CM-4	Comprehensive Small Integrated Restoration
CM-5	Comprehensive Interior Perimeter Salinity Control
CM-6	Comprehensive Marsh & Shoreline
CMA-1	Comprehensive Large Integrated Restoration w/ Entry Salinity Control
CMA-2	Comprehensive Moderate Integrated Restoration w/ Entry Salinity Control
CMA-3	Comprehensive Moderate Integrated Restoration w/ Gum Cove & Entry Salinity Control
CMA-4	Comprehensive Small Integrated Restoration w/ Entry Salinity Control
M-1	Mermentau Large Integrated Restoration
M-2	Mermentau Moderate Integrated Restoration
M-3	Mermentau Moderate Integrated Restoration
M-4	Mermentau Small Integrated Restoration
M-5	Mermentau Interior Perimeter Salinity Control
M-6	Mermentau Marsh & Shoreline

Table 47
Southwest Coastal, LA Feasibility Study
Costs and Net AAHU's

Name	Cost ($)	Net AAHUs
A	638,754,179	5,969
C-1	1,007,506,800	6,875
C-2	1,007,506,800	7,929
C-3	1,219,537,866	2,013
C-4	457,412,479	5,036
C-5	801,648,479	4,457
C-6	1,005,766,800	9,240
CA-1	1,646,260,979	12,844
CA-2	1,550,472,045	13,898
CA-3	1,858,292,045	7,982
CA-4	1,096,166,658	11,005
CM-1	2,465,675,681	23,101
CM-2	1,901,658,190	19,218
CM-3	2,113,689,256	12,990
CM-4	1,319,822,939	16,539
CM-5	1,664,058,939	15,537
CM-6	2,321,547,245	23,026
CMA-1	3,104,429,860	29,070
CMA-2	2,444,623,435	25,187
CMA-3	2,752,443,435	18,959
CMA-4	1,958,577,118	22,508
M-1	1,458,168,881	16,226
M-2	894,151,390	11,289
M-3	894,151,390	10,977
M-4	862,410,460	11,503
M-5	862,410,460	11,080
M-6	1,315,780,445	13,786

Table 48
Southwest Coastal, LA Feasibility Study
Construction Cost Schedule

Year	Period of Analysis	Construction Costs	PV Factor	PV Construction Costs
2015	-9	$0	1.363	0
2016	-8	$0	1.317	0
2017	-7	$0	1.272	0
2018	-6	$0	1.229	0
2019	-5	$0	1.188	0
2020	-4	$0	1.148	0
2021	-3	$0	1.109	0
2022	-2	$426,807,331	1.071	$457,206,683
2023	-1	$489,049,762	1.035	$506,166,504
2024	0	$75,886,091	1	$75,886,091
2025	1	$0	0.966	0
2026	2	$0	0.934	0
2027	3	$0	0.902	0
2028	4	$0	0.871	0
2029	5	$0	0.842	0
2030	6	$0	0.814	0
2031	7	$0	0.786	0
2032	8	$0	0.759	0
2033	9	$0	0.734	0
2034	10	$0	0.709	0
2035	11	$0	0.685	0
2036	12	$0	0.662	0
2037	13	$0	0.639	0
2038	14	$0	0.618	0
2039	15	$0	0.597	0
2040	16	$0	0.577	0
2041	17	$0	0.557	0
2042	18	$0	0.538	0
2043	19	$0	0.52	0
2044	20	$0	0.503	0
2045	21	$0	0.486	0
2046	22	$0	0.469	0
2047	23	$0	0.453	0
2048	24	$0	0.438	0
2049	25	$0	0.423	0
2050	26	$0	0.409	0
2051	27	$0	0.395	0
2052	28	$0	0.382	0
2053	29	$0	0.369	0
2054	30	$0	0.356	0
2055	31	$0	0.344	0
2056	32	$0	0.333	0
2057	33	$0	0.321	0
2058	34	$0	0.31	0
2059	35	$0	0.3	0
2060	36	$0	0.29	0
2061	37	$0	0.28	0
2062	38	$0	0.271	0
2063	39	$0	0.261	0
2064	40	$0	0.253	0
2065	41	$0	0.244	0
2066	42	$0	0.236	0
2067	43	$0	0.228	0
2068	44	$0	0.22	0
2069	45	$0	0.213	0
2070	46	$0	0.205	0
2071	47	$0	0.199	0
2072	48	$0	0.192	0
2073	49	$0	0.185	0
2074	50	$0	0.179	0
Total		$991,743,184		$1,039,259,278

Table 49
Southwest Coastal, LA Feasibility Study
Operations and Maintenance Cost Schedule

Year	Period of Analysis	Construction Costs	PV Factor	PV Construction Costs
2015	-9	$0	1.363	$0
2016	-8	$0	1.317	$0
2017	-7	$0	1.272	$0
2018	-6	$0	1.229	$0
2019	-5	$0	1.188	$0
2020	-4	$0	1.148	$0
2021	-3	$0	1.109	$0
2022	-2	$0	1.071	$0
2023	-1	$0	1.035	$0
2024	0	$0	1	$0
2025	1	$0	0.966	$0
2026	2	$0	0.934	$0
2027	3	$0	0.902	$0
2028	4	$0	0.871	$0
2029	5	$0	0.842	$0
2030	6	$0	0.814	$0
2031	7	$0	0.786	$0
2032	8	$0	0.759	$0
2033	9	$0	0.734	$0
2034	10	$0	0.709	$0
2035	11	$0	0.685	$0
2036	12	$0	0.662	$0
2037	13	$0	0.639	$0
2038	14	$0	0.618	$0
2039	15	$27,646,145	0.597	$16,501,724
2040	16	$0	0.577	$0
2041	17	$0	0.557	$0
2042	18	$0	0.538	$0
2043	19	$0	0.52	$0
2044	20	$0	0.503	$0
2045	21	$0	0.486	$0
2046	22	$0	0.469	$0
2047	23	$0	0.453	$0
2048	24	$0	0.438	$0
2049	25	$56,171,821	0.423	$23,768,937
2050	26	$0	0.409	$0
2051	27	$0	0.395	$0
2052	28	$0	0.382	$0
2053	29	$0	0.369	$0
2054	30	$225,418,402	0.356	$80,311,710
2055	31	$16,433,375	0.344	$5,656,866
2056	32	$0	0.333	$0
2057	33	$0	0.321	$0
2058	34	$0	0.31	$0
2059	35	$0	0.3	$0
2060	36	$0	0.29	$0
2061	37	$0	0.28	$0
2062	38	$0	0.271	$0
2063	39	$0	0.261	$0
2064	40	$0	0.253	$0
2065	41	$0	0.244	$0
2066	42	$0	0.236	$0
2067	43	$0	0.228	$0
2068	44	$0	0.22	$0
2069	45	$0	0.213	$0
2070	46	$0	0.205	$0
2071	47	$0	0.199	$0
2072	48	$0	0.192	$0
2073	49	$0	0.185	$0
2074	50	$0	0.179	$0
Total		$325,669,743		$126,239,238

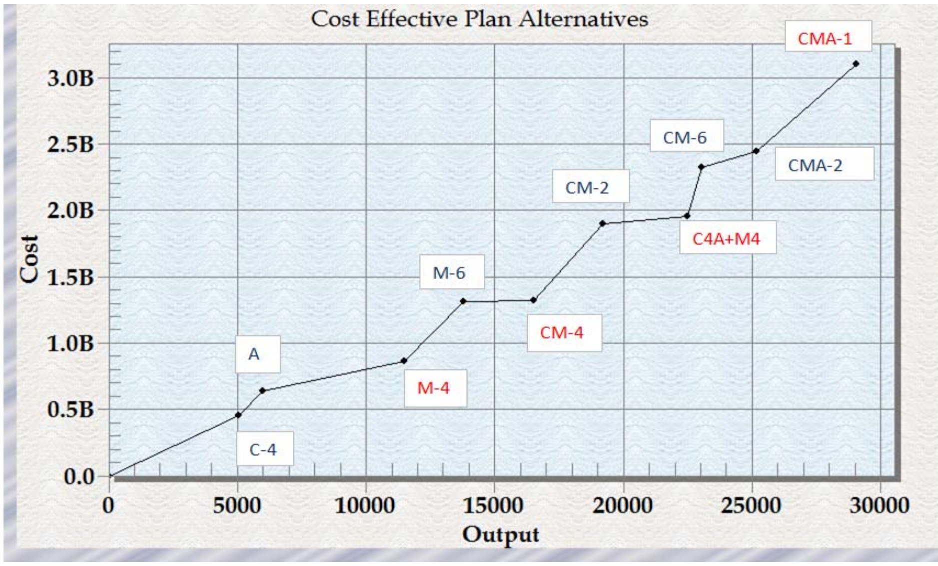
Table 50
Southwest Coastal, LA Feasibility Study
Average Annual Cost of the TSP (CM-4)

Interest Rate		3.50%
Amortization Factor		0.04263
Construction Cost	$	1,039,259,278
O&M Cost	$	126,239,238
Average Annual Construction Cost	$	44,307,478
Average Annual O&M Cost	$	5,382,047
Total Average Annual Cost	$	49,689,525

Table 51
Southwest Coastal, LA Feasibility Study
Best Buys and Cost-Effective Plans

Name	Cost ($)	Net AAHUs	Cost Effective
CM-4	1,319,822,939	16,539	Yes/Best Buy
CMA-1	3,104,429,860	29,070	Yes/Best Buy
CMA-4	1,958,577,118	22,508	Yes/Best Buy
M-4	862,410,460	11,503	Yes/Best Buy
A	638,754,179	5,969	Yes
C-4	457,412,479	5,036	Yes
CM-2	1,901,658,190	19,218	Yes
CM-6	2,321,547,245	23,026	Yes
CMA-2	2,444,623,435	25,187	Yes
M-6	1,315,780,445	13,786	Yes

Figure 1
Southwest Coastal, LA Feasibility Study
Cost-Efficiency Frontier

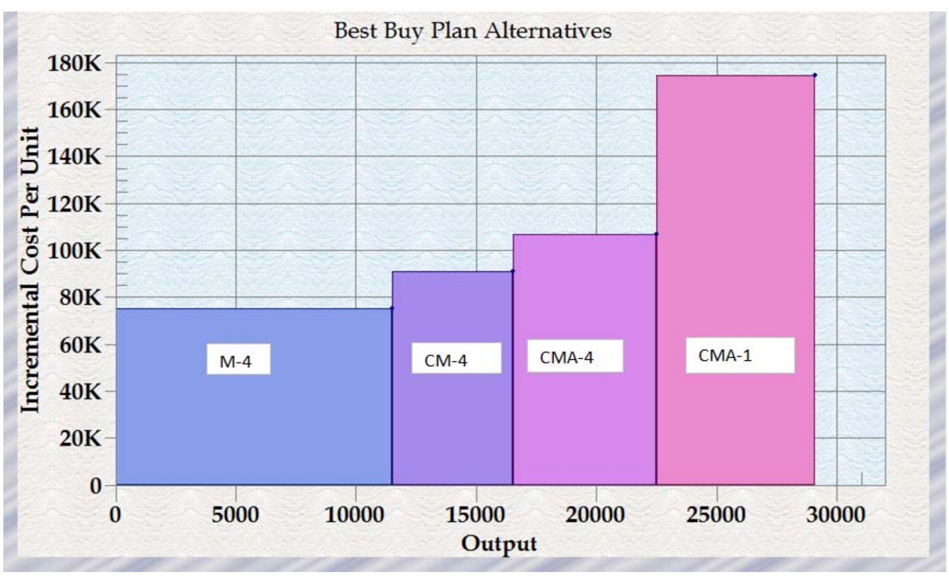


Plans in Blue are cost effective; plans in red are best buys.

Table 52
Southwest Coastal, LA Feasibility Study
Incremental Cost Analysis Results

Plan	Net AAHUs (Output)	Total Cost ($)	Average Cost ($)	Incremental Cost ($)	Incremental Output	Inc. Cost Per Inc. Output ($)	Increase in Per Incremental Unit Cost ($)
M-4	11503	862,410,460	74,973	862,410,460	11,503	74,973	-
CM-4	16539	1,319,822,939	79,801	457,412,479	5,036	90,829	15,856
CMA-4	22508	1,958,577,118	87,017	638,754,179	5,969	107,012	16,183
CMA-1	29070	3,104,429,860	106,792	1,145,852,742	6,562	174,619	67,607

Figure 2
Southwest Coastal, LA Feasibility Study
Incremental Cost Per Unit



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SOUTHWEST COASTAL LOUISIANA
INTEGRATED DRAFT FEASIBILITY REPORT
AND
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

APPENDIX G

INDEX

LIST OF PREPARERS

Name	Office	Discipline/Role
Tim Axtman	RPEDS Plan Formulation Branch	Senior Plan Formulator
Elizabeth Behrens	RPEDS Environmental Planning Branch	Wildlife Resource
Paul Bellocq	Engineering Division, Hydraulics and Hydrologic Branch	Hydraulic Design
Richard Boe	RPEDS Environmental Compliance Branch	Coastal Resources
Darrel Broussard	Programs & Project Management Division	Senior Project Manager
Getrisc Coulson	RPEDS Plan Formulation Branch	Other Social Effects
Nathan Dayan	RPEDS Environmental Planning Branch	Environmental Mgr, Fisheries Resources, Essential Fish Habitat
Pamela DeLoach	Engineering Division, Engineering Control Branch	Project Engineer
Tammy Gilmore	RPEDS Environmental Planning Branch	Endangered Species
Eric Glisch	Engineering Division, Hydraulics and Hydrologic Branch	Water Quality
Judith Gutierrez	Real Estate Division	District Quality Control
Rebecca Hill	RPEDS Environmental Planning Branch	New Orleans District Tribal Liaison
Sam Kearns	Engineering Division, Civil Branch	Levee Design
William P. Klein Jr.	RPEDS Environmental Planning Branch	Environmental Mgr, Environmental Resources Planning, Mitigation, Adaptive Management and Monitoring, Habitat Impacts
Fay Lachney	RPEDS Plan Formulation Branch	District Quality Control
Patricia Leroux	RPEDS Environmental Planning Branch	Environmental Appendix
Ben Logan	RPEDS Economics Branch	Socio-Economic Impacts
Leslie Lombard	Engineering Division, Engineering Control Branch	District Quality Control
Keven Lovetro	RPEDS Economics Branch	District Quality Control
Brian Maestri	RPEDS Economics Branch	Economics
Andrew MacInnes	RPEDS Plan Formulation Branch	Plan Formulator
Kelly McCaffrey	RPEDS Environmental Planning Branch	Aesthetic Resources
Alissa Miller	Engineering Division, Structures Branch	Structures Design
Joseph Musso	RPEDS Environmental Compliance Branch	HTRW
John Petitbon	Engineering Division, Design Services Branch	Cost Engineering
Andrew Perez	RPEDS Environmental Planning Branch	Recreational Resources
Hasan Pourtaheri	Engineering Division, Hydraulics and Hydrologic Branch	ADCIRC & Surge Modeling
Courtney Reed	RPEDS Economics Branch	Economics
Sandra Stiles-Estis	RPEDS Environmental Planning Branch	Senior Environmental Mgr, District Quality Control
Danielle Tommaso	RPEDS Plan Formulation Branch	Plan Formulator
Karen Vance-Orange	Real Estate Division	Real Estate
Paul Varnado	Programs & Project Management Division	Project Manager
Eric Williams	RPEDS Environmental Planning Branch	Soils, Prime and Unique Farmland

LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE REPORT WERE SENT

Name	Organization	Address
David Bernhart	NMFS - Protected Species Division	263 13th avenue south St. Petersburg, FL 33701
Mr. Michael Trusclair	NRCS District Conservationist	P.O.Box 531 Boutte, LA 70039
Jeff Weller	U.S. Fish and Wildlife Service	646 Cajundome Blvd-Suite 400 Lafayette, LA 70506
Mr. Richard D. Hartman	NMFS - Habitat Conservation Division	Baton Rouge LA 70803-7535
Ms. Pam Breaux	LA Office of Cultural Development	P.O.Box 44247 Baton Rouge, LA 710804-4247
Mr. Keith Lovell	Interagency Affairs - LADNR	P.O Box 44487 Capital Station Baton Rouge, LA 70804-4487
Scott Guilliams	Louisiana Dept. of Env. Quality	P.O. Box 47313 Baton Rouge, LA 70821-4313
Kevin Norton	State Conservationist - NRCS	9797 Government St Alexandria, LA71302
Ms. Rhonda Smith	EPA, Region VI - Off. of Planning and Coord. / Mail Code 6EN-XP	1445 Ross Avenue Dallas, TX 7502-2733
Mr. Gray Zimmerer	FEMA - Region VI, Federal Center	800 North Loop 288 Denton TX 76201-3698

This document has also been sent to interested parties who have requested to be in the CEMVN District stakeholder and NEPA mailing lists. This mailing list is maintained as a database and contains personal information.

RESPONSES TO COMMENTS

Responses to comments received during the public review and comment period will be included in the Integrated Final Feasibility Report and EIS.