6 Coastal Protection and Restoration

Introduction

Coastal restoration plays a paramount role in protecting Plaquemines' citizens from storm surge and maximizes protection will allow for the expansion of Plaquemines' economic base. The purpose of the coastal restoration element of the Comprehensive Master Plan is to review and assess coastal restoration plans and activities in Plaquemines Parish. The goal of this section is to help the Parish government more effectively plan and prepare for future growth in a manner that offers maximum protection for residential, commercial, and industrial investment.

The Community Assessment portion of the Coastal Protection and Restoration Element consists of five parts:

6.1 Review of Coastal Protection and Restoration Principles
6.2 Review of Existing Conditions
6.3 Review of State and Federal coastal restoration plans
6.4 Assessment of Current Restoration Projects and Implementation Programs in Plaquemines Parish
6.6 Identification of Future Issues and Needs

Coastal restoration measures have been recognized as sustainable solutions along with flood protection levees to provide the Parish citizens with adequate flood protection against storm surge. The Plaquemines Parish Coastal restoration strategy was developed under the guidelines of the State of Louisiana coastal restoration plan and the regional plan by U.S. Corps of Engineers (USACE). Part 6.3 of this element will review the planning strategy for Plaquemines at various institutional levels.

In the Coastal Protection and Restoration Element of the Community Agenda, coastal protection and restoration projects in Plaquemines Parish will be assessed along with their implementation status, budget, schedule, and issues.

6.1 Review of Coastal Protection and Restoration Principles

The coastal protection and restoration process is a dynamic balance of the natural environment and the man-made environment. Plaquemines Parish is placed in a narrow peninsula bounded by two coastlines of the Gulf of Mexico with the Mississippi River in the center. Much of its land area is below sea level and also below the mean elevation of the Mississippi River. Therefore it is vulnerable to flooding due to a number of complex threats:

- Flooding of the Mississippi River
- Hurricanes in the Gulf of Mexico
- Erosion
- Subsidence of land

- Sea level rise

Therefore, unlike other parishes that need levee protection in some areas of their parish, Plaquemines is bordered by levees on all sides.

The natural processes of coastal land formation are based on the sedimentary load delivered by the Mississippi River over many centuries. Sediments play a vital role in maintaining the landforms needed by for deltaic plains, including wetlands. Clearly, the flood protection levees permanently disrupted this natural process, resulting in a steady loss of wetlands.

Deposits of sediments at the mouth of the river and through flood overtopping of the riverbanks and land ridges form the basis of coastal land and marshes. These natural processes, known as accretion, led to a net gain of 1-2 square miles of coastal land per year for thousands of years until the recent millennium when negative impact by natural disturbance and human intervention became accelerated.

The wetlands surrounding Plaquemines Parish are valuable estuaries that are the spawning grounds and nurseries for a rich abundance of sea life and also have provided much of the nation's desirable seafood. Coastal wetlands require healthy inputs of freshwater to balance their salinity to a level essential to the wetlands habitats. Forms of natural disturbance to the wetlands of the Mississippi River Delta that contribute to disturbing the natural balance leading to coastal land loss include: erosion caused by hurricanes, sea level rise, land subsidence, and saltwater intrusion.

Human intervention has had a substantial impact on the wetlands in Plaquemines. The main forms of human disturbance are flood-control structures such as dams and levees, canal dredging, and oil and gas production. Levee structures along the Mississippi River cut off the natural, replenishing flow of sediments and fresh water from the Gulf of Mexico, causing the land to subside inside the levees, and also causing the wetlands to be vulnerable to erosion and increased salinity due to intrusion of sea water into their fresh water regimes. Without the confinement of engineered levees, flooding water as well as sediment would have spread over the natural land ridges into wetlands which had sustained the Mississippi River delta for thousands for thousands of years. Canals dug by the oil and gas production crews over time have also increased erosion on the outside of the levees. Oil and gas extraction has also hastened land subsidence on the inside of the levees.

Since Hurricanes Katrina and Rita, both the wetlands and the population living along the narrow fringe of land between the Mississippi River and the Gulf of Mexico have entered a kind of 'death spiral'. At the same time as the lack of nutrients and fresh water from the river chokes them, the impact of hurricanes has dramatically reduced the wetlands through erosion and saltwater intrusion. Coastal wetlands are disappearing at the rate of 40 square miles a year, which is 80 percent of the national's total coastal wetland loss. Wetlands provide natural flood control, natural hurricane protection and natural filtration system to protect water quality. Loss of wetlands in turn increases the vulnerability of the land and population to hurricanes

because it has been the wetlands, not levees, that have most protected the populated strips of land along the river from the devastating storm surges and flooding of major hurricanes.

Hurricanes have made massive impact on coastal wetlands and marshes due to the erosive forces exerted on coastal land forms. Catastrophic hurricane events have impacted the Gulf of Mexico more frequently in the past century. Research by USACE indicated that not all areas of the Gulf Coastal have the same chance of experiencing power hurricanes. Probability analysis based on historical record from 1960 to 2006 showed that New Orleans areas, Louisiana is twice as likely as Galveston, Texas or western Alabama to be hit by a Category 2 or higher hurricane (a four percent chance versus a two percent chance in any given year) (LACPR, 2008).

6.2 Review of Existing Conditions

Plaquemines Parish occupies the lowland peninsula south of the City of New Orleans and is the most vulnerable parish to damages caused by tropical storm surge in coastal Louisiana. South of Belle Chase, virtually all developments in Plaquemines is confined to the narrow corridor bounded by the Mississippi River levees and the backside hurricane protection levees. **Figure 6.2** outlines these levee sub-basins in red. These lands between the levees are also referred to as "fastlands" and are drained by networks of canals and pump stations, which discharge fresh water into the neighboring wetlands. The Mississippi River Corridor provides the major access to the extensive facilities and infrastructures of the energy and coastal resources in Plaquemines Peninsula.

Since Hurricane Katrina in 2006, a significant number of studies and planning efforts have been undertaken at local, state, and federal levels to expedite the development of a long-term strategy that is both effective and sustainable to protect and restore the Louisiana coast. These studies have recommended a range of strategies including the following:

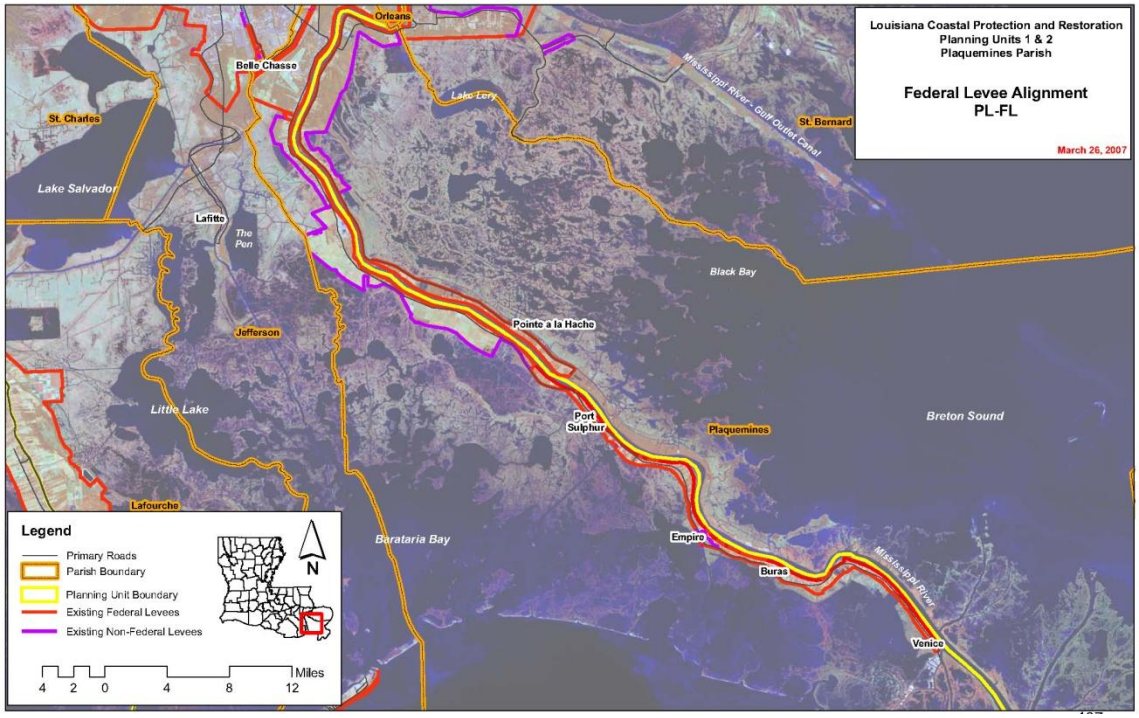
a. Construction of a complete "back levee' system along the exposed, outer open water edges of the populated land facing the Gulf Coast on both sides of the river where the wetlands have disappeared;
b. Restoration and enhancement of wetlands outside the levees, primarily through diversion of large volumes of sediment and fresh water piped across the levees directly into the struggling wetlands; and
c. Construction of off-shore barrier islands to further protect the shoreline of Plaquemines Parish by dredging and disposition of sediment in shallow waters off the Gulf coast..

a. Levees

There are extensive levee systems in Plaquemines Parish. The USACE built the Mississippi River levee system (also referred to as federal levee systems) at the beginning of the nineteenth century for the primary function of confining the flood water within the areas between East and West Banks of the River. On the West Bank, the Mississippi River levees end at Venice; whereas on the East Bank, the river levee system ends just south of Pointe a la Hache. The height of Mississippi River flood protection levees range from a high of approximately 19.8 feet at Braithwaite to a low of approximately 12.6 feet at Venice. The back levees, most of which are

not owned by the federal government, are hurricane protection levees constructed against storm surge and wave actions. Aside from Belle Chasse, most of the Parish's developable land is confined between the river levees and back levees. The USACE has completed most of the levee repairs and enhancement projects in Plaquemines Parish since Hurricanes Katrina and Rita. Many non-federal levees are scheduled to be federalized as one of the main flood protection measures to promote compliance with federal flood control requirements and coordination of maintenance. **Figure 6.1** shows the existing levee systems in Plaquemines Parish.

Figure 6.1. Existing Levee Systems in Plaquemines Parish



Source: (USACE, 2007)

Studies and data have shown a continuing trend in sea water rise and land subsidence of the Louisiana coast, indicated by steady loss of dry land and increasing susceptibility to flood damages. Until the 20th century when USACE started constructing flood control levee systems along Mississippi River, the natural function of the Mississippi River was to spread the flooding water and sediments across riverbanks into the neighboring coastal Louisiana wetlands, creating the ecosystem that has existed thousands of years. This function has since been changed as the fresh river water and sediments are now confined within the levee banks and are transported to the Mississippi deltaic gulf. River channelization effectively disrupted the supply of sediment and freshwater that is essential to the coastal wetlands and barrier islands, which serve as energy-reducing buffers to the levee system. It is now widely accepted that relying on levees alone for flood protection, no matter how high they are raised, cannot be sustainable without alleviating the loss of the coastal wetlands and marshes outside the levee systems.

b. Restoration and Enhancement of Wetlands

Wetland enhancement through freshwater diversions: Engineered diversions divert river water and sediments to nourish and replenish coastal wetlands. It is one of the main restoration techniques practiced in Plaquemines Parish. Diversion design depends on many variables, including water release rate and schedule, sediment budget, outfall areas, habitat composition, and the characteristics of the receiving wetlands. Coastal wetlands help preserve ecosystem diversity, maintain coastal landform, and dissipate surge and wave energy from directly impacting the flood protection structures.

c. Reconstruction of Barrier Islands

Barrier islands are part of the coast's natural defenses against wind and storm surge from tropical storms. Most of the coastline of the Gulf of Mexico has barrier islands, but Plaquemines Parish lies on a peninsula made by the sediments of the Mississippi River so it lacks the row of protective barrier islands present elsewhere. The effort to construct barrier islands in areas like Barrataria Bay outside Plaquemines Parish is in experimental stages and is described further in the Community Agenda.

ABFE and 100-year Flood Protection

Because most of Plaquemines Parish is below sea level and bordered by levees, flooding is an everyday risk. (See the Drainage and Stormwater Management Element of the Comprehensive Master Plan for additional details regarding the Parish's stormwater and drainage infrastructure.) The periodic incidence of major hurricanes like Katrina creates a major threat unlike routine flooding from rainfall. Therefore, the primary hazard that drives federal intervention for Plaquemines' coastal protection is the hazard of flooding from such devastating storm surges.

FEMA characterizes flooding levels resulted from a storm event in terms of its likelihood of occurrence that is derived from long-term storm statistics in the area. For example, the 100-year flood, also referred to as base flood, has a 1 percent chance of happening in any given year. Base flood elevations (BFEs) are peak flood elevations corresponding to the 1 percent chance storm and they are often resulted from rigorous modeling in Flood Insurance Studies (FIS). BFEs are published by FEMA in the Flood Insurance Study (FIS) report and flood mapping are shown in the Flood Insurance Rate Maps (FIRM). Inland BFEs along rivers, streams, and small lakes depend on the amount of water expected to enter an area (such as stormwater runoff) and the geometry of the floodplain. Flood elevations in coastal areas are dependent on storm surge and wave actions. Storm surge is the main component of coastal BFE which is determined by sophisticated mathematical models or statistic analysis of historical tidal gage records. Storm surge elevations are also referred to as "stillwater elevations" because they do not account for wave effects. Wave action component includes wave height, wave set up, and wave run-up. Storm surge is a function of large-scale shoreline geometries generally not influenced by human activities, whereas wave actions are small- scale and often locally influenced by human activities and structures. Therefore, the base flood elevation (BFE) is the combined height of the 100-year (1 percent chance) stillwater level plus wave effects.

The flood maps for Plaquemines Parish prior to 2006 hurricanes were based on coastal studies performed more than 36 years ago. Due to land subsidence and continuing loss of protective coastal barriers over the last decades, higher storm surges and larger waves can be expected to propagate further inland than previously estimated, which was evidenced by the disastrous destruction of Hurricanes in 2006. After hurricanes Katrina and Rita, FEMA has issued Flood Recovery Guidance as an interim guidance for the Parish's rebuilding effort against future storm events. In October 2008, FEMA released new flood maps for preliminary review.

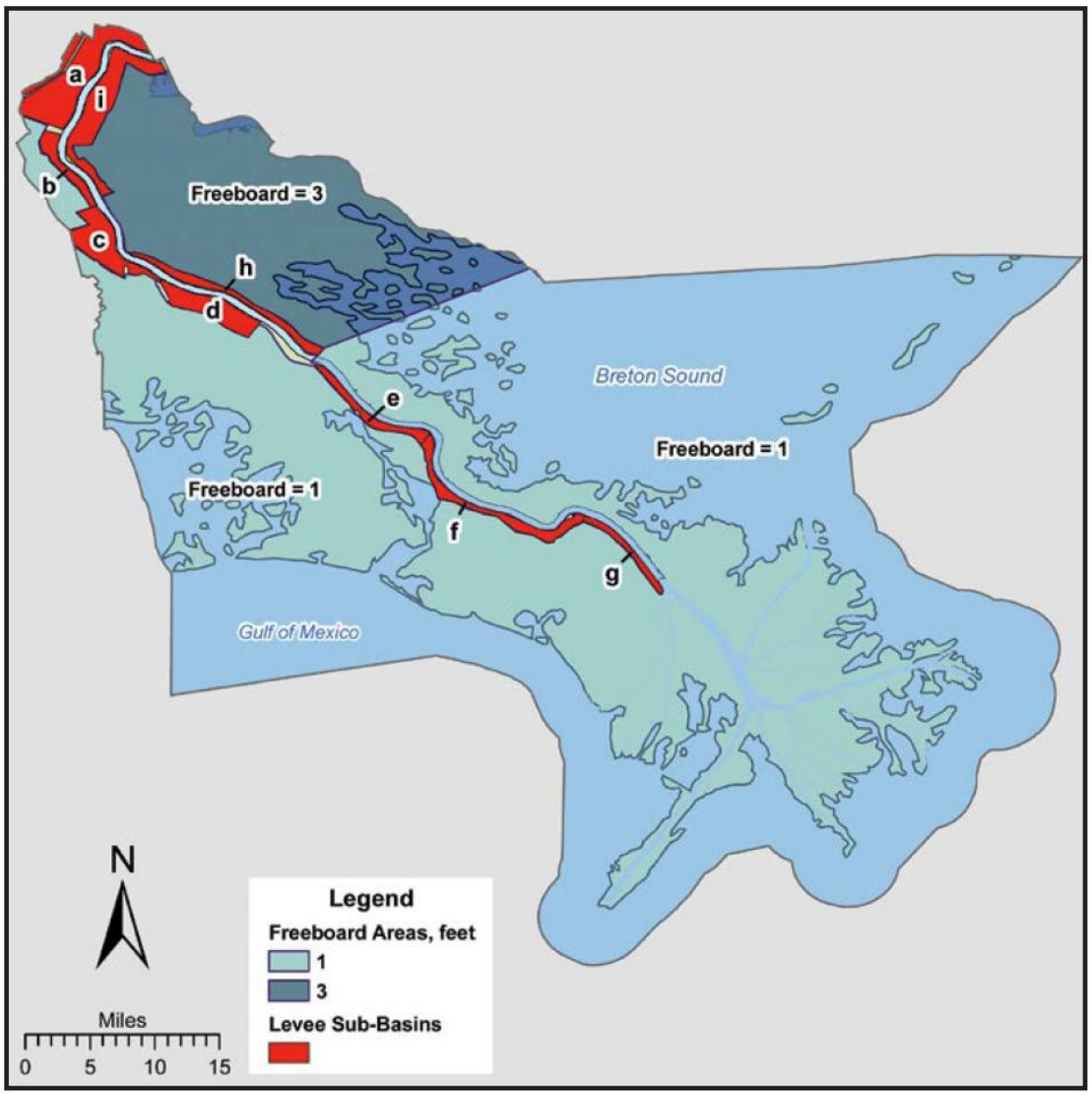
The ABFEs guidance for Plaquemines Parish is explained in **Table 6.1** and shown in **Figure 6.2**. The guidance provides recommendations as follows:

- Inside Levee-Protection Areas: For sub-basin "a", new construction and substantially damaged homes and business are elevated to the higher of the effective BFE or 3 feet above the adjacent grade. For sub-basins "b" to "I," FEMA recommends applying the higher of effective FIRM BFE or ABFE.
- Outside Levee – Protected Areas: Applying freeboard of 1 foot to 3 feet above the effective FIRM BFE in areas indicated in **Figure 6.2**.

Table 6.1. Plaquemines ABFE sub-basin information with USACE levee polder names. (after FEMA, 2007)

Parish ABFE Levee Sub-Basin Identification Code	USACE Levee Polder Name	FEMA ABFE Based on USACE SWELs (feet, NAVD88)
a	Belle Chasse	Effect BFE or 3 ft above adjacent grade, whichever is higher
b	Plaquemines, Non-Federal, Area 6 West	8 feet
c	Plaquemines, Non-Federal, Area 6 West	9 feet
d	Plaquemines, Non-Federal, Area 4 West	10 feet
e	Plaquemines, West Bank Reach A	12 feet
f	Plaquemines, West Bank Reach B-1	11 feet
g	Plaquemines, West Bank Reach B-2	11 feet
h	Plaquemines, West Bank Reach C	16 feet
i	N/A (non-USACE levee Polder on east Bank)	18 feet

Figure 6.2. ABFE Guidance and levee sub-basin for Plaquemines Parish (after FEMA, 2006)



Higher ABFEs imposed by FEMA in many areas of the Parish adds institutional challenges to Plaquemines Parish redevelopment initiatives. In order to qualify for federal flood insurance assistance, buildings must be elevated or be installed with additional flood proof measures, resulting in higher construction cost to property owners. Even with the repairs and improvements completed for existing flood control systems by USACE after hurricane Katrina, the current control systems do not provide flood protection against the 1-percent-annual-chance (100-year) flood as indicated by USACE computer modeling. In areas that are not certified with 100-year protection, higher flood insurance premiums can be expected for businesses and homeowners.

In response to the new regulatory requirements for flood protection, Plaquemines Parish established both near-term and long-term strategies. In the near term, the Parish has engaged in a comprehensive review of the data and analysis used in developing the ABFE maps. The objective is to identify deficiencies in FEMA's analysis and to provide better data to create more accurate flood maps before the map revision is finalized. Raising levees to the current ABFE levels alone cannot be sustainable for flood protection as coastal marshes and barrier islands continue to diminish and land continues to subside. It is expected that future ABFEs will rise even higher if these current trends continue. In fact, both the construction cost and land requirements for levee construction increase exponentially with levee height. Coastal wetlands, marshes, and barrier islands are the frontline defenses against storm surge and can potentially reduce flood elevations. In the long-term, the Parish is committed to a sustainable implementation strategy that combines flood protection with restoration activities. Utilizing the same hydrologic modeling methodologies applied by FEMA and USACE, the Parish is able to quantify flood-control benefits of its restoration projects and in turn establish a defensible argument to lower its ABFEs in the future. A sustainable, ecosystem-based coastal restoration plan will allow the Parish Government to pursue strategic courses of actions to lower the Parish's ABFE.

6.3. Review of State and Federal Coastal Restoration Plans

a. State Coastal Restoration Plan

Louisiana's Comprehensive Master Plan for a Sustainable Coast by the Coastal Protection and Restoration Authorization (CPRA) of Louisiana established the coastal restoration framework for coastal Louisiana Parishes. The master plan set long-term vision for the complete integration of coastal restoration and flood protection. The master plan adopts the multiple lines of defense strategy that combines natural features such as barrier islands, marshes, cheniers, and forested ridges to complement man-made structures such as highways, levees, and raised buildings. The restoration projects identified by the CPRA master plan are summarized in **Table 6.2**.

In addition to the coastal restoration projects, the CPRA plan made the following recommendation for enhanced hurricane protection capability:

- From the upper portions of the Parish to Oakville on the West Bank of the Mississippi River, recommends 1 percent flood protection level by increasing the height of the existing levees.
- From Oakville to Myrtle Grove on the West Bank and from Caernarvon to White Ditch on the East Bank, recommends 1 percent flood protection by raising the current levee heights and federalization of back levees.
- South of Myrtle Grove, federalize the drainage levee and raise the levee elevation.
- South of St. Jude on the West Bank and south of Phoenix on the East Bank, maintain the levees at the current height.

Table 6.2. Coastal Restoration Projects for Plaquemines Parish identified by CPRA Master Plan, 2007

Restoration Measures	CPRA Recommended Projects for Plaquemines Parish
Fresh Water Diversions	Mississippi River water diversion at Violet
	Caernarvon Diversion modification
	Mississippi River diversion at White Ditch
	Mississippi River diversion at Bayou Lamoque
	Mississippi River diversion at Myrtle Grove with dedicated dredging
	Mississippi River diversion at West Point a la Hache with dedicated dredging
	Mississippi River Delta management
Marsh Restoration with Dredged Materials	Maintain and restore Breton Sound marshes
	Maintain and restore Biloxi landbridge and barrier reefs
	Central wetlands restoration
	Marsh restoration using dredged material at Golden Triangle
	Marsh restoration using dredged material in Barataria Basin
Barrier Island Restoration	Barataria Basin from Sandy Point to Quatre Bayous Pass
Shoreline Stabilization	Shoreline protection on south shore of Lake Pontchartrain
	Grand Isle and vicinity protection and shoreline restoration
Ridge Habitat Restoration	Restore Bayou LaLoutre Ridge
	Ridge habitat restoration in the Barataria Basin

Maintaining or raising the height of back levees in Plaquemines Parish is challenging due to land subsidence and rising sea levels, particularly in the lower regions of the peninsula. These systems withstand constant impact by the enormous amount of energy from wave and storm surge. In order to sustain the flood protection function of the levee systems, use of coastal restoration measures must be maximized to alleviate the stress on the structural systems.

b. Federal Coastal Restoration Plan

The USACE is responsible for federal planning efforts for coastal restoration and flood protection in Louisiana. The USACE's 2004 Louisiana Coastal (LCA) Louisiana identified similar restoration projects for Plaquemines Parish:

- Barataria Basin barrier shoreline restoration
- Medium diversion with dedicated at Myrtle Grove
- Medium diversion at White's Ditch (pending congressional approval)
- Modification of Caernarvon Diversion (pending Congressional approval)
- Modification of Davis Pond Diversion (pending Congressional approval)

The USACE (2004) also recommended large scale studies of Mississippi River hydrodynamics and Mississippi River Delta Management.

The USACE released the Draft Louisiana Coastal Protection and Restoration (LACPR) report in 2008 and the final draft report in 2009. The plan proposed similar restoration strategies (**Table 6.3**) to supplement the structural enhancement for flood control systems.

Table 6.3. Coastal Restoration Projects Proposed in 2008 Louisiana Coastal Protection and Restoration (LACPR)

Restoration Measures	LACPR Recommended Projects for Plaquemines Parish
Marsh Creation using Dredged Material	- Caernarvon - Bayou Lamoque - North of Baptiste Collette - Boothville - Buras - Port Sulphur - West Pointe a la Hache - Myrtle Grove - Naomi
Freshwater Diversions	- East back levee: from Caernarvon to Phoenix - Lower inter-distributary basin from Pointe a la Hache to Lake Cuatro Caballo - Along the eastern perimeter of Barataria Bay
Barrier Island Restoration	- From Sandy Point to Quatre Bayou Pass

Source: USACE, 2008

6.4. Assessment of Current Restoration Projects and Implementation Programs in Plaquemines Parish

Table 6.4 summarizes the restoration techniques that have been practiced or employed experimentally to restore coastal land forms and enhance flood protection levels in coastal Louisiana.

Table 6.4. Common Coastal Restoration Techniques

Restoration Technique	Descriptions and Key Characteristics
Barrier Island Restoration	▪ Transfer and deposit dredged material to increase island height and width ▪ Reinforce barrier island shoreline with various mixtures of structures and vegetation to minimize erosion ▪ Build sand dunes back of beaches with sand trapping fences and dune vegetation.
Fresh Water Diversion	▪ Divert fresh water, sediment and nutrients from major channel ▪ Use gates, siphons or pumps to control flow release schedule ▪ Slow saltwater back flow ▪ Balance salinity and promote wetland habitat development
Mash Creation with Dredged Material	Recreate marsh through dredging of sediment and deposition in deteriorated marsh area at elevation conductive to re-establishment of wetland vegetation via planting or natural colonization.
Marsh Management	▪ Mitigate wetland loss, preserve and enhance wetland habitats through management of water level and salinity in coastal marsh environment. ▪ Directly manipulate water level and flow via use of structural controls such as weirs, levees, adjustable water control device. ▪ Indirectly influence the growth of desirable or undesirable species of plants, such as marsh burning and chemical intervention.
Sediment Diversion	Re-establishment of natural land-building processes through overflow of sediment laden fresh water from major river ways into wetlands and open water areas.

Restoration Technique	Descriptions and Key Characteristics
Sediment and Nutrient Trapping	Retaining sediments and nutrient to promote the buildup of new land and/or protect vegetated shorelines through structure controls that slow water movement and facilitate sediment deposition.
Shoreline Stabilization and Erosion Control	▪ Use various techniques to control shore line erosion by dampening wave energy and promoting sediment retention. ▪ Shore line: rock berms, vegetation ▪ Off Shore: segmented breakwaters and wave-dampening fences
Vegetation Planting	Plant desired landform being established with appropriate species (e.g., saline marsh, saline forest, freshwater swamps, and bottom land hardwood).
Surge and Wave Barriers	Reduce wetland and shoreline erosion and protect inhabited areas through placement of segmented barrier units in open water areas.
Ridge Restoration	▪ Create ridge landforms parallel to levee ridges with dredge material; ▪ Plant or allow vegetation to enhance bio-diversity and dampen storm surge; ▪ Plant suitable flooded inter-ridge depressions in freshwater areas with swamp species to dampen storm surge.
Bio-Engineered Ridges	Reduce wetland and shoreline erosion and enhance biodiversity and substrate accretion through use of oyster reef units in shallow water areas.
Fastland Elevation	Use dredge material to elevate levee-protected areas for development

Source: Plaquemine Parish Strategic Implementation Plan, 2008

Over the past two decades, over 80 government funded projects have been planned or implemented in Plaquemines Parish. These projects were funded through various state and federal legislation as listed in **Table 6.5**.

Table 6.5. Major Coastal Restoration Programs

Current/Past Coastal Restoration Programs	Descriptions
State-Funded Projects	Restoration projects funded primarily by the State of Louisiana through the Coastal Restoration Division
Breaux Act Projects	Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA)
PCWPRP Projects	Parish Coastal Wetlands Restoration Program (Christmas Tree Program)
Vegetation Planting ,Program	Manage by Louisiana State Department of Natural Resources (DNR)/Natural Resources Conservation Service (NRCS) / Soil and Water Conservation Committee (SWCC). Plant and monitor native marsh vegetation in coastal Louisiana.
Coastal Impact Assistance Program (CIAP)	Establish by Section 384 of Energy Policy Act of 2006 to help producing states and their coastal political subdivisions to mitigate impacts from Outer Continental Shelf oil and gas production. $610 million statewide from 2007 for 4 years.
State Surplus	Funded by fiscal year 2009-2010 State of Louisiana budget surplus, $290 million statewide.
Water Resources Development Act 2007 (WRDA)	Federal law that authorizes flood control, navigation, and environmental projects and studies by USACE.
Section 204/1136	Water Resources Development Act Sections 204 and 1136 beneficial use of dredged material projects.

Table 6.6 summarizes the status of the projects through 2007 using the information presented in the Parish's Strategic Implementation Plan (2008). During the time period, three freshwater diversions, two outfall management projects, and four sediment diversion projects are completed as major structure expenditures, accounting for about 21 percent of the $287.6 million originally budgeted for the projects in Plaquemines Parish. Small projects such as 36 vegetation planting projects and four demonstration projects have been completed, which accounts for only 1.4 percent of the original restoration budget. Six small projects (totaling about $0.816 million), including two freshwater diversions, one outfall management, two sediment diversions, and one demonstration, have been de-authorized. The rest of the projects are pending for various reasons.

Table 6.6. Coastal Restoration Project Status in Plaquemines Parish through 2007 (after Plaquemine Parish Strategic Implementation Plan, 2008)

Project Type	Project Status			2007 Cost Estimate ($1000s)
	Completed	Pending	De-authorized	
Freshwater Diversion	3	2	2	$31,486 $2,126 $638
Barrier Island Restoration		4		$131,636
Marsh Creation		6		$67,960
Outfall Management	2	2	1	$6,717 $6,664 $33
Sediment Division	4	8	2	$22,313 $19,863 $186
Demonstration	4		1	$3,669 $68
Vegetation Planting	36			$326
Sediment Trap		1		$1,880
Marsh Creation / Sediment Creation		1		$1,074
Outfall Management/ Shoreline Protection		1		$2,666
TOTAL:	**49**	**24**	**6**	**$287,679**

6.5 Identification of Future Issues and Needs

The Plaquemines Parish's coastal restoration plan focuses on the idea of constructing a forested ridge immediately outside the back levees. The forested ridge improvement can reduce the wave action on top of tidal surge to a level below levee height, achieving 100-year flood protection within the protected Parish land.

Sediments - Plaquemines Parish's plan involves a long-term lease of dredging equipment that would pump sediment from the Mississippi River through pipes across the river levee, under LA 23 and over the back levee into the adjacent marshes. The aim is to create elevated ridges of 76 to 100 feet wide leading up to the back levee, and then plan series of marsh plants and large

cypress trees along the ridge to serve as a speed bump for waves and flooding from storm surges. The plan differs from the state's plan in the way of how sediment is transported to the outside of the back levee to create new land.

Large-scale restoration of Plaquemines wetlands requires extensive use of riverine sediments which is obtained by dedicated dredging using cutterhead dredgers. Cutterhead dredgers have efficiency over conventional dredgers and are critical to provide the quantity of sediments and to support the long-distance transport to project sites. Use of a cutterhead dredger in the lower delta may affect channel navigation and thus must be coordinated with shipping interests, the USACE, and the US Coast Guard.

Computer Modeling – Plaquemines Parish President and Council signed a Memorandum of Cooperation with the USACE's Hydraulic Coastal Laboratory to conduct storm surge modeling based on its own restoration master plan. This effort allows the Parish to evaluate the effectiveness of coastal restoration projects in conjunction with flood protection levees. For each environmental zones or smaller sub-management units, focus should be placed on optimizing project clusters to achieve the most reduction of ABFEs. Further analysis of the Mississippi River sediment budget should be conducted including a review of the current literature and modeling.

Maintenance of Artificially Created Forms - Many Parish marsh creation and barrier island projects require a large supply of riverine sediments. It is important to not only to provide the sediments during project construction, but to supply the sediment quantities that are needed to sustain the marshes and barrier island over time.

Funding – Review of the past and current restoration programs revealed that although more than $287 million were budgeted for Plaquemines coastal restoration, only 21 percent have been implemented in the past two decades. Many projects, particularly large-scale projects, were delayed for various reasons, among which lack of consistent funding was the key cause especially during tough economic times. A financial study may be performed to evaluate the cost-to-benefit ratio for proposed restoration projects. Project implementation must be prioritized based on its physical merits as well as the cost-effectiveness in the competition for limited funding resources.

Intergovernmental Cooperation and Cost Sharing - The Parish needs to continue close coordination with state and federal agencies for planning and constructing restoration projects. Many parish restoration projects can be implemented in coordination with regional programs performed by state and federal agencies. **Table 6.7** lists federal agencies that have sponsored restoration projects in coastal Louisiana. The Parish should also aggressively seek opportunities to partner with other coastal parishes and regional organizations for cost-sharing.

Table 6.7: Federal Sponsoring Agencies

Abbrev.	Sponsor
EPA	Environmental Protection Agency
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

Deep Water Horizon Oil Spill

The Deepwater Horizon oil Spill (also referred to as BP oil spill) is oil spill in the Gulf of Mexico about 40 miles southeast of Plaquemines Parish's coast. The spill stemmed from a sea-floor Deepwater Horizon drilling rig explosion on April 20, 2010. From the time of the explosion, to capping the gushing wellhead on July 16, and to permanent well closure on September 19, 2010, approximately 206.8 million gallons of crude oil was released into the Gulf of Mexico open water. The impact of the Horizon Oil Spill has had both positive and negative impacts on the Plaquemines Parish Coastal Protection and Restoration program.

The negative impacts are most publicized. The extensive damage caused by the oil spill to marine and wildlife habitats as well as the Gulf's fishing tourism industries continues beyond the 6-month incident period, with even longer-term impact to the coastal environment and ecosystem based on information about the impacts of other offshore oil spills in history. Petroleum toxicity, oxygen depletion, and the use of Corexit dispersant are thought to be the main cause of damage to ecosystem. More than 400 species that live in Gulf islands and marshlands are threatened. Experts cautioned that the oil could harm fish directly, and microbes used to consume the oil would also reduce oxygen levels in the water. Recovery of the ecosystem may take years, even decades, as was the case with previous oil spills. As the main responsible party, BP created a $20 billion spill response fund in June 2010. The fund can be used to compensate for natural resource damages, state and local response costs and individual losses.

In Plaquemines Parish, of the 271,667 acres of wetlands, more than 3,000 were impacted by oil as of June 2010 (Nungesser, 2010). The event also shifted focus of Parish government with an enormous amount of effort dedicated to emergency response to the spill in the summer of 2010. Impacts of the spill to barrier islands, marshes, and wetlands are still being investigated at both state and local level. It is expected that the spill could set back the restoration effort in terms of implementation schedule and scope of the restoration plan as new projects become necessary to repair and restore the coastal system damaged by oil.

The Horizon oil spill focused an enormous amount of attention on Plaquemines Parish and its plight. The benefits included:

1. National exposure to the need to increase funding for coastal protection and restoration in the Louisiana Gulf Coast;

2. Increased funding from BP that enabled Plaquemines Parish to aggressively pursue some of its coastal restoration projects; and
3. Permission to speed up the construction of barrier islands as an emergency measure to prevent further oil contamination.

References

Plaquemines Parish Strategic Implementation Plan (August, 2008)

Louisiana Coastal Area (LCA), Louisiana Ecosystem Restoration Study (USACE, 2004)

Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast, (Coastal Protection and Restoration Authority of Louisiana, 2007)

Louisiana Coastal Protection and Restoration Technical Report (USACE, 2009)

Oil Spill Impact on Plaquemines Parish, Louisiana, Testimony of Billy Nungesser, Plaquemines Parish President, Before the Subcommittee on State, Local, and Private Sector Preparedness and Integration, June 10, 2010.

Conservation of Louisiana's Coastal Wetland Forests, Jim L. Chambers, et al., T.F. Shupe and M.A. Dunn, Proceedings of Louisiana Natural Resources Symposium.

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