



Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast

Appendix A: Final Plan and Implementation

**Coastal Protection and Restoration Authority
of Louisiana**

April 2007



Table of Contents

1.0	INTRODUCTION	1
2.0	COASTAL LOUISIANA	2
2.1	CRITICAL NEED	2
2.2	THE CPRA – A NEW APPROACH	4
3.0	MASTER PLAN PRINCIPLES AND OBJECTIVES	5
3.1	MASTER PLAN PURPOSE	5
3.2	PROGRAM PRINCIPLES	5
3.3	COASTWIDE PLANNING OBJECTIVES AND PLAN FORMULATION PRINCIPLES	7
4.0	THE FULL PLAN	9
4.1	BACKGROUND	9
4.1.1	<i>Plan Formulation</i>	9
4.1.2	<i>Measure Definition</i>	9
4.2	COASTWIDE BENEFITS OF THE PLAN	10
4.3	MEASURES MAPS	11
4.4	LARGE-SCALE PLANNING	24
4.5	PROGRAMMATIC MEASURES	25
4.6	PLANNING UNIT 1: EAST OF THE MISSISSIPPI RIVER	26
4.7	PLANNING UNIT 2: MISSISSIPPI RIVER TO BAYOU LAFOURCHE	30
4.8	PLANNING UNIT 3A: BAYOU LAFOURCHE TO BAYOU DE WEST	34
4.9	PLANNING UNIT 3B: BAYOU DE WEST TO FRESHWATER BAYOU CANAL	37
4.10	PLANNING UNIT 4: FRESHWATER BAYOU CANAL TO SABINE RIVER	40
5.0	PROGRAM IMPLEMENTATION STRATEGY	43
5.1	INTRODUCTION	43
5.2	URGENT EARLY ACTIONS AND IMPLEMENTATION SEQUENCING	43
5.2.1	<i>Background</i>	43
5.2.2	<i>Process</i>	45
5.2.3	<i>Identifying the Urgent Early Actions</i>	45
5.2.4	<i>Sequencing of Urgent Early Action Measures</i>	48
5.3	PROGRAM MANAGEMENT	50
5.4	POLICY AND LEGISLATIVE ISSUES FOR EARLY RESOLUTION	52
5.4.1	<i>Increase Awareness and Use of Non-Structural Protection Measures</i>	52
5.4.2	<i>Land Use Planning/Zoning/Permitting</i>	52
5.4.3	<i>Land Owner Concerns/Partnership</i>	53
5.4.4	<i>Coastal Forestry</i>	54
5.4.5	<i>Dedicated Funding Source</i>	55
5.4.6	<i>Implementation Process</i>	56
5.5	ADAPTIVE MANAGEMENT FRAMEWORK FOR DECISION SUPPORT	56
5.5.1	<i>Master Plan Management – Adaptive Implementation</i>	58
5.5.2	<i>Scientific & Technical Needs – Early Actions</i>	61
6.0	FUTURE PLAN REVIEW & MODIFICATION	66
6.1	THE NEED FOR REVIEW	66
6.1.1	<i>Scheduled review</i>	66
6.1.2	<i>Unscheduled Review</i>	67
6.2	MASTER PLAN REVIEW PROCESS	67
6.2.1	<i>Review of Principles and Objectives</i>	69
6.2.2	<i>Define the Decision Process</i>	69
6.2.3	<i>Collate and Review Available Information</i>	69



6.2.4 *Current and Future Status* 70

6.2.5 *Assess Extent of Revision Necessary*..... 71

6.2.6 *Public and Stakeholder Engagement* 71

6.2.7 *Identify Potential New Measures* 71

6.2.8 *Define Alternative Plans for Appraisal*..... 72

6.2.9 *Alternative Plan Evaluation*..... 72

6.2.10 *Define Draft Preferred Plan*..... 72

6.2.11 *Confirm Preferred Plan*..... 73

6.2.12 *Identify Implementation Plan*..... 73

6.2.13 *Plan Dissemination and Implementation* 74

7.0 ACKNOWLEDGEMENTS **75**

List of Figures

Figure 2.1: Mississippi River water shed and close-up of coastal Louisiana. 2

Figure 4.1: Ecosystem Restoration in the Mississippi River Delta Plain 12

Figure 4.2a: Hurricane Protection for the New Orleans Metropolitan area and surrounding communities, showing Lake Pontchartrain Barrier Alternative 1 – Interior of Golden Triangle. 14

Figure 4.2b: Hurricane Protection for the New Orleans Metropolitan area and surrounding communities, showing Lake Pontchartrain Barrier Alternative 2 – Rim of Lake Borgne. 14

Figure 4.2c: Hurricane Protection for the New Orleans Metropolitan area and surrounding communities, showing Lake Pontchartrain Barrier Alternative 3 – Lake Borgne. 14

Figure 4.3a: Hurricane Protection for New Orleans West Bank, Lafourche Parish, and Barataria Basin Communities, showing Donaldsonville to the Gulf Alternative 1 – Swamp..... 16

Figure 4.3b: Hurricane Protection for New Orleans West Bank, Lafourche Parish, and Barataria Basin Communities, showing Donaldsonville to the Gulf Alternative 2 – Highway 90 16

Figure 4.3c: Hurricane Protection for New Orleans West Bank, Lafourche Parish, and Barataria Basin Communities, showing Donaldsonville to the Gulf Alternative 3 – GIWW..... 16

Figure 4.4: Hurricane Protection for Plaquemines Parish and Grand Isle..... 18

Figure 4.5a: Hurricane Protection for Terrebonne and Lafourche parishes, showing Morganza to the Gulf Alignment – Project Awaiting Authorization 20

Figure 4.5b: Hurricane Protection for Terrebonne and Lafourche parishes, showing Morganza to the Gulf Alignment addition – Pointe au Chien to Golden Meadow..... 20

Figure 4.6: Ecosystem Restoration and Hurricane Protection for Atchafalaya River Delta, Acadiana, and the Chenier Plain. 22

Figure 5.1: Steps in Determining Urgent Early Actions and Sequencing 45

Figure 5.2: A two-tiered approach to adaptive management illustrating the coordination and interdependence of the project- and system-level approaches..... 57

Figure 5.3: Basic components of plan management and their relationships 58

Figure 6.1: Process for future review and modification of the Master Plan. 68



1.0 Introduction

This appendix describes the Master Plan in full together with the process for its implementation and future review. The first step in development of this Master Plan was the definition of the principles and objectives that provide the vision and direction for creation of the Plan. These are set out in full in Chapter 3, and provide the foundation for the entire decision making process (as reported in Appendices B and H).

The plan was defined through application of the decision making process and consultation upon the November 2006 Preliminary Draft and February 2007 Draft of the Master Plan. The complete set of measures, studies and programs that constitute the Master Plan are described in Chapter 4 of this Appendix.

Chapter 5 then sets out the process to be followed in implementation of this first iteration of the Master Plan. It should be noted that the priorities and sequence of implementation for this first iteration of the Master Plan is reported in the ‘Fiscal Year 2008 Annual Plan: Ecosystem Restoration and Hurricane Protection in Coastal Louisiana’ (Annual Plan) in order that it can be regularly reviewed and updated. Implementation recommendations include several critical components for the success of the Master Plan, beyond the sequencing of implementation of the individual measure and study recommendations. Included within this ‘Program Implementation Strategy’ are recommendations for the following actions.

- Establish a ‘Coastal Assessment Group’ to oversee and facilitate implementation of the Master Plan.
- Establish an Applied Coastal Engineering and Science Program to resolve areas of scientific uncertainty and promote technological advancements that will advance program implementation.
- Make necessary changes to policy and legislative issues such as land use planning, the need for dedicated funding sources and review of the Congressional authorization and appropriations process.
- Formulate and implement an adaptive plan management process, to include monitoring of measure and program performance, knowledge management, focused research, feedback mechanisms, reporting of progress and ongoing stakeholder engagement.

This Annual Plan will reflect the priorities and dependencies identified through the sequencing process.

The final chapter of this appendix then looks beyond the implementation of this version of the Master Plan to consider future iterations of the plan. The Master Plan is intended to be a ‘living document’ that will be reviewed periodically to reflect the new knowledge arising from plan implementation and changes to the physical, environmental, social or political setting. It is anticipated that the first review of the plan will occur within a relatively short timeframe (within 5 years) as the framework and understanding are anticipated to develop relatively rapidly following this initial plan. Thereafter, a regular cycle of plan review will be recommended together with unscheduled reviews as required when circumstances unexpectedly change. Chapter 6 also includes details of the process that should be adopted when undertaking a review of the Master Plan, from review of the objectives through to identification of the preferred plan.



2.0 Coastal Louisiana

2.1 Critical Need

Coastal Louisiana is a complex ecosystem composed of bottomland hardwood forests, swamps, marshes, cheniers (forested coastal ridges), prairies, bayous, bays, and barrier islands. Threaded through the eastern portion of the landscape are a series of ridges along former distributaries of the Mississippi River, upon which the majority of communities settled. In the west, the prairie and cheniers were the focus of settlement. The coastal Louisiana ecosystem contains 30 percent of the coastal marsh in the contiguous United States, yet it suffers 90 percent of the total coastal marsh loss. The alarming rate of land loss in coastal Louisiana has been well documented. Since the 1930s, coastal Louisiana has lost over 1.2 million acres (1,875 mi²), an area nearly the size of Delaware (Barras et al., 2003; and Dunbar et al., 1992). At present, the rate of loss is approximately 15,300 acres per year (23.9 mi²/yr), but estimates indicate that coastal Louisiana could experience a net loss of an additional 328,000 acres (513 mi²/yr) by the year 2050 (Figure 2.1; Barras et al., 2003).

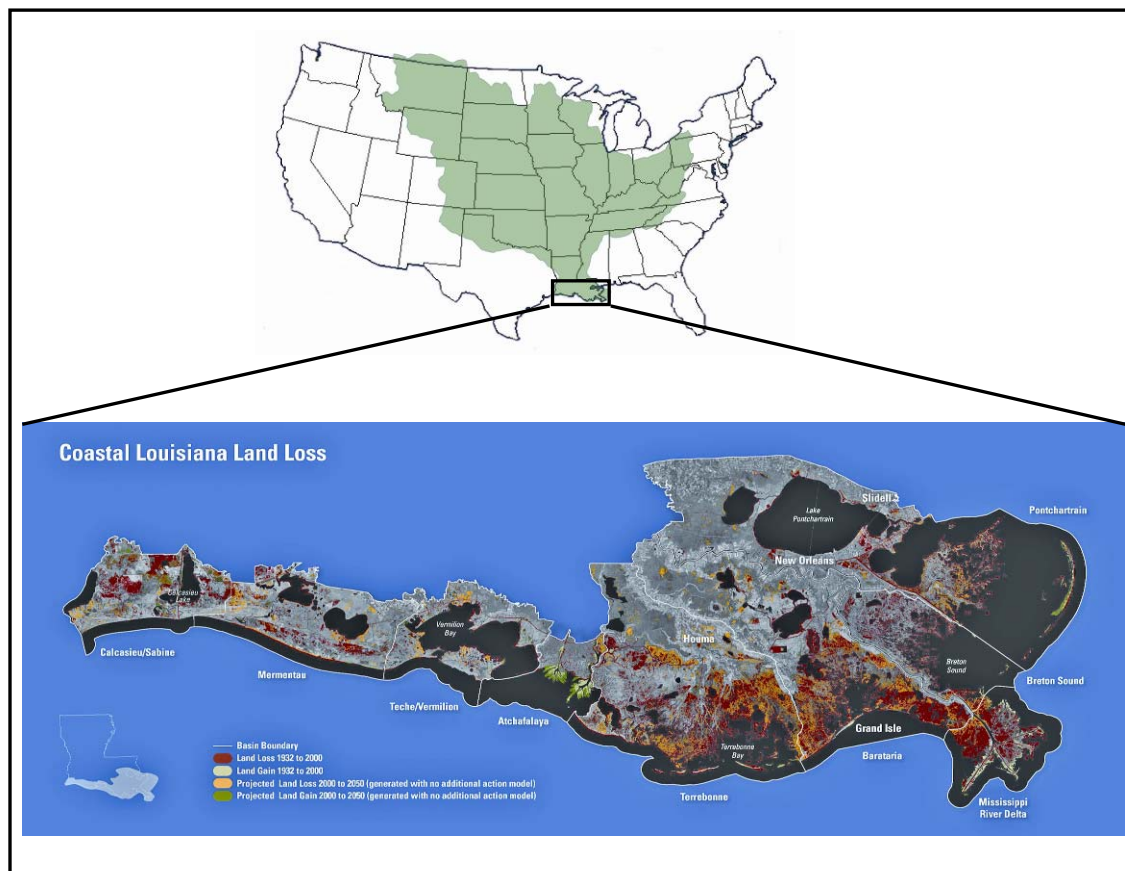


Figure 2.1: Mississippi River water shed and close-up of coastal Louisiana. Watershed map modified from Theodora Maps. Colors in Louisiana land loss map: red indicates land lost between 1932 and 2000; yellow indicates projected land loss from 2000 to 2050 if no additional action is taken to offset this trend (Barras et al. 2003).



In addition to this predicted trend, a study by the U.S. Geological Survey (USGS) has reported that the storms of 2005 converted approximately 138,880 acres (217 mi²) of marsh to water (Barras 2006). Of this total, 98 square miles of land were lost in southwestern Louisiana, and 119 square miles were lost in southeastern Louisiana. Analyses of future growing seasons will indicate how much of this damage is permanent, as marsh plants may rebound in some spots and not in others. Regardless of the final outcome, the storms have aggravated an already dire land loss emergency. The storms of 2005 called out another extreme vulnerability to the long-term viability of coastal Louisiana – that of the inadequacy of hurricane protection measures in this fragile region. Hurricanes Katrina and Rita caused severe damage to over 200,000 homes, and one year after the storm approximately 440,000 Louisiana citizens were still displaced from their homes. The Congressional Budget Office estimated that losses of physical capital totaled between \$70 and \$130 billion. Approximately 45% of these losses involved business structures or equipment, including resources owned by national concerns.

The past and continual degradation of Louisiana's coastal landscape will have significant ecological, societal, and economic impacts on the region and the Nation as tremendous resources supported by the coastal zone are put at risk. According to the 2000 census two million people, or over 65 percent of the population of Louisiana, live within 50 miles of the coast. Based on 2001 census estimates, the total population for the seventeen coastal parishes and the nine adjacent parishes that “connect economically to the coastal parishes” was almost three million (Richardson et al., 2004). Louisiana’s economy is concentrated in the southern region of the state. This includes 73.5 percent of total state employment, almost 60 percent of oil and gas employment, 77 percent of pre-Katrina/Rita construction employment, and 67 percent of all manufacturing employment in the state (Richardson et al., 2004). Nationally important industries directly tied to locations on the coast and major waterways include not only the production of oil and gas, but offshore oil and gas exploration, development and transport; shipbuilding and other manufacturing of transportation equipment; petroleum and chemical refining; and waterborne transportation, as well as seafood production and harvest.

Nearly 9,300 miles of oil and gas pipelines cross the wetlands of coastal Louisiana (USACE 2004). The network of associated energy facilities produces or transports nearly one-third of the nation’s oil and gas supply, and is tied to 50% of the nation’s refining capacity (DNR 2006). Additionally, 80% of the nation’s offshore domestic oil and gas supply is transported through coastal Louisiana. Coastal Louisiana also supports intermodal transportation that is critical to the viability of the nation. Five of the busiest cargo ports in the United States, ranked by total tons, are located here, handling approximately 19% of the annual U.S. waterborne commerce (USACE 2003). Louisiana is known as “Sportsman’s Paradise” for the diverse habitats found along its coast, which in turn support a vast diversity of fish and wildlife species. Louisiana is by far the nation’s largest shrimp, oyster, and blue crab producer and provides 26% (by weight) of the commercial fish landings in the lower 48 states. In fact, Louisiana is second only to Alaska in annual volume of seafood landings. According to National Oceanography and Atmospheric Administration reports (US Department of Commerce 2004; US Department of Commerce 2005), three of the nation’s top seafood ports by volume are in Louisiana. Coastal Louisiana’s wetlands also provide stopover habitat for millions of threatened and endangered neotropical migratory birds, and more than five million migratory waterfowl. These natural resources provide the state with vital jobs to support the commercial and recreational industries, and the nation with valued seafood. The richness of Louisiana’s culture, a richness in part driven by the history that is present throughout the state, is also a tremendous attraction to the Nation and the world. It is this indefinable richness that has made tourism such an important contributor to Louisiana’s economy, whether this richness comes from historic architecture, food, music, language or culture. According to the Louisiana Department of Culture, Recreation & Tourism over \$4.4 billion of visitor spending in Louisiana in 2004 was from New Orleans and Lake Charles. Where coastal Louisianans live, work, and play, is part of their identity. Sustaining Louisiana’s coastal culture is dependant on sustaining Louisiana’s coast.



Without barrier islands, wetlands and the protection of infrastructure and communities that supply the workforce for these industries, these nationally important resources would be at much greater risk to storm damage and supply disruptions. For these reasons and more, this region must be sustained for the well being of the state and the nation.

2.2 The CPRA – A New Approach

The Louisiana Legislature, through Act 8 of the First Extraordinary Session of the 2005 Louisiana Legislature, established the Coastal Protection and Restoration Authority (CPRA) to develop, implement, make reports on, and provide oversight for a comprehensive coastal protection master plan (Master Plan) and annual coastal protection plans, working in conjunction with state agencies, political subdivisions, including levee districts, and federal agencies. The Master Plan, as described herein, portrays the State's desires and needs relative to hurricane protection and coastal restoration, integrating these efforts in order to achieve long-term and comprehensive coastal sustainability.

The Master Plan builds on past efforts and existing programs to provide this comprehensive vision, and serves to unite the work of on-going programs including the Coastal Wetlands, Planning, Protection, and Restoration Act (CWPPRA); the Louisiana Coastal Area (LCA) Ecosystem Restoration plan; the Coastal Impact Assistance Program (CIAP); hurricane protection proposals; and the US Army Corps of Engineers (USACE) Louisiana Coastal Protection and Restoration (LACPR) Study. The CWPPRA, which is overseen by five Federal agencies and the State, has provided Louisiana and its Federal Partners with a dedicated funding source for coastal restoration projects. The CWPPRA Program has developed: an Annual Priority Project List Report since 1991; the Louisiana Coastal Wetlands Restoration Plan with its 10 appendices in 1993; a Quality Management Plan and Monitoring Program; the Coast 2050 Plan with its 6 appendices in 1998 (LCWCRTF and WCRA); and a Revised Coast 2050 Plan in 2001 (LCWCRTF and WCRA). Since 1991, the CWPPRA Program has constructed 67 projects, with another 72 projects either in engineering and design or currently under construction.

The LCA report, with its 12 appendices, was completed by the USACE and the State of Louisiana in 2005. The LCA Plan was developed with input from all resource agencies, stakeholders, and the public at large. Although not a comprehensive solution to the challenges facing coastal Louisiana, it lays the groundwork for a system-scale coastal restoration effort. Numerous studies, interagency and agency engineer manuals and handbooks, and technical reports by the USACE, Natural Resources Conservation Service, U. S. Geological Survey, and U. S. Fish and Wildlife Service have also been compiled over the past 30 years that include data on the Mississippi River and other rivers pertinent to Louisiana's sediment sources, and Coastal Louisiana data as they relate to problems on the Louisiana coast (listed in Appendix K, Bibliography).

The Master Plan has also been developed in close coordination with the Coastal Impact Assistance Program (CIAP) plan that was released in February 2007. These two plans are complementary, and in fact the CIAP plan serves as an early opportunity for substantial progress toward implementation of the Master Plan.

At the same time, other nations have been faced with similar problems with their shorelines, wetlands, and river deltas, such as the Netherlands, the United Kingdom (UK), Germany, France and Italy. All efforts provide important insights into the technologies that may be used to provide coastal protection in Louisiana. In particular, the technologies and lessons learned by the Dutch are of relevance to issues we face in coastal Louisiana today. However, for the purposes of developing a strategic planning approach, the approach used in the United Kingdom was identified as the most suitable. This approach has been developed over the past 15 years by the UK Department of Environment, Food, and Rural Affairs (formerly the Ministry of Agriculture, Fisheries, and Food).



3.0 Master Plan Principles and Objectives

Central to the definition of a long-term and comprehensive coastal protection and restoration plan is the concept of sustainability. Put simply, sustainability seeks to ensure that actions taken today, to address present day issues, avoid to the extent possible tying future generations into inflexible and unacceptably expensive approaches. There are many aspects to sustainability to consider in a comprehensive plan that is seeking to address the long-term management of both coastal protection and restoration. The Master Plan sets a path toward the achievement of sustainable long-term management of coastal Louisiana.

The process of defining the Comprehensive Coastal Protection Master Plan began with identification of principles to provide fundamental guidance for that plan. Concepts related to sustainable management of the coast (described in detail in Appendix D), were translated into a series of principles and objectives to direct definition of the Master Plan. In addition to these concepts, the State directive, in identifying broader plan requirements, provided a further basis for the principles.

These principles identify the range of value-based considerations applied in developing the comprehensive plan, and in doing so, they build on legislative directives. Many of the principles defining environmental-related considerations are derived directly from those developed for the Louisiana Coastal Area (LCA) Ecosystem Restoration Study. Additional principles are included that define the considerations associated with risk reduction of coastal economic and environmental assets and the ability to balance and sustain current uses with improved risk reduction.

These principles define a broader set of subcomponents of those common fundamental objectives found in the State and Federal directives. They also aid in the identification of assets and risks in the landscape and support the definition of planning objectives that indicate levels of success.

3.1 Master Plan Purpose

For the benefit and protection of the state as a whole, its citizens and its localities, hurricane protection and ecosystem restoration are vital to survival. It is without question that the viability of residential communities; agricultural, energy, fish and wildlife production; and commercial and industrial development in coastal Louisiana is dependent on a sustainable coastal ecosystem. The State and Nation must therefore act to provide protection to coastal Louisiana through the use of a holistic, comprehensive plan integrating ecosystem restoration with structural and non-structural measures for storm damage reduction.

3.2 Program Principles

Program principles identify the critical manners in which implemented plans and measures may ultimately interrelate with and alter the activities and assets within the coastal landscape. They describe the range of critical considerations required to develop appropriate and effective plans and plan components. These principles, set out below, represent the *rules* by which the program implementation, including the plan formulation process, is conducted.

- In order to achieve a sustainable long-term solution for comprehensive hurricane protection and coastal restoration, projects and plans will be integrated and evaluated on a 100 year planning horizon to understand future implications of current actions.



- The comprehensive hurricane protection and coastal restoration plan will provide a basis for follow-on decisions regarding redevelopment of south Louisiana and effective evacuation planning.
- The plan will identify the frequency and severity of future flooding and erosion risks so informed decisions can be made regarding future development and land use in coastal Louisiana, to reduce inundation of coastal communities, and to ensure sustainable and productive coastal habitation.
- The Master Plan will be developed and implemented with the participation and input of the numerous and diverse interests that live, work, and play in coastal Louisiana, along with national interests who depend upon coastal Louisiana's continued health and existence.
- An integrated, standardized procedure and scoring system will be developed and followed that will allow reasonable and informed decisions between and within planning units.
- The protection and restoration of coastal Louisiana will be an ongoing and evolving process. The selected plan will include an effective monitoring and evaluation process that reduces scientific and engineering uncertainty, assesses the success of the plan, and supports adaptive management of plan implementation.
- The level of detail provided for a measure may only be as great as the level of understanding of the problems, needs, and opportunities for a region or the proposed solutions. Promising concepts must be evaluated expeditiously and implemented if shown to be appropriate.
- The plan will be reviewed on a regularly scheduled basis and after exceptional events, and will be reformulated as necessary to respond to changing economic, social, and environmental conditions.
- Limited sediment availability is one of the constraints on system rehabilitation. Therefore, plan elements including mechanical sediment retrieval and placement may be considered where landscape objectives cannot be met using natural processes. Because sediment mining can contribute to ecosystem degradation in the source area, such alternatives should, to the extent practicable, maximize use of sediment sources outside the wetland ecosystems, such as from rivers or from the Gulf of Mexico.
- Constraints on coastal protection and restoration will be identified in plan formulation. Such constraints may include resource limitations (e.g., sediment availability, freshwater sources, funding), scientific or technical uncertainties (e.g., subsidence and sea level rise rates, effectiveness of certain restoration techniques, modeling uncertainty), and socio-economic considerations (public acceptability of proposed actions; preferred land uses such as agricultural, residential, industrial, fisheries).
- Projects will be designed and implemented in the most cost efficient manner using adaptive management and appropriate engineering, economic, and scientific criteria.
- Synergies between traditional flood and storm protection measures and coastal restoration opportunities will be encouraged, and cost-effective solutions will be sought.
- Protection and restoration alternatives that minimize long-term operation and maintenance costs will be preferred. For example, restoration measures should always be considered in conjunction with levees in order to minimize exposure of hard structures to open Gulf conditions. Further, restoration alternatives that rely on natural cycles and processes for ecosystem sustainability, rather than external energy subsidies, will be preferred.
- Allowing development of low-lying areas within protection systems not only increases exposure to damages in the event of a system failure, but also diminishes effectiveness of the protection works themselves by removing water storage areas from the system. This program will support and promote close coordination among all jurisdictional authorities to encourage strict enforcement of laws and regulations. Appropriate easements will be obtained in wetlands landward of hurricane protection systems to maintain these important natural buffer zones.



- Recognizing that disturbed and degraded ecosystems can be vulnerable to invasive species, implementation of the plan needs to be coordinated with other State and Federal programs addressing such invasions. Project designs will promote conditions conducive to native species by incorporating appropriate features to protect against invasion to the extent possible without diminishing project effectiveness.
- Program implementation, including development of the plan, will comply with all applicable state and federal laws and regulations. It is understood that a component of program implementation is to seek revisions to laws and regulations, if appropriate, to ensure timely implementation of the master plan.

3.3 Coastwide Planning Objectives and Plan Formulation Principles

The ‘Coastwide Planning Objectives’ provide a broad set of overall aspirations, which the Master Plan seeks to deliver. These objectives provide the basis for determining the relative success of all potential plans or individual plan components.

By establishing a full and diverse range of values, these objectives ensure that the Master Plan is gauged and selected to meet both State and Federal directives, while delivering a sustainable long-term Master Plan. The coastwide planning objectives, which represent the desired attributes of any plan, are listed below.

Plan formulation principles identify the necessary considerations for identifying potential measures and the comprehensive coastal protection plan. They address the definition of potential measures, potential constraints for development of plans, possible limitations in application of types of measures, and provide guidance on how these factors should be addressed. These principles, as set out below for each of the objectives, serve as the guidelines that cannot be violated during plan formulation.

Objective 1. Reduce economic losses from storm based flooding to residential, public, industrial, and commercial infrastructure, assuring that assets are protected, at a minimum, from a storm surge that has a 1% chance of occurring in any given year.

- This may be achieved by implementing plans, projects, policies, and programs intended to provide for hurricane protection and coastal conservation and restoration, including constructing levee and floodgate systems, enhancing natural landscape elements, and elevating, flood-proofing or relocating structures.
- Protection of resources of national and statewide significance will be a priority; including major oil and gas facilities and refineries, deep draft ports and waterways, military and military-support facilities, the Gulf Intracoastal Waterway, interstate and other major highways, and historic sites.
- This objective explicitly deals with protection of assets. Effective evacuation procedures must be implemented.

Objective 2. Promote a sustainable coastal ecosystem by harnessing the processes of the natural system.

- A sustainable system is one characterized by high levels of productivity and resilience (the ability of a system to withstand naturally variable conditions and/or recover from disturbances).
- This may be achieved by providing for daily, seasonal and episodic fluctuations in water levels and salinities, and/or reestablishing natural pathways of sediment movement and nutrient uptake.
- Appreciation of the dynamic nature of the coastal system must be integral to the planning and selection of preferred alternatives.



- Design, construction, and operation of new flood and storm protection measures should avoid or minimize effects that would reduce ecosystem resilience. Where practicable, disrupted hydrologic systems should be rehabilitated to re-establish sustainable processes.
- Project design should promote conditions that route riverine waters through estuarine basins and promote sheet flow over wetlands in order to maximize nutrient assimilation.

Objective 3. Provide habitats suitable to support an array of commercial and recreational activities coastwide.

- As Louisiana's coastal ecosystem degrades, critical habitat that supports fish and wildlife species continues to be lost. Therefore, the plan will seek to increase the magnitude of suitable fish and wildlife habitats coastwide.
- The plan will seek to ensure a continued diversity of fish and wildlife habitats coastwide.

Objective 4. Sustain, to the extent practicable, the unique heritage of coastal Louisiana by protecting historic properties and traditional living cultures and their ties and relationships to the natural environment.

- Louisiana coastal communities are valuable. They are living stewards of the culture, history, land and environmental resources of the coast for themselves, for the state, and for the nation.
- Sensitivity and fairness must be shown to those in the coastal communities whose homes, lands, livelihoods, and ways of life may be adversely affected by the implementation of any selected alternatives.
- Displacement and dislocation of resources, infrastructure, and possibly communities may be unavoidable under some scenarios. Because of the negative near-term effects some restoration projects may have on the sustainability of existing cultures, careful consideration of mitigation efforts on human disruption must be undertaken.



4.0 The Full Plan

4.1 Background

The long-term Master Plan is a detailed vision that provides guidance for the future of Coastal Louisiana. This plan represents the State's first approximation of the comprehensive, integrated solution for ecosystem restoration and hurricane protection. It builds upon previous planning, research, and lessons learned. The Master Plan is also an integrated approach meant to balance objectives in a comprehensive manner while allowing implementation in a feasible, cost-effective way to provide for all the resources and citizens of Louisiana. This plan represents a point of departure from how planning of activities along coastal Louisiana has been done in the past. As such, it does not represent an end product, but instead a new direction and a new philosophy for how we live in, and manage the resources of, coastal Louisiana.

Many adjustments will need to be made in the first few years of implementation, including revisions to existing management practices, policies, and legislation. Additionally, although the Master Plan builds upon decades of experience, implementation of this program and some of the measures which comprise the plan will require much further analysis including modeling, engineering & design, and environmental study. Therefore, mechanisms for change – not only early in plan implementation, but throughout the life of its implementation – will be required to meet the needs of the Master Plan. Such activities are discussed further in Chapter 5 of this appendix. This chapter, describing the plan, lays out the “constructable” components of the Master Plan, including those large-scale planning, and coastwide programmatic, measures that will support construction of measures. Order of presentation does not indicate order of priority; for further discussion of the process for identification of urgent early actions, refer to Chapter 5.2.

4.1.1 Plan Formulation

A decision making process (described in Appendix B) was developed in order to provide a consistent framework to consider the relative merits of any potential management options to achieve the principles and objectives (Chapter 2). The process was supported by technical analyses (see appendices E, F, and G) and applied to evaluate the outputs from appraisal of two alternative plans which had been developed as an aid to the process of defining the Master Plan (see Appendix H). The outputs from evaluation of these alternative plans, together with the assessments of the certainty of these evaluations, were used to generate the Preliminary Draft Master Plan, also presented in Appendix B. The IPT sought public comments on the Preliminary Draft Master Plan, which was released for public review on November 29, 2006, through a series of nine public meetings, meetings with the LCA Science Board and the CPRA Science and Engineering Review Team, and a public comment period that ended on January 5, 2007. Based upon comments (see Appendix C-2) and further analyses of the Preliminary Draft Master Plan, the Draft Master Plan was prepared and released for public review on February 6, 2007. The IPT sought public comments on the Draft Master Plan through a series of three public hearings, two public meetings, a joint meeting with the LCA Science Board and the CPRA Science and Engineering Review Team, and a public comment period that ended on April 2, 2007. Based upon comments (see Appendix C-1) Final Master Plan was revised and is presented below. This plan was approved by the CPRA on April 12, 2007.

4.1.2 Measure Definition

Measure descriptions contained in this chapter were used to generate cost estimates for planning purposes. In many cases, there is extensive planning and design that will be necessary, including more detailed analyses of alternatives, before finalizing alignments, features, costs, and operational schemes. For example, we have identified areas of Louisiana's coast that require hurricane protection through construction of hurricane protection



structures. It is recommended that certain areas of the coast are protected from storm surges that have a 1% chance of occurring in any given year. Other areas are recommended for protection from larger storm surges, but given the status of ongoing data collection and storm surge, engineering, and economic analyses, it is difficult to say with certainty how high the level of protection may be. For the purposes of this report, these areas have been analyzed as being provided protection from storm surges with a 0.2% chance of occurring in any given year because planning data indicate risks that require substantially greater protection measures than the baseline level (1%). Completion of additional analyses, such as those progressing within the Corps of Engineers' *Louisiana Coastal Protection and Restoration Project*, will inform and ultimately define the technically feasible level of protection. In any case, the goal is to provide protection to these areas proportional to the total economic consequences that may be incurred when larger storm surges impact the coast.

4.2 Coastwide Benefits of the Plan

The appraisals undertaken to support development of this plan clearly demonstrated that without significant action the coastal landscape of Louisiana will continue to degrade, reducing the sustainability and productivity of the coast, while also increasing the flooding risk to built assets. With no further action, it has been previously estimated that 513 square miles of land may be lost by 2050 (Barras, 2003). Analyses undertaken for this study (see Appendix G) indicate that as much as 762 square miles of land could be lost by 2050.

The economic consequences from storm surge flooding include direct damages to property and infrastructure, emergency costs, evacuation and subsistence costs, and reoccupation and clean up costs. The storm surge and economic appraisals have demonstrated that, under existing conditions, the areas vulnerable to flooding with a 1 percent annual probability includes over 430,000 residencies, with potential economic consequences of over \$34 billion coastwide. The 0.2% probability risk area includes over 871,000 residencies, with potential economic consequences of over \$157 billion coastwide.

Although the above represent total coastwide risk, any individual storm of these magnitudes would also result in tremendous losses to the economy of the entire Nation by increasing the costs of goods because of disruptions to navigation and by increasing the costs of natural gas and oil products. Additionally, tremendous burdens are placed on other areas in the region by the large number of evacuees that must be provided for in the wake of hurricanes. In summary, hurricane protection for south Louisiana can be considered of critical importance to the local citizens, the Region, and the Nation. The Master Plan sets out an integrated combination of measures representing a significant reduction in these potential negative future impacts.

The proposed protection measures provide for the avoidance of the large majority of potential damages to built assets under the two storm surge levels analyzed. If aggressively implemented the plan is capable of reducing total potential damages to areas vulnerable to flooding with a 1 percent annual probability by 90 percent to less than \$4 billion, and reduces the number of residences at risk by 96 percent. The 0.2% annual probability risk damages may be reduced by 84 percent to less than \$25 billion and the number of residences at risk is reduced by 80 percent. Additional to these benefits is the avoidance of many of the National economic impacts identified above. These figures represent strong economic case for the storm surge protection measures set out in this preliminary draft plan.

Analyses performed to forecast the nature of changes to the coastal wetland system under the Master Plan indicate that if all of the Master Plan's restoration projects were aggressively implemented, Louisiana will be able to increase sustainability in significant portions of the coastal zone. It should be noted, however, that this analysis did not account for effects of some of the larger restoration measures, such as the Mississippi River Delta



Management plan because of their conceptual nature (see description of large-scale planning efforts, chapter 4.4 of this appendix). Therefore, the Master Plan holds the possibility that past and continued land loss could be substantially slowed or even reversed if all measures were fully implemented. Possibly more important than the reversion of land loss trends will be the creation of a more sustainable system whereby freshwater and tidal flows naturally maintain coastal landscapes and their associated ecosystems. The plan will also provide for a continued diversity of habitats in coastal Louisiana that support recreational and commercial activities on the coast. This improved coastal landscape will also increase storm surge protection to many built coastal assets and buffer levee systems from open water conditions. In combination, these hurricane protection and ecosystem restoration improvements provide coastal communities an understood degree of risk reduction that will allow them to make informed decisions for shaping their future.

4.3 Measures Maps

Figures 4.1 through 4.6 contain conceptual representations of all measures. Note that these should not be viewed as definite footprints of proposed measures. Further planning, engineering, and design; as well as scientific, engineering, stakeholder, and public input is required to determine exact specifications for construction. Descriptions of measures may be found in sections 4.4 through 4.10.