Biloxi Marsh Living Shoreline

RESTORE Proposal

Coastal Protection & Restoration Authority

I. Summary Sheet

Appendix A: Council Member Applicant and Proposal Information Summary Sheet

Council Member: State of Louisiana	Point of Contact: Jerome Zeringue Phone: (225) 342-7669 Email: Jerome.Zeringue@LA.GOV

Project Identification

Project Title: Biloxi Marsh Living Shoreline

State(s): Louisiana | County/City/Region: St. Bernard Parish, Southeastern Louisiana

Specific Location: *Projects must be located within the Gulf Coast Region as defined in RESTORE Act. (attach map or photos, if applicable)*
Please see attached.

Project Description

RESTORE Goals: *Identify all RESTORE Act goals this project supports. Place a **P** for Primary Goal, and **S** for secondary goals.*

P Restore and Conserve Habitat
S Restore Water Quality
S Restore and Revitalize the Gulf Economy
S Replenish and Protect Living Coastal and Marine Resources
S Enhance Community Resilience

RESTORE Objectives: *Identify all RESTORE Act objectives this project supports. Place a **P** for Primary Objective, and **S** for secondary objectives.*

P Restore, Enhance, and Protect Habitats
S Restore, Improve, and Protect Water Resources
S Protect and Restore Living Coastal and Marine Resources
S Restore and Enhance Natural Processes and Shorelines
S Promote Community Resilience
S Promote Natural Resource Stewardship and Environmental Education
S Improve Science-Based Decision-Making Processes

RESTORE Priorities: *Identify all RESTORE Act priorities that this project supports.*

_X_ Priority 1: Projects that are projected to make the greatest contribution
_X_ Priority 2: Large-scale projects and programs that are projected to substantially contribute to restoring
_X_ Priority 3: Projects contained in existing Gulf Coast State comprehensive plans for the restoration ….
_X_ Priority 4: Projects that restore long-term resiliency of the natural resources, ecosystems, fisheries …

RESTORE Commitments: *Identify all RESTORE Comprehensive Plan commitments that this project supports.*

_X_ Commitment to Science-based Decision Making
_X_ Commitment to Regional Ecosystem-based Approach to Restoration
_X_ Commitment to Engagement, Inclusion, and Transparency
_X_ Commitment to Leverage Resources and Partnerships
_X_ Commitment to Delivering Results and Measuring Impacts

RESTORE Proposal Type and Phases: *Please identify which type and phase best suits this proposal.*

_X_ Project _X_ Planning ___ Technical Assistance ___ Implementation ___ Program

Project Cost and Duration

Project Cost Estimate:	**Total Project: $3,220,460**	**Project Timing Estimate**:
Total:		Date Anticipated to Start: 09/2015 Time to Completion: 25 **months** / years Anticipated Project Lifespan: 20 years

II. Executive Summary

The Biloxi Marsh Living Shoreline project is an important project for Louisiana and the Gulf of Mexico area as it is needed to protect, enhance, and restore the Biloxi Marshes. These marshes function as an important storm buffer for the city of New Orleans, an important cultural and economic center for the Gulf region, and will provide habitat as well as a variety of eco-system services.

The Biloxi Marshes consist of approximately 49,000 hectares of brackish and salt marshes, which have been greatly impacted by shoreline erosion from wind-driven waves. The purpose of this project is to create bioengineered, marsh-fringing oyster reefs to promote the formation of self-sustaining living shoreline protection structures. The project is estimated to create approximately 47,000 feet of oyster barrier reef along the eastern shore of Biloxi Marsh which will provide oyster habitat, reduce wave erosion, and prevent further marsh degradation.

Oyster reefs help protect marsh habitats by reducing shoreline recession. Oyster reefs frequently occur just offshore of the marsh edge, and their vertical structure serves to attenuate wave energies and reduce water velocities resulting in reduced erosion as well as increased sediment deposition behind the reef, both of which act to stabilize the shoreline (Campbell 2004; Piazza et al. 2005). However, many marsh-fringing, vertical oyster reefs have been lost due to saltwater intrusion, disease, and overharvest, and there has been a concomitant loss in shoreline erosion control (Stone et al. 2004; Beck et al. 2011).

Bioengineered oyster reefs, which are man-made structures designed to promote the formation of marsh-fringing oyster reefs, have been implemented in many locations in Louisiana (Furlong 2012; La Peyre et al. 2013). Of those that have been adequately monitored, these types of projects have shown that they can significantly reduce shoreline recession and support good oyster recruitment and survival, such that the reefs created may be self-sustaining (Piazza et al. 2005; Melancon et al. 2013).

In addition to the aforementioned protection features, eastern oysters are a key species in Louisiana's coastal ecosystem. Due to the high productivity of Louisiana's oyster grounds, the State is a national leader in oyster landings with annual values typically in excess of $35 million in dockside sales (Louisiana Department of Wildlife and Fisheries (LDWF) 2013). In addition to their economic importance, oysters and their reefs provide important ecosystem benefits such as enhanced water quality and nutrient loading mitigation (Wall et al. 2011). Oyster reefs also provide unique, structurally-complex habitat that supports distinct and diverse aquatic communities and functions as nursery habitat for many fish and shellfish species, which enhances local productivity for both commercial and recreational fisheries (Soniat et al., 2004; Plunket and La Peyre 2005; Schyphers et al. 2011).

The Biloxi Marsh Living Shoreline project will be constructed by mechanically placing a manufactured product, or suite of products, just off the shoreline to create a living breakwater structure. The products may consist of concrete, plastic mesh, steel rebar, limestone, oyster

shells, and/or concrete admixtures. These living breakwaters will be placed at the -2.0' contour, and extend offshore. The width of the living breakwaters can vary depending on manufactured product and wave conditions. The target height for the living breakwaters is mean water level (MWL). A mechanical dredge will be used to provide access and flotation to the project area. The project area is located along the shoreline of Eloi Bay and Eloi Point, near the mouth of Bayou la Loutre. The timeline for this project is 25 months for engineering and design and permitting, followed by 25 months of construction.

The Biloxi Marsh Living Shoreline project will be deemed successful if monitoring shows that it reduces shoreline recession and supports good oyster recruitment and survival such that the reefs are self-sustaining. At the project-scale, performance measures will track the progress towards meeting management goals and objectives. When monitored over time, performance measures can help reduce uncertainty surrounding predictive models and inform whether intended results are being achieved or if additional actions are needed to fulfill program expectations.

CPRA is currently working with the Water Institute of the Gulf to more fully develop a System-Wide Assessment and Monitoring Program (SWAMP) that will bring existing monitoring and assessment programs under one comprehensive umbrella in an effort to avoid duplication and improve efficiency. SWAMP is envisioned to be a scalable program that will allow for data assessments to be completed at the project-, basin-, and program-scales. Individual projects will generate monitoring plans which will nest within the larger SWAMP framework and will allow for periodic assessment of project performance against performance expectations.

The largest single environmental uncertainty in planning and implementing restoration projects in south Louisiana is accounting for the potentially high, and highly variable, rates of relative sea level rise (RSLR). For shoreline protection projects, maximum ecological benefits require that placed protection elements maintain their elevation relative to mean sea level. Under- or over-estimating RSLR can result in either infrastructure sinking below supra-tidal elevations earlier than intended, or in overspending of limited funds during construction or installing excessive structures. However, CPRA has a variety of resources and partnerships with which it is able to apply and leverage for the benefit of this project. Through the Coastal Master Plan, CPRA is able to apply the integrated suite of Predictive Models and Planning Tool, a science-based decision support system developed for the Master Plan, to work towards achieving the RESTORE objectives of habitat protection and restoration. This project originally began as a Coastal Impact Assistance Program (CIAP) project, and CPRA is able to leverage the initial engineering and design work conducted for that project to evaluate the ability of the candidate reef-base technologies to withstand the surge associated with a Category 1 hurricane. The CPRA Biloxi Marsh Living Shoreline project will build on this knowledge and that of the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) program’s Terrebonne Bay Shore Protection Demonstration project that has evaluated different types of engineering structures and their effectiveness for reducing shoreline recession and enhancing local oyster production.

III. Proposal Narrative

1. Introduction and Background

Enacted in July 2012, the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE Act) established the Gulf Coast Ecosystem Restoration Council (Council), and tasked the Council with developing a comprehensive plan for restoration of the Gulf Coast's ecosystem and economy. Overarching goals of this plan are to: restore and conserve habitat; restore water quality; replenish and protect living coastal and marine resources; enhance community resilience; and restore and revitalize the Gulf economy (Gulf Coast Ecosystem Restoration Council 2013). These comprehensive goals require large-scale projects that have a commensurate level of ecosystem benefits and far-reaching effects, particularly when combined with complementary projects as part of a coordinated program. The State of Louisiana, in response to an ongoing coastal land loss crisis, has identified a large number of projects in its Comprehensive Master Plan for a Sustainable Coast (Master Plan) (2012) that align with the Council's aforementioned goals for comprehensive restoration. These projects have been rigorously studied, analyzed, and publicly vetted; and will significantly contribute to the restoration and protection of the Gulf Coast region and the more inclusive Gulf of Mexico Large Marine Ecosystem. Restoring the Gulf from the 2010 Deepwater Horizon oil spill is an especially significant issue for Louisiana which has suffered and continues to suffer the greatest impacts from that disaster.

CPRA Coastal Master Plan

The Coastal Protection and Restoration Authority (CPRA) developed a robust decision-making process to ensure that formulation of the 2012 Coastal Master Plan (Master Plan) relied on the best science and technical information available, while still incorporating an extensive public outreach campaign. The process was guided by clearly-articulated objectives developed for the 2007 Master Plan and by planning principles developed to aid in meeting those objectives. The objectives were clearly defined to reflect key issues affecting communities in and around Louisiana's coast:

1. Reduce economic losses from storm surge flooding,
2. Promote a sustainable coastal ecosystem by harnessing the natural processes of the system,
3. Provide habitats suitable to support an array of commercial and recreational activities coast wide,
4. Sustain the unique cultural heritage of coastal Louisiana, and
5. Promote a viable working coast to support regionally and nationally important businesses and industries.

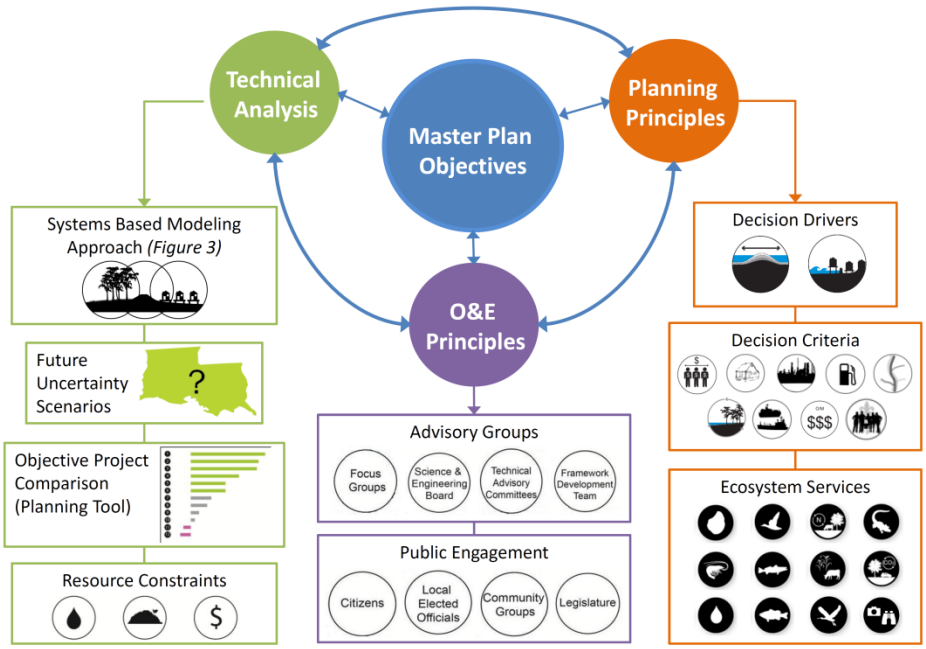


Figure 1. The decision-making process is a complex interaction of input and feedbacks between a technical analysis, outreach and engagement (O&E) and planning principles. The overall goal of the Master Plan is defined by the objectives. The systems-based modeling approach, future uncertainty scenarios, planning tool and resource constraints all contribute to the technical data needed for the decision-making process. The planning principles and formulation involve decision drivers, decision criteria and ecosystem services metrics, as described in the methods section, which help determine the plan's ability to meet the objectives. The O&E strategy was designed to ensure public input and acceptance throughout the decision-making process and multiple groups were involved in defining and reviewing the technical analysis and plan formulation (Peyronnin et al. 2013).

Evaluating Projects

The purpose for the 2012 Coastal Master Plan was to identify coastal protection and restoration projects that would improve the lives of coastal residents by creating a more resilient south Louisiana. Achieving this goal required new tools that helped us better understand our coast and how projects could provide benefits. The coast is a complex system. We needed to better understand how it is changing today and the kinds of changes we can expect in the future. We also had hundreds of project ideas and different views about how to move forward, and needed a way to sort through our many options and find those that would work best for us.

To meet these needs, CPRA used a systems approach to coastal planning and a science-based decision making process that resulted in a plan that was both funding- and resource- constrained. These tools helped us understand the practical implications of different project options and how gains in one area might create losses in another. Based on the preferences we wanted to explore, our tools helped identify strategies for investing in coastal protection and restoration projects. This analysis improved our understanding of how projects were affected by: our budget and the river water and sediment that we have to work with. We also used the tools to consider possible future coastal conditions that could affect the way our projects operate, along with other factors such as construction time.

The Predictive Models

The 2012 Coastal Master Plan analyzed both protection and restoration measures, which influenced the models we selected and how they work. To estimate risk reduction outcomes, we used models that evaluated storm surge and the risk of expected annual damages. To estimate restoration outcomes, the models looked at how land changes throughout the coast—where land is building and where it is disappearing. These models examined how water moves through the coastal system as well as how salt and fresh water affect vegetation and habitats for key species and ecosystem services.

The integrated suite of Predictive Models developed for the Master Plan assessed how Louisiana's coastal landscape may change and how much damage communities may face from storm flooding over the next 50 years if we take no further action and for comparison then assessed how the coastal ecosystem and our level of risk could change if certain risk reduction and restoration projects are constructed. The models incorporated what we know about the way the coast works, and they made it easier to identify projects that best achieve our objectives.

Ecosystem services are benefits that the environment provides to people. In Louisiana, these range from providing the right habitats for oysters and shrimp to nature-based tourism. We could not detail the economic aspect of ecosystem services in our analysis. Instead, we focused on proxy characteristics of the coast, such as provision of habitat (i.e. habitat suitability indices) and other factors that can support ecosystem services.

The Predictive Models used in the Master Plan were organized into seven linked groups (Figure 2), involving the work of over 60 scientists and engineers. Each group worked on a different aspect of how the coastal system changes over time. Our effort was based on existing models where they were appropriate. New models were developed for vegetation, nitrogen uptake, barrier shorelines, flood risk, and to reflect potential for nature based tourism, fresh water availability, and support for agriculture/ aquaculture.

The models were designed to work together, following the precedent set by earlier State planning efforts, such as the Coastal Louisiana Ecosystem Assessment and Restoration (CLEAR) work conducted for the Louisiana Coastal Area Study (Nuttle et al., 2004; USACE, 2004). We also found new ways to link the expanded set of models to more fully capture how the coast works as a system. The level of modeling in the 2012 Coastal Master Plan was a significant technical achievement in the systems approach, the linked nature of the models, and in the breadth of subjects evaluated.

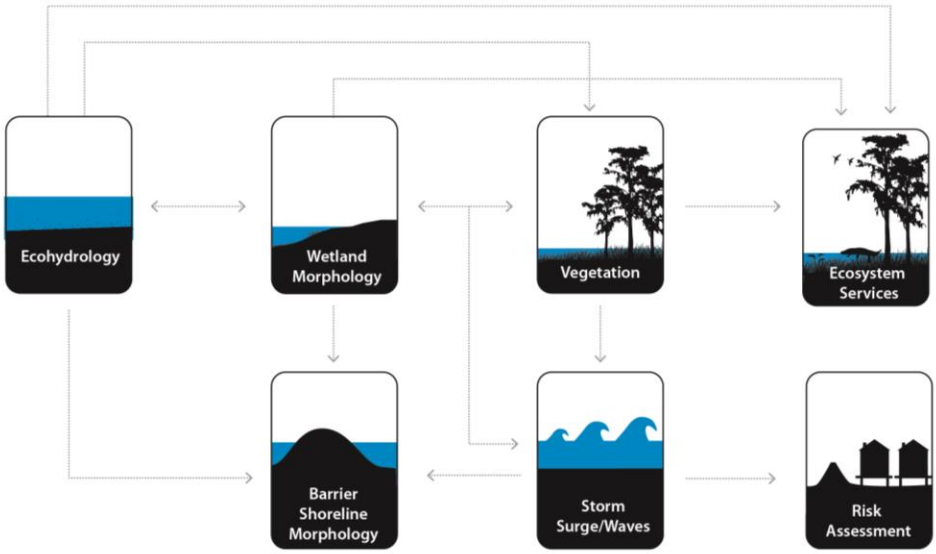


Figure 2. 2012 Master Plan predictive model groups (Meselhe et al. 2013, Couvillion et al. 2013, Visser et al. 2013, Nyman et al. 2013, Cobell et al. 2013, Johnson et al. 2013).

Future Environmental Scenarios

Many factors that will have a profound effect on the future of Louisiana's coast cannot be easily predicted or are outside of our control. These include factors such as subsidence and the levels of nutrients in the river, as well as the effects of climate change, such as sea level rise, changes in rainfall patterns, and storm frequency and intensity. Climate change was central to our analysis, given coastal Louisiana's vulnerability to increased flooding and the sensitivity of its habitats.

To account for these factors when developing the Master Plan, we worked with experts to develop two different sets of assumptions or scenarios. These scenarios reflect different ways future coastal conditions could affect our ability to achieve protection and build land:

- **Moderate scenario - assumed limited changes in the factors on the facing page over the next 50 years.**
- **Less optimistic scenario - assumed more dramatic changes in these factors over the next 50 years.**

CPRA found that restoration projects selected under the less optimistic scenario tended to be in the upper end of the estuaries and closer to existing land rather than near the Gulf of Mexico. As a result, the final Master Plan is largely comprised of projects selected under the less optimistic scenario.

The Planning Tool

The Planning Tool, in concert with the modeling effort, offered a way to examine these projects. The model results, represented by terabytes of data, are the building blocks of the 2012 Coastal Master Plan. We needed a user friendly way to sort and view these results so that we could identify groups of projects to examine in greater detail. The Planning Tool is a decision support

system that helps the state choose smart investments for the coast. The tool integrates information from the models with other information such as funding constraints, compares how different coastal restoration and risk reduction projects could be grouped, and allows us to systematically consider many variables (e.g., project costs, funding, landscape conditions, and stakeholder preferences). These science-based tools help us understand the practical implications of different project options. Based on the outcomes, our tools suggested a strategy for investing in coastal flood risk reduction and restoration projects. As part of this strategy, the tools considered the constraints, such as the limited money, water, and sediment that we have to work with. The tools also considered possible future conditions that will affect the way our projects operate, along with other important factors such as construction time and how combinations of projects will work together. These results were translated so that citizens and state leaders could understand the projects' real world effects.

We used predictive models and the Planning Tool to help us select 109 high-performing projects that could deliver measurable benefits to our communities and coastal ecosystem over the coming decades. The Planning Tool was designed to translate the models' scientific output and show the practical implications of different options. Decision making for the plan followed directly from this analysis.

Biloxi Marsh Living Shoreline Project

Eastern oysters (*Crassostrea virginica*) are considered a key species in Louisiana's coastal ecosystem because of the many ecosystem services they provide (Coen et al. 2007). Oysters are an important commercial fishery species, and the high productivity of Louisiana's oyster grounds has made the State a national leader in oyster landings with annual values typically in excess of $35 million in dockside sales (Louisiana Department of Wildlife and Fisheries (LDWF) 2013). The shell reefs created by oysters provide unique, structurally-complex habitat that supports distinct and diverse aquatic communities, functions as nursery habitat for many fish and shellfish species, and enhances local productivity (Soniat et al., 2004; Plunket and La Peyre 2005; Schyphers et al. 2011). Because these reefs provide abundant and concentrated prey resources, they are valuable foraging sites for transient, predatory fishes such as flounder, drum, and speckled trout (Plunket and La Peyre 2005; Schyphers et al. 2011); therefore, oyster reefs likely enhance recreational fisheries. Oysters also enhance water quality by filtering large volumes of water daily to feed. By removing large amounts of carbon, phosphorus, and nitrogen incorporated into phytoplankton biomass, oysters can mitigate nutrient loading and help prevent eutrophication and hypoxia (Wall et al. 2011).

In addition to the aforementioned ecosystem services, oyster reefs help protect marsh habitats by reducing shoreline recession. Oyster reefs frequently occur just offshore of the marsh edge, and their vertical structure serves to attenuate wave energies and reduce water velocities resulting in reduced erosion as well as increased sediment deposition behind the reef, both of which act to stabilize the shoreline (Campbell 2004; Piazza et al. 2005). However, many marsh-fringing, vertical oyster reefs have been lost due to saltwater intrusion, disease, and overharvest, and there has been a concomitant loss in shoreline erosion control (Stone et al. 2004; Beck et al. 2011). There has been increasing interest in restoring such oyster reefs as a substitute for shoreline protection structures such as rock breakwaters, which are unnatural and require additional

placement of material to maintain their effectiveness in pace with structure settlement and sea level rise. By comparison, living oyster reefs can be self-sustaining shoreline protection structures, provided there is adequate oyster recruitment and survival over time to ensure continuous three-dimensional reef growth.

Bioengineered oyster reefs, which are man-made structures designed to promote the formation of marsh-fringing oyster reefs, have been implemented in many locations in Louisiana (Furlong 2012; La Peyre et al. 2013). Although most of these projects have been constructed too recently to determine their effectiveness, those that have been monitored adequately have shown that they can significantly reduce shoreline recession while also supporting good oyster recruitment and survival such that the reefs may be sustainable (Piazza et al. 2005; Melancon et al. 2013). These projects have also employed a variety of structures and materials. Piazza et al. (2005) created reefs from mounds of oyster shell (cultch), and found that these reefs were most effective in low-energy environments. The CWPPRA Terrebonne Bay Shore Protection Demonstration project has evaluated three different types of engineered structures designed to encourage oyster spat settlement. While the structures have shown varying degrees of effectiveness, all have reduced shoreline recession and have enhanced local oyster production (Melancon et al. 2013). Continued monitoring of these projects is obviously critical to determine the conditions (e.g., sediments, salinities) under which bioengineered oyster reefs can be sustainable and effective in reducing erosion and providing other ecosystem services.

The goals of the Biloxi Marsh Living Shoreline project are to reduce shoreline recession and enhance local oyster production through the implementation of marsh-fringing, bioengineered oyster reefs. The Biloxi Marshes consist of approximately 49,000 hectares of brackish and salt marshes that have been greatly impacted by shoreline erosion from wind-driven waves, with shoreline retreat rates ranging from 1 to 4 meters per year (CPRA unpublished data). These marshes represent an important storm buffer to the city of New Orleans, and are also productive habitats for many fish and wildlife species, as evidenced by the 14,400 hectares incorporated into the Biloxi Wildlife Management Area. The water bottoms around the Biloxi Marshes contain extensive areas of low-relief oyster shell cultch, which supports one of the most productive oyster stocks in Louisiana (Figure 3) (LDWF 2013). Spawning oysters from these grounds and nearby oyster seed grounds and bioengineered oyster reef projects (e.g. the Nature Conservancy's Lake Fortuna and Eloi Bay reefs, and CPRA's pending Living Shoreline Protection Demonstration project) should provide ample larvae to facilitate development of the Biloxi Marsh Living Shoreline project (Figure 3). Once established, the Biloxi Marsh Living Shoreline project could enhance the productivity of local oyster stocks. This is particularly important considering the Biloxi Marsh area is less prone to Mississippi River flooding events that impact oyster grounds in nearby Breton Sound (Soniat et al. 2013). The Biloxi Marsh reefs, therefore, could supply recruits to expedite recovery of flood-damaged oyster grounds, as well as other nearby reefs affected by natural and anthropogenic disturbances, thus improving the resiliency of the system as a whole.

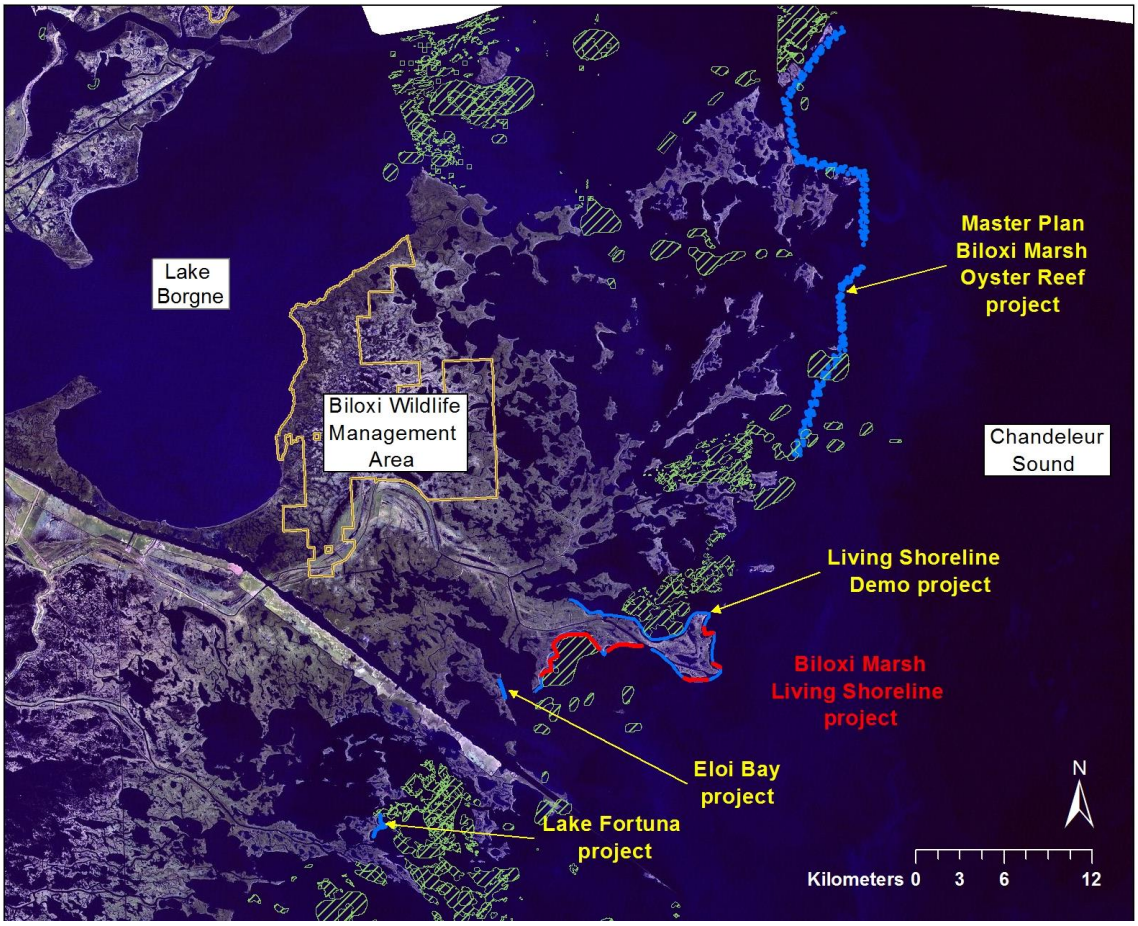


Figure 3. Location of the proposed Biloxi Marsh Living Shoreline project and other constructed and planned bioengineered oyster reef projects. Red line segments indicate the shoreline reaches addressed by the Biloxi Marsh Living Shoreline project; green-hatched polygons represent known oyster cultch and reefs surveyed by LDWF.

2. Implementation Methodology

The Biloxi Marsh Living Shoreline project will be constructed by mechanically placing a manufactured product, or suite of products, just off the shoreline to create a living breakwater structure. The products may consist of concrete, plastic mesh, steel rebar, limestone, oyster shells, and/or concrete admixtures. These living breakwaters will be placed at the -2.0' contour, and extend offshore. The width of the living breakwaters can vary depending on manufactured product and wave conditions. The target height for the living breakwaters is mean water level. A mechanical dredge will be used to provide access and flotation to the project area. The project area is located along the shoreline of Eloi Bay and Eloi Point, near the mouth Bayou la Loutre.

3. Monitoring & Adaptive Management

CPRA and collaborators collect a variety of data, both programmatic and project-specific, in support of coastal protection and restoration projects and activities. These data can support

various aspects of the project from strategic planning, construction, operations, maintenance and adaptive management. These data typically include but are not limited to hydrographic (e.g., water level, water quality, salinity), bathymetric and topographic (e.g., above and below water surface land elevations including erosion, land loss/gain, accretion), geotechnical (e.g., soil analysis and mechanics), geophysical (e.g., seismic, sidescan sonar), biological (e.g., fish and wildlife, vegetation), and photographic (aerial and satellite imagery). Specifically, CPRA has several ongoing coast-wide and programmatic data collection systems for program evaluation and facilitation. The Coastwide Reference Monitoring System-Wetlands (CRMS) contains 390 sites that enable ecological assessments at the project, basin, and ecosystem level based on the collection of hydrographic data, forested swamp and herbaceous marsh vegetation data, accretion, surface elevation, and soil properties data. The Barrier Island Comprehensive Monitoring Program (BICM) began in 2006 to provide long-term data on the barrier islands of Louisiana that could be used to plan, design, evaluate, and maintain current and future barrier island restoration projects. The BICM program uses both historical and newly acquired data to assess and monitor changes in the aerial and subaqueous extent of islands, habitat types, geotechnical properties, environmental processes, and vegetation composition. BICM datasets included aerial still and video photography for shoreline positions, habitat mapping, and land loss; light detection and ranging (Lidar) surveys for topographic elevations; single-beam and swath bathymetry; and sediment grab samples. To manage sediment resources for coastal restoration projects the Louisiana Sand/Sediment Resource Database (LASARD) has been developed to identify and maintain geological, geotechnical, and geophysical data for marsh creation and barrier island projects. CPRA is currently working with the Water Institute of the Gulf to more fully develop a System-Wide Assessment and Monitoring Program (SWAMP) that will bring these monitoring and assessment programs under one comprehensive umbrella in an effort to avoid duplication and improve efficiency.

Managing complex environments in which the natural and socio-economic systems are highly integrated is inherently difficult. In addition, deltaic environments are uniquely challenged due to the interdependence and delicate balance of water, land and economic systems and future uncertainties regarding the magnitude and rate of climate change impacts. Adaptive management in deltaic environments is a relatively recent science and encourages the integrated and flexible approach to land and water management that considers risk and uncertainty. It promotes solutions that are sustainable even if conditions change by providing a mechanism for robust decision making. Connecting short-term investments with long-term challenges and the selection of action paths that allow for maximum flexibility of future decisions are two of the key concepts of "Adaptive Delta Management" (Delta Alliance 2014). Historically, as human developments evolved in deltas, decisions were made that cannot be easily changed (such as the location of New Orleans). This results in some "path dependency", meaning that future options are limited or constrained by past decisions. However, learning from past decisions and understanding the range of possible future scenarios will allow us to avoid these constraints in the future by using "adaptation pathways" to make decisions that allow for maximum future flexibility (Delta Alliance 2014; Haasnoot 2013). As new techniques and projects for restoration and risk reduction are being developed, there exists an opportunity for learning how the system will respond to the coastal protection and restoration program implementation and using that learning to improve future program management decisions. Adaptive management provides a structured

process for making decisions over time through active learning and enables adjustments in program implementation as new information becomes available. Adaptive management embraces a scientific approach that involves identifying explicit goals and objectives, developing and implementing management actions, assessing the system's response to the action(s), and then using that knowledge to make management decisions. It is designed to be iterative, allowing for the incorporation of new knowledge through every step of the process (The Water Institute of the Gulf 2013).

Due to the complexity of CPRA's program, the uncertainty in future environmental conditions, and the "future without action" prognosis, CPRA's adaptive management strategy is complex. Project and program assessment, communication, and feedback loops are critical to CPRA's adaptive management strategy and affect every step in project and program implementation. Therefore, supporting efforts, such as focused applied research, science advisory boards, and modeling tool development are critical. CPRA's Adaptive Management Strategy streamlines the implementation of the Master Plan and maximizes its long-term benefits by institutionalizing the learning process, providing a process for resolving uncertainties and integrating new knowledge into the construction and operations of projects, and providing adaptation pathways to allow maximum flexibility for future management decisions.

4. Measures of Success

The Biloxi Marsh Living Shoreline project will be deemed successful if monitoring shows that it reduces shoreline recession and supports oyster recruitment and survival such that the reefs are self-sustaining. At the project-scale, performance measures will track the progress towards meeting management goals and objectives. When monitored over time, performance measures can help reduce uncertainty surrounding predictive models and inform whether intended results are being achieved or if additional actions are needed to fulfill program expectations. In addition, performance measures can also be used to inform the public of the system's response to management actions. Defining the health of a system is inherently complex, however, and requires a systematic approach to develop a manageable list of metrics that can be quantified and monitored over time (The Water Institute of the Gulf, 2013).

CPRA is currently working with the Water Institute of the Gulf to more fully develop a System-wide Assessment and Monitoring Program (SWAMP) that will bring existing monitoring and assessment programs under one comprehensive umbrella in an effort to avoid duplication and improve efficiency. SWAMP is envisioned to be a scalable program that will allow for data assessments to be completed at the project-, basin-, and program-scales. Individual projects will generate monitoring plans which will nest within the larger SWAMP framework and will allow for periodic assessment of project performance against performance expectations. Concurrent with this effort, existing monitoring programs, such as CRMS and BICM are being incorporated into the SWAMP design framework, and projects that require monitoring strategies are being informed and nested within this overall framework. That is not to say that some projects will not require additional monitoring to supplement SWAMP; however, SWAMP will provide the backbone to facilitate comprehensive programmatic performance assessment.

5. Risks & Uncertainties

The largest single environmental uncertainty in planning and implementing restoration projects in south Louisiana is accounting for the potentially high, and highly variable, rates of relative sea level rise (RSLR). For shoreline protection projects, maximum ecological benefits require that placed protection elements (e.g. rip-rap) maintain their elevation relative to mean sea level. Underestimating RSLR can result in infrastructure that sinks below supra-tidal elevations earlier than intended. In contrast, overestimating RSLR can result both in the overspending of limited funds during construction and in excessive infrastructure being placed.

Uncertainty exists for both future changes in the water level of the Gulf of Mexico (regional) and subsidence components of RSLR. CPRA believes that it has made prudent assumptions of future regional sea levels, independent of subsidence, consistent with the scientific literature. CPRA also has a spatially-variable map of predicted subsidence rates that was developed for the 2012 Coastal Master Plan following the convening of an expert workgroup. Geographically-specific subsidence values derived from that map have since been shown to be consistent with calculated subsidence inferred from tide gauge observations.

An additional component of predicted and realized soil settlement is the geotechnical stability of the underlying native soils, which can vary substantially across the coast. This is especially important for shoreline protection projects where placed protection elements need to maintain relative elevation. Planning for this project has advanced to the point where geotechnical analyses and nominal wave dynamics have been determined. At this point other practical uncertainties governing construction planning, such as the presence of pipelines and/or cultural resources in the project area, which might reduce project construction feasibility, have not been confirmed.

Initial work on this project investigated up to nine technologies for shoreline protection onto which it is assumed that oyster spat will settle and establish viable populations. Although that list has been winnowed down to a short list of five candidate technologies, it is uncertain at this point which technology will be used in which location. The actual spat settlement performance of whichever product is used in a particular shoreline reach is also going to be dependent on the regional oyster population providing spat and the local hydrodynamics being conducive to supply that spat to the project areas.

The initial engineering and design that has been conducted for the CIAP-funded portion of this project evaluated the ability of the candidate reef-base technologies to withstand the surge associated with a Category 1 hurricane. The ability of each technology to withstand stronger storms is still in question.

6. Outreach & Education

CPRA established a strategic outreach and engagement framework for the Coastal Master Plan that helped to guide communications and interactions with diverse audiences throughout the planning process. These audiences include key citizen groups and organizations, non-governmental organizations, local and State officials, business groups and the general public. CPRA's outreach and engagement framework provides a variety of ways for stakeholders and citizens to learn about and participate in the master planning process, including small group gatherings, web offerings, direct communication with local and State government, and through monthly public meetings.

A successful restoration project is built on local knowledge, input from a diverse range of coastal stakeholders, and extensive dialogue with the public. We continue to reach out to the public in new ways to better share information on increasing flood risk and CPRA restoration and protection projects. Having a strong outreach and engagement component in the Louisiana's coastal program provides long-term benefits and will positively impact the future of coastal restoration and protection planning. CPRA is committed to engaging stakeholders and citizens in the effort to ensure their voices are heard and their input is incorporated.

People from all walks of life have rallied around the 2012 Coastal Master Plan, recognizing that we must embrace bold solutions if we are to tackle the crisis that has gripped our coast for so long. A poll conducted by the National Audubon Society showed that Louisiana voters feel strongly that our state's coastal areas and wetlands are crucial to save. Specifically, 86% of Louisiana voters supported adoption of the 2012 Coastal Master Plan and 98% of coastal voters felt that Louisiana's coastal areas and wetlands are "very important" to the state's future.

The solutions presented in the Coastal Master Plan and through these projects will preserve our nation's energy and economic security, restore the health of the gulf region, and support a bright and safe future for all coastal residents. Louisiana is committed to maximizing its investment in oil spill recovery activities by implementing restoration projects that are consistent with the Coastal Master Plan and have been through a transparent and robust public engagement process.

Below are additional details on current outreach and engagement opportunities CPRA provides.

CPRA Board Monthly Public Meetings
The CPRA Board holds monthly meetings to provide the public with updates related to projects, programs, and policies. A public comment period is included at the close of each monthly meeting allowing the opportunity for citizens to ask questions or provide comments for the record.

CPRA staff regularly attends these meetings and are available before and after to discuss agency initiatives with members of the public. Meeting details, including itemized agendas, are posted to CPRA's online calendar which is located at www.coastal.la.gov.

National Environmental Policy Act / Permitting Project-Specific Opportunities
Throughout project development there are a number of project-specific opportunities for public engagement and comment incorporated into the National Environmental Policy Act (NEPA) and permitting processes.

Community Meetings
As the project progresses, the state will be available to meet with local groups and leaders to provide information. CPRA also has staff available to meet with citizens in smaller groups, so that we can answer questions and share updates. To request a meeting on the status of this project or to be added to our mailing list, please send an email to: Coastal@LA.gov.

7. Leveraging of Partnerships

CPRA has a variety of resources and partnerships with which it is able to leverage for the benefit of this project. Through the Coastal Master Plan, CPRA is able to apply the integrated suite of Predictive Models and Planning Tool, a science-based decision support system developed for the Master Plan, to work towards the RESTORE objectives of habitat protection and restoration. SWAMP will bring the previously described CRMS-*Wetlands*, BICM, and LASARD monitoring and assessment programs together into one framework in an effort to avoid duplication, improve efficiency, and provide the data needed to perform programmatic performance assessments.

As this project originally began as a CIAP project, CPRA is able to leverage the initial engineering and design that has been conducted for the CIAP-funded portion of the project which was to evaluate the ability of the candidate reef-base technologies to withstand the surge associated with a Category 1 hurricane. The CPRA Biloxi Marsh Living Shoreline project will build on this knowledge and that of the CWPPRA Terrebonne Bay Shore Protection Demonstration project that has evaluated different types of engineering structures and their effectiveness for reducing shoreline recession and enhancing local oyster production. In addition to these resources, this project has the benefit of being located adjacent to the complementary CIAP Living Shoreline Demonstration project as well as the Nature Conservancy's Lake Fortuna and Eloi Bay reef projects, as shown in Figure 3.

8. Proposal Project Benefits

The Biloxi Marsh Living Shoreline Project will control shoreline erosion and thus protect and preserve valuable marsh habitats in the Biloxi Marsh area. These marshes are critical habitat for a wide range of commercially- and recreationally-important fish and wildlife species, including shrimp, crab, finfishes, alligator, ducks, and furbearing mammals. The importance of these marshes is underscored by incorporation of a large area (approximately 14,400 hectares) into the Biloxi Wildlife Management Area. The Wildlife Management Area and surrounding wetlands are popular locations for hunting, fishing, and bird and wildlife watching; activities which are critically important to the region's economy. Southwick and Associates (2008) found that hunting, fishing, boating, and wildlife viewing and photography had a total economic effect of

$6.75 billion (including direct, indirect, and induced economic impacts) and supported a total of 76,700 jobs.

The oyster reefs created by the project should greatly benefit the region's oyster fishery. Louisiana is a national leader in oyster landings with annual values typically in excess of $35 million in dockside sales (Louisiana Department of Wildlife and Fisheries (LDWF 2013). Furthermore, the oyster industry alone has a total economic effect of $317 million and supports a total of 3,565 jobs (Southwick and Associates 2008). Though the created oyster reefs are unlikely to be harvested directly, they should provide a valuable seed source to replenish nearby harvested public and privately-leased oyster grounds, which support one of the most productive oyster stocks in Louisiana (LDWF 2013).

The shell reefs created by oysters provide unique, structurally-complex habitat that supports distinct and diverse aquatic communities, functions as nursery habitat for many fish and shellfish species, and enhances local productivity (Soniat et al., 2004; Plunket and La Peyre 2005; Schyphers et al. 2011). Because these reefs provide abundant and concentrated prey resources, they are valuable foraging sites for transient, predatory fishes such as flounder, drum, and speckled trout (Plunket and La Peyre 2005; Schyphers et al. 2011). For this reason, oyster reefs are frequently targeted by anglers. Consequently, this project also should enhance the recreational fishing industry and the economy it supports.

In addition to the benefits to fish and wildlife resources, the Biloxi Marsh Living Shoreline project, is expected to contribute to improving water quality. Because oysters filter large volumes of water daily to feed, they remove significant amounts of nitrogen, phosphorus, and carbon incorporated into phytoplankton biomass (Wall et al. 2011). It has been estimated that oysters raised in an aquaculture operation may remove up to 378 kg of total nitrogen, 54 kg of total phosphorus, and 10,934 kg of total carbon per hectare by the time they reach market-size (Higgins et al. 2011). Thus, oysters can significantly mitigate nutrient loading and help reduce eutrophication and hypoxia along the northern Gulf of Mexico.

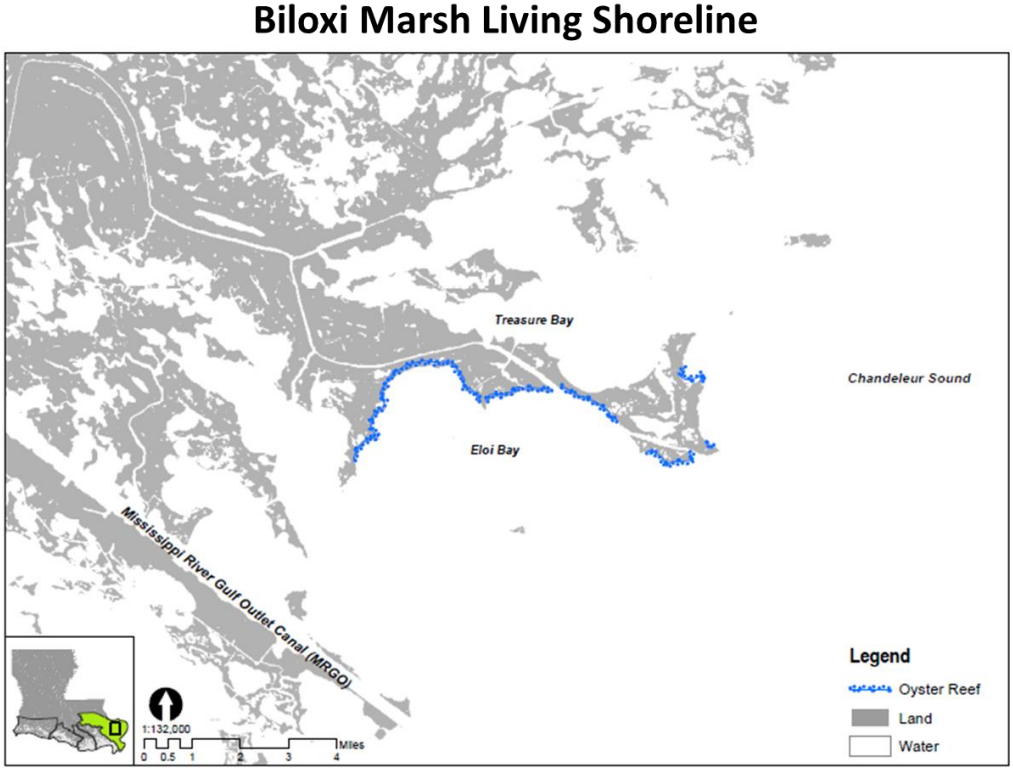
Land loss and flooding risks are changing the way people live, work, and do business throughout Louisiana's coast. The projects in the 2012 Coastal Master Plan are intended to prevent the environmental and economic collapse that will occur if land loss continues and these projects also provide an opportunity to create jobs through a new restoration economy.

Several recent studies have examined how coastal restoration measures will help Louisiana's working coast. A common theme in these studies is how readily coastal restoration and protection efforts create jobs. A recent LSU/Louisiana Workforce Commission study (Louisiana Workforce Commission 2011) found that the $618 million spent by the state in 2010 on coastal restoration created 4,880 direct jobs and an additional 4,020 indirect and induced jobs, for a total impact of 8,900 Louisiana jobs. The spinoff benefits of these jobs were considerable; the study estimated that the state's initial investment in 2010 created more than $1.1 billion in sales. Louisiana's annual investment in coastal restoration alone is expected to be between $400 million to $1 billion, which would translate into 5,500 and 10,300 total jobs, $270-$520 million in wages, and between $720 million and $1.35 billion in total sales per year.

Duke University's Center on Globalization, Governance & Competitiveness (2011) found that Louisiana is already a national leader in the creation of coastal restoration jobs, with the highest concentration of related business headquarters in the Gulf. According to this study, restoration jobs spur investments and jobs in a range of sectors including shipbuilding, equipment repair, and manufacturing. The Duke study emphasized that to expand this job creation engine, Louisiana would need to maintain a steady investment in restoration efforts so that relevant firms will have an incentive to scale up their investments. A third study by Restore America's Estuaries (Restore America's Estuaries 2011), which looked at restoration efforts nationwide, found that restoring our coasts can create more than 30 jobs for each million dollars invested. This is more than twice as many jobs per dollars invested as is gained by the oil and gas and road construction industries combined. Further, the study found that investing in restoration provides long lasting benefits to local economies, such as higher property values, better water quality, sustainable fisheries, and increases in tourism dollars.

Since 2007, the State has made unprecedented investments in our coast, and the Coastal Master Plan builds on this momentum. The projects outlined here strike a balance between providing immediate relief to hard hit areas and laying the groundwork for the large scale projects that are needed if we are to protect communities and sustain our landscape into the future.

IV. Location Information



V. Budget Narrative

Biloxi Marsh Living Shoreline	
Phase I	
Engineering & Design / Permitting	$2,995,777
Phase I Adaptive Management	$224,683
TOTAL PHASE I COST ESTIMATE	**$3,220,460**
Phase II	
Estimated Construction Cost	$50,696,996
Phase II Adaptive Management	$3,802,275
TOTAL PHASE II COST ESTIMATE	**$54,499,271**
TOTAL ESTIMATED PROJECT COST	**$57,719,731**

*The cost estimate for the project may be affected by change in project features, adjustment of quantities, or change in industry prices prior to bid openings.

The total estimated cost for the Biloxi Marsh Living Shoreline project is $57,719,731. Of this total project cost, CPRA is requesting $3,220,460 in RESTORE funds to see this project through Phase I of engineering and design and permitting. Due to the extensive work already performed for the 2012 Coastal Master Plan, CPRA has completed the necessary high level planning exercises for this project. The requested $2,995,777 for the engineering and design and permitting line item includes all of the expected permitting, land rights, engineering and design, and state supervision and administration project needs. In addition to these dollars, CPRA is requesting $224,683 for Adaptive Management purposes in order to effectively manage resources and monitor complex environmental conditions to ensure the project's success and reduce foreseeable risks and uncertainties to the utmost, most feasible extent. Therefore, to build upon CPRA's experience and existing capacity, CPRA is requesting a total of $3,220,460 in RESTORE funds for the Biloxi Marsh Living Shoreline project.

VI. Environmental Compliance Checklist (Appendix B)

Gulf Coast Ecosystem Restoration Council
Environmental Compliance Checklist

Please check all federal and state environmental compliance and permit requirements as appropriate to the proposed project/program

Environmental Compliance Type	**Yes**	**No**	**Applied For**	**N/A**
Federal				
National Marine Sanctuaries Act (NMSA)				X
Coastal Zone Management Act (CZMA)		X		
Fish and Wildlife Coordination Act		X		
Farmland Protection Policy Act (FPPA)				X
NEPA – Categorical Exclusion				X
NEPA – Environmental Assessment		X		
NEPA – Environmental Impact Statement	X			
Clean Water Act – 404 – Individual Permit (USACE)		X		
Clean Water Act – 404 – General Permit(USACE)				X
Clean Water Act – 404 – Letters of Permission(USACE)				X
Clean Water Act – 401 – WQ certification		X		
Clean Water Act – 402 – NPDES				X
Rivers and Harbors Act – Section 10 (USACE)		X		
Endangered Species Act – Section 7 – Informal and Formal Consultation (NMFS, USFWS)	X	X		
Endangered Species Act – Section 7 - Biological Assessment (BOEM,USACE)	X	X		
Endangered Species Act – Section 7 – Biological Opinion (NMFS, USFWS)	X			
Endangered Species Act – Section 7 – Permit for Take (NMFS, USFWS)				X
Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) – Consultation (NMFS)	X	X		
Marine Mammal Protection Act – Incidental Take Permit (106) (NMFS, USFWS)				X
Migratory Bird Treaty Act (USFWS)	X	X		
Bald and Golden Eagle Protection Act – Consultation and Planning (USFWS)	X	X		
Marine Protection, Research and Sanctuaries Act – Section 103 permit (NMFS)				X
BOEM Outer Continental Shelf Lands Act – Section 8 OCS Lands Sand Permit				X
NHPA Section 106 – Consultation and Planning ACHP, SHPO(s), and/or THPO(s)	X	X		
NHPA Section 106 – Memorandum of Agreement/Programmatic Agreement	X			
Tribal Consultation (Government to Government)	X			
Coastal Barriers Resource Act – CBRS (Consultation)				X
State				
As Applicable per State		X		

Biloxi Marsh Living Shoreline

RESTORE Proposal
Coastal Protection & Restoration Authority

A portion of the Biloxi Marsh Living Shoreline is included in the U.S. Army Corps of Engineers New Orleans District (USACE NOD) Tentatively Selected Plan (TSP) for the Mississippi River Gulf Outlet (MRGO) Ecosystem Restoration Project. The Environmental Impact Statement (EIS) documents the features of the TSP, which includes swamp nourishment and restoration, marsh nourishment and restoration, shoreline protection, and ridge restoration and recommends three tiers for implementation. Artificial oyster reef alternatives proposed as shoreline protection for the Biloxi Marsh from Eloi Point to the south side of Bayou La Loutre consisted of 30,750 linear feet (5.8 miles) of three demonstration sections: 1) loose shells; 2) interlocking triangular structures; and 3) concrete rings with loose shells in the middle. Each alternative would create 2.5 miles of artificial oyster reef. The artificial oyster reefs for the Biloxi Marsh were identified as feature BS-2 in Tier 1 and were recommended for construction contingent upon identification of a non-federal sponsor.

CPRA is utilizing CIAP funds to design and construct a small portion of a larger 21-mile shoreline protection project called the Living Shoreline Demonstration Project. A pre-application meeting was held on October 21, 2014 with the Louisiana Department of Natural Resources Office of Coastal Management (LDNR OCM), Louisiana Department of Wildlife and Fisheries (LDWF), NOAA's National Marine Fisheries Service (NMFS), and the State Historic Preservation Office. The project, as proposed, is a demonstration project to test the effectiveness of different types of artificial oyster reef products placed to reduce shoreline erosion from wave attenuation in this portion of the Biloxi Marsh.

Coastal Zone Management Act

A Coastal Use Permit is required for this project. CPRA intends to submit an application specifically for the Biloxi Marsh Living Shoreline project as part of the larger 21-mile CIAP Living Shoreline Demonstration project.

Clean Water Act – 404 – USACE/Rivers and Harbors Act – Section 10 (USACE)

CPRA has not yet submitted the Joint Coastal Use Permit application specifically for the CIAP Living Shoreline Demonstration Project.

NEPA – Environmental Assessment

USACE NOD Regulatory Branch will complete an Environmental Assessment specifically for the CIAP Living Shoreline Demonstration Project during the public interest review of permit application.

NEPA—Environmental Impact Statement

USACE Civil Works published a Notice of Intent (NOI) to prepare an EIS for MRGO Ecosystem Restoration in the Federal Register on October 2, 2008. As proposed, the plan would include: "(1) physically modifying the MRGO channel and restoring the areas affected by the channel; (2) restoring natural ecosystem features to reduce damage from storm surge; (3) measures preventing saltwater intrusion into the waterway; (4) measures protecting, restoring or increasing wetlands to prevent saltwater intrusion or storm surge; (5) measures reducing risk of storm damage to communities by preventing or reducing wetland losses or restoring wetlands in

areas affected by navigation, oil and gas and other manmade channels; (6) diversions to restore the Lake Borgne ecosystem."

The Draft EIS availability for public review was published in the Federal Register on December 10, 2010 with a closing date of January 31, 2011; the public review/comment period was extended to March 5, 2011. The Final EIS was made available for public review/comment on June 22, 2012. A Record of Decision was signed on September 28, 2012.

Appendices for the Final EIS can be viewed at
http://www.mrgo.gov/ProductList.aspx?ProdType=study&folder=1717

Endangered Species Act – Section 7 – Informal and Formal Consultation (NMFS, USFWS)
Consultation with USFWS and NMFS specifically for the CIAP Living Shoreline Demonstration and Biloxi Marsh Living Shoreline projects will be initiated through the joint LDNR OCM – USACE public notice on the permit application.

Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) – Consultation (NMFS)
Consultation with NMFS for the CIAP Living Shoreline Demonstration and Biloxi Marsh Living Shoreline projects in regard to EFH will be initiated through the joint LDNR OCM – USACE public notice on the permit application.

USACE NOD consulted with NMFS on EFH for the MRGO Ecosystem Restoration Project. The EIS prepared for the MRGO Ecosystem Restoration Project documented the direct, indirect, and cumulative impacts of the projects to EFH.

Migratory Bird Treaty Act (USFWS)
Consultation with USFWS in regard to migratory birds specifically for the CIAP Living Shoreline Demonstration and Biloxi Marsh Living Shoreline projects will be initiated through the joint LDNR OCM – USACE public notice on the permit application.

Bald and Golden Eagle Protection Act – Consultation and Planning (USFWS)
Consultation with USFWS in regard to bald and golden eagles specifically for the CIAP Living Shoreline Demonstration and Biloxi Marsh Living Shoreline projects will be initiated through the joint LDNR OCM – USACE public notice on the permit application.

NHPA Section 106 – Consultation and Planning ACHP, SHPO(s), and/or THPO(s)
Three previously recorded archaeological sites are located along the shoreline of the Biloxi Marsh Living Shoreline Project. CPRA initiated consultation with SHPO specifically for the CIAP Living Shoreline Demonstration Project at the pre-application meeting held on October 21, 2014. USFWS is the lead federal agency through the CIAP Program and will consult with SHPO in regard to the effect of the CIAP Living Shoreline Demonstration Project on cultural resources.

NHPA Section 106 – Memorandum of Agreement/Programmatic Agreement
As part of the MRGO Ecosystem Restoration project, USACE executed a Programmatic Agreement with the Advisory Council on Historic Preservation, SHOP, the Chitimacha Tribe of Louisiana, and the Jena Band of Choctaw Indians. The PA lays forth the process for the identification of historic properties, assessment of project effects, and resolution of any adverse effects.

Tribal Consultation (Government to Government)
USFWS, as the lead federal agency for the CIAP Living Shoreline Demonstration Project, will undertake consultation with Federally-recognized tribes.

As part of the MRGO Ecosystem Restoration Project, USACE consulted with Federally-recognized tribes. USACE consulted the Coushatta Tribe of Louisiana, the Quapaw Tribe of Oklahoma, the Seminole Tribe of Louisiana, the Alabama Coushatta Tribe of Texas, the Caddo Nation of Oklahoma, the Seminole Nation of Oklahoma, the Mississippi Band of Choctaw Indians, the Chitimacha Tribe of Louisiana, the Choctaw Nation of Oklahoma, the Jena Band of Choctaw Indians, and the Tunica-Biloxi Tribe of Louisiana.

VII. Data / Information Sharing Plan

Introduction
CPRA has for over a decade made its coastal protection and restoration data and information widely available on the internet using a web-enabled, GIS-integrated system called SONRIS. Recently, ever growing responsibilities, an increase in data generation, and the need to deliver this information in a more timely and efficient manner have inspired an effort by the CPRA to significantly improve its data management and delivery capabilities. The first step was the development of a Data Management Plan in 2013 through a partnership with The Water Institute of the Gulf (The Water Institute of the Gulf, 2013). CPRA then partnered with the U.S. Geological Survey's National Wetlands Research Center (USGS) to produce the CPRA Coastal Information Management System (CIMS) in an effort to redesign and improve its data management and delivery capabilities. CIMS combines a network of webpages hosted by CPRA (www.coastal.la.gov), a GIS database, and a relational tabular database into one GIS-integrated system capable of robust visualizations and data delivery. Any data generated through this RESTORE project will be made available to the public as part of CPRA's ongoing efforts to share data and improve transparency. CPRA is committed to sharing information to help the public make science-based decisions.

Data Generation
CPRA and collaborators collect a variety of data, both programmatic and project-specific, in support of coastal protection and restoration projects and activities These data typically include but are not limited to hydrographic (e.g., water level, water quality, salinity), bathymetric and topographic (e.g., above and below water surface land elevations including erosion, land loss/gain, accretion), geotechnical (e.g., soil analysis and mechanics), geophysical (e.g., seismic, sidescan sonar), biological (e.g., fish and wildlife, vegetation), and photographic (aerial and

satellite imagery). Specifically, CPRA has several ongoing coast-wide and programmatic data collection systems for program evaluation and facilitation. The Coast-wide Reference Monitoring System-Wetlands (CRMS) contains 390 sites and several thousand ecological monitoring stations that enable ecological assessments at the project, basin, and ecosystem level. These stations collect hourly hydrographic data, forested swamp and herbaceous marsh vegetation data, accretion, surface elevation, and soil properties data. The Barrier Island Comprehensive Monitoring Program (BICM) began in 2006 to provide long-term data on the barrier islands of Louisiana that could be used to plan, design, evaluate, and maintain current and future barrier island restoration projects. The BICM program uses both historical and newly acquired data to assess and monitor changes in the aerial and subaqueous extent of islands, habitat types, geotechnical properties, environmental processes, and vegetation composition. BICM datasets included aerial still and video photography for shoreline positions, habitat mapping, and land loss; light detection and ranging (Lidar) surveys for topographic elevations; single-beam and swath bathymetry; and sediment grab samples. To manage sediment resources for coastal restoration projects the Louisiana Sand/Sediment Resource Database (LASARD) has been developed to identify and maintain geological, geotechnical, and geophysical data for marsh creation and barrier island projects. The CPRA is currently working with the Water Institute of the Gulf to more fully develop a System-wide Assessment and Monitoring Program (SWAMP) that will bring these monitoring and assessment programs under one comprehensive umbrella in an effort to avoid duplication and improve efficiency.

Data Standards and Metadata

CPRA has an established Data Management Team (DMT) and is the primary contributor to the data system with additional data streams from federal and state agencies, universities and private contractors. CPRA has developed and documented policies, standard operating procedures, data conventions, and quality assurance/quality control procedures (QA/QC) for data collection of all data generated in support of the coastal protection and restoration program (Folse et al., 2012; BEM Systems, Inc. and Coastal Planning and Engineering, Inc., 2012; Coastal Protection and Restoration Authority of Louisiana, 2013). In conjunction with the development of the CIMS system, CPRA and USGS are developing and maintaining metadata for all CPRA data using Federal Geographic Data Committee (FGDC) standards.

Data Stewardship and Preservation

Data stewardship is provided by the CPRA DMT and associated consultants. Data integrity is checked with very detailed and complex QA/QC software routines prior to input into the database and additional automated routines when input into the database. Intensive use of data by CPRA staff and contractors who collect and input data into the database provide feedback on data quality and software routines to the CPRA DMT. Data preservation of the database is largely done through regular tape backup and/or cloud storage. All data and documents are kept in perpetuity.

Data Access and Security for Adaptive Management

The ability to learn from previous actions and to adaptively manage existing efforts is a critical step to improve the success of the State's coastal protection and restoration program. An important step in that process is sound data management that makes past data and information on

project and program effectiveness available to project planners, engineers, and scientists. Also of critical importance is making coastal protection and restoration program information readily available to interested parties outside of the CPRA. Academic researchers can use the data generated by the program to improve the science informing the decision-making process. The general public can use the information to understand how current and future program actions will affect their daily activities, which helps promote program transparency. To that end, the CPRA provides a web-based portal for all geospatial and tabular data and documents associated with coastal protection and restoration projects and for coast-wide programmatic data such as CRMS and BICM. In addition to background information on the State's coastal protection and restoration program, a wide variety of up-to-date information is available such as program documents, remote imagery, project information and boundaries, project infrastructure (including levees, floodwalls, and pump stations), monitoring station locations, elevation benchmarks, ecological data, geophysical data, and information on the State's coastal community resiliency program. Users are able to perform a wide range of custom data retrievals for refining and summarizing information. Private-facing aspects of CIMS include remote data upload and QA/QC by CPRA staff and contractors. Security is provided through Secure Socket Layers of username/password access and software assignment of roles that allows differential access to database functions.

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IX. Other

Letters of support.

November 14, 2014

Coastal Protection and Restoration Authority
c/o Mr. Jerome Zeringue, Chairman
Office of the Governor, Coastal Activities
Capitol Annex Building, Suite 138
Baton Rouge, Louisiana 70802

Re: Comments on the State of Louisiana Projects for the RESTORE Act Funded Priorities List; Biloxi Marsh Oyster Reef Project

Dear Coastal Protection and Restoration Authority members,

The undersigned groups appreciate this opportunity to share our collective supporting comments on the Biloxi Marsh Oyster Reef Project, submitted by the State of Louisiana for RESTORE Council consideration for the first Funded Priorities List of the RESTORE Pot 2 Council-selected projects.

We represent a coalition of conservation interests that have worked for decades to restore a healthy Gulf of Mexico ecosystem – starting with prompt restoration of the Mississippi River Delta – reconnecting the Mississippi River to its delta to protect communities, environment, and economies. Our groups continue to recommend urgent action on projects that will reduce land loss and restore wetlands in the Mississippi River Delta through comprehensive restoration actions that have the potential to provide multiple benefits and services over the long term to the entire Gulf of Mexico.

Most of the necessary restoration actions to be undertaken in Louisiana are already fully authorized under the Water Resources Development Act (WRDA) of 2007, were unanimously approved by the Louisiana legislature in the 2012 Coastal Master Plan, enjoy broad public support, and have been vetted by scientists and lawmakers for many years. In the case of the Biloxi Marsh Oyster Reef Project, it has a completed Programmatic EIS and a signed Chief's Report from the Corps of Engineers.

The Biloxi Marsh platform is relatively stable and enjoys a fairly low rate of subsidence; however, erosion on the marsh edge by wave action has resulted in significant loss of this wetlands habitat over time. Construction of an oyster barrier reef along the southern and eastern shores of the Biloxi Marsh will provide a natural protective barrier to reduce the damaging effects of storm surges and provide wave attenuation. In addition to providing protection against waves, oyster reefs also provide a myriad of ecosystem services including water quality enhancement and benefits to fish populations in both Breton Sound and Mississippi Sound.

Reestablishment of vertical oyster reefs in Biloxi Marsh, in conjunction with the reintroduction of small amounts of river water (River Reintroduction into Maurepas Swamp, Central Wetlands diversions), will

help slow marsh deterioration. Additionally, once established, unlike rock and other materials, these reefs are naturally self-maintaining.

Our groups support the development of the Biloxi Marsh Oyster Reef Project—and the concept of living shorelines in general—and commend the selection of this important "line of defense" by the Coastal Protection and Restoration Authority. We look forward to the construction of this project within the next few years as funding becomes available.

Sincerely,

Kim Reyher
Executive Director
Coalition to Restore Coastal Louisiana

Steve Cochran
Director, Mississippi River Delta Program
Environmental Defense Fund

John Lopez, PhD
Coastal Director
Lake Pontchartrain Basin Foundation

David Muth
Director
Mississippi River Delta Restoration Program
National Wildlife Federation

Doug Meffert
Executive Director/Vice President
Audubon Louisiana

Karen Gautreaux
Director of Governmental Relations
The Nature Conservancy of Louisiana

Rebecca Triche
Executive Director
Louisiana Wildlife Federation

cc: Kyle Graham, Director, CPRA Implementation Office

November 14, 2014

Coastal Protection and Restoration Authority
Attn: Jerome Zeringue, Chair
Coastal@la.gov

RE: *Letter of Support for Mississippi River Gulf Outlet (MRGO) Ecosystem Restoration Projects*

Dear Coastal Protection and Restoration Authority-

We are writing to express support for three projects to be submitted by the Coastal Protection and Restoration Authority (CPRA) to the Gulf Coast Ecosystem Restoration Council (Council) for Council-Selected Restoration Component (Bucket 2) funding. The projects include the River Reintroduction into Maurepas Swamp, the Biloxi Oyster Reef and the Golden Triangle Marsh Creation, all within the MRGO ecosystem restoration area, and all projects that will significantly contribute to the long-term sustainability of estuarine environment of southeast Louisiana and Mississippi.

The MRGO was a federal navigation channel that severely altered the hydrology of the region, destroying tens of thousands of acres of protective wetlands surrounding Greater New Orleans. It was singled out as a key factor in the catastrophic flooding that Hurricane Katrina caused in communities like the Lower Ninth Ward in New Orleans and communities like Arabi, Chalmette and Violet in St. Bernard Parish. Since 2006, the MRGO Must Go Coalition, representing 17 conservation and community organizations, has worked with local, state, and federal governments to advance planning and lay the groundwork for large-scale restoration of the MRGO area. **Over 76,000 members of the public commented in support of ecosystem restoration projects along the MRGO through the USACE MRGO ecosystem restoration planning process and the 2012 Louisiana State Master Plan planning process.**

The MRGO ecosystem restoration area, which covers 3.8 million acres, stretches from Lake Maurepas to Chandeleur Sound including Mississippi Sound and its bordering wetlands and barrier islands. Though impacted by the MRGO, it is a resilient wetland landscape that can continue to provide ecosystem services to the Gulf of Mexico marine and estuarine environments of Louisiana, Mississippi and Alabama. These same wetlands provide storm surge protection in communities in coastal Mississippi, New Orleans and around the entire perimeter of Lake Pontchartrain. In particular, the Biloxi Marsh and Maurepas Land Bridge were identified as a "critical landscape feature" by the Army Corps of Engineers (Corps LACPR study released in 2009) because of its importance in reducing storm surge.

The MRGO ecosystem restoration area incurred significant damage during the 2010 Deepwater Horizon disaster, with oil moving through Breton, Mississippi, and Chandeleur Sounds, resulting in shoreline oil reported in the Biloxi Marsh, Chandeleur Islands, and the New Orleans East Land Bridge. Wildlife death attributed to oiling occurred in these areas and beyond, including in Lake Pontchartrain itself and along the Lake Borgne Land Bridge.

- **Golden Triangle Marsh Creation Project**, located near the confluence of the MRGO shipping channel and the Gulf Intracoastal Waterway, is in an area badly damaged by the saltwater intrusion and erosion that followed the dredging of the MRGO. The restored marsh will help

buffer the newly constructed IHNC Surge Barrier, which is essential to the resilience and flood protection of communities in the Greater New Orleans area. This marsh creation will also provide important estuarine services for Lake Borgne and Mississippi Sound. The project has undergone technical analysis completed by the Corps and the State of Louisiana through the Mississippi River Gulf Outlet Ecosystem Restoration Plan authorized in WRDA 2007. The project has a signed Chief's Report and a completed Programmatic EIS.

- Erosion of the Biloxi Marsh by wave action has resulted in significant loss of the once productive habitat. The **Biloxi Oyster Reef Project** will reestablish vertical oyster reefs along the southeastern shore of the marsh and will help slow marsh deterioration. In addition to providing protection against waves and storm surge, oyster reefs also provide a broad range of other ecosystem and economic benefits. Once established, these reefs are naturally self-maintaining. This project also has a completed Programmatic EIS and a signed Chief's Report from the Corps.

- **River reintroduction into Maurepas Swamp** aims to restore freshwater flow from the Mississippi River that has been cut-off since the construction of the Mississippi River flood control levees and the closure of Bayou Manchac. The lack of freshwater, sediment and nutrient input has caused saltwater intrusion and lower productivity, enhancing net subsidence. Without restoration, one of the largest bald cypress swamps in the nation is threatened to convert to open water. Most of the preliminary feasibility and design work for the diversion has been completed and the Corps has just filed a Notice of Intent to prepare an Environmental Impact Statement (EIS) for the project. Once complete, the project is expected to maintain over 45,000 acres of land, southwest of Lake Maurepas, over the next 50 years.

These projects are primed for implementation and are all authorized in the 2012 Coastal Master Plan. They are also cornerstone projects to restoring a 6000 square mile estuary connected to the Gulf of Mexico, and all three projects will advance gulf-wide restoration of marine and estuarine services, while also contributing to community and economic resiliency. **Our Coalition believes that the Council should build on previous efforts by targeting these vital ecosystem restoration projects for immediate implementation funding.**

These projects are well-studied, mostly designed, and have enjoyed unprecedented public input and rigorous review over the past seven years since the passage of WRDA 2007. They are ready to move forward with final design and construction, and they meet all four Restoration Priorities found in the RESTORE Act.

The RESTORE Act provides a powerful opportunity to move these urgent projects forward and help remedy some of the damage incurred to the coastal ecosystem by the infamous MRGO.

Thank you for your work and please let us know how was can best help you in your efforts. Our member organizations represent millions of knowledgeable and capable individuals whose shared interest is the recovery of our precious wetlands and natural resources. Please contact Coalition coordinator, Amanda Moore, at moorea@nwf.org should you have any questions.

Sincerely,

MRGO Must Go Coalition

American Rivers
Citizens Against Widening the Industrial Canal
Coalition to Restore Coastal Louisiana
Environmental Defense Fund
Global Green
Gulf Restoration Network
Holy Cross Neighborhood Association
Lake Pontchartrain Basin Foundation
Levees.org
Louisiana Environmental Action Network
Louisiana Wildlife Federation
Lower Mississippi Riverkeeper
Lower Ninth Ward Center for Sustainable Engagement and Development
Mary Queen of Vietnam Community Development Corporation
National Audubon Society
National Wildlife Federation
Sierra Club – Delta Chapter

Additional Supporters:
Atchafalaya Basinkeeper
Orleans Audubon Society

Cc:
Justin Ehrenwerth
Executive Director
Gulf Coast Ecosystem Restoration Council

N. Gunter Guy
Commissioner
Alabama Department of Conservation and Natural Resources

Mimi Drew
NRDA Trustee
Former Secretary, Florida Department of Environmental Protection

Jerome Zeringue
Chair
Louisiana Coastal Protection and Restoration Authority

Gary Rikard
Executive Director
Mississippi Department of Environmental Quality

Toby Baker
Commissioner
Texas Commission on Environmental Quality

Robert Bonnie
Under Secretary for Natural Resources and Environment
Department of Agriculture

Jo Ellen Darcy
Assistant Secretary for Army (Civil Works)
Department of the Army

Ken Kopocis
Assistant Administrator for the Office of Water
Environmental Protection Agency

VADM John Currier
Vice Commandant of the Coast Guard
United States Coast Guard

Rachel Jacobson
Principal Deputy Assistant Secretary for Fish and Wildlife and Parks
Department of the Interior