

Appendix G1 – Adaptive Management

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Please note this is a working-draft document currently undergoing review and revision. The final version will be posted in March 2012 along with the final version of the 2012 Coastal Master Plan

1.1 Foreword

We cannot predict with complete certainty how the Louisiana coast will change under future conditions, with or without additional restoration and risk reduction projects. Adaptive Management has been defined as an integrated, multidisciplinary strategy for addressing uncertainties when dealing with natural resources (Walters 1986). The dynamic nature of the Louisiana coast requires that we use adaptive management to implement the projects recommended in the 2012 Coastal Master Plan using procedures or techniques that are flexible, agile, and based on the best available scientific, technical and social information, including modeling, monitoring, and assessment. Uncertainties abound with regard to long-term coastal planning and implementation. For example, coastal conditions change, our understanding of coastal processes change, and the amount of funding allocated to the coastal program may change. The Coastal Protection and Restoration Authority (CPRA) must be able to react and adjust its course to unforeseen challenges in a nimble and strategic way. A key to ensuring the most effective use of future state and federal investment to provide for a sustainable coast will be the development of an Adaptive Management Framework. The purpose of adaptive management is to ensure that CPRA systematically considers new information and changing performance of both environmental and social systems in response to project implementation, no actions and future disasters, and when necessary¹, makes appropriate adjustments to planning, designing, monitoring, operating, and implementing projects to ensure continued progress toward achieving master plan objectives. This document provides an overview of the approach that will be used to develop a programmatic Adaptive Management Framework during the initial stages of master plan implementation.

The CPRA Adaptive Management Framework will help to ensure that the master plan objectives are achieved by identifying a sequence of activities that guide adjustments to planning, designing, monitoring, operating, and implementing projects with a programmatic perspective of accomplishment over the next 50 years. The Adaptive Management Framework will integrate project design and construction with system level monitoring by creating a comprehensive strategy to identify lessons learned and linking activities within CPRA and across different state agencies. This framework will allow the coastal program to stay abreast of the latest science and technical information, and apply this knowledge to adjust and optimize the master plan. It will focus on integrating risk reduction and ecological restoration efforts with the institutional knowledge that is built through a strategic and program-wide learning process. By design, the Adaptive Management Framework will be a living document that is updated to reflect new understanding and information to improve the effectiveness and efficiency of the entire coastal program of Louisiana. In this way, CPRA intends to incorporate “adaptive learning” (changing sequential projects based on learning from prior projects) and true “adaptive management” (changing ‘within’ projects and their operation as they are evaluated).

¹ Performance measures will be identified as part of the Adaptive Management Framework.

The complexity and magnitude of master plan implementation requires the resources of the state to be organized and focused. The Adaptive Management Framework will be based around the five focus teams of the implementation strategy and identify roles and responsibilities for all aspects of the coastal program, and thus will be implemented throughout all the divisions of CPRA. The Adaptive Management Framework will also rely on collaborative partnerships with federal and local agencies, other state agencies, and research institutions to participate as members of the framework.

As pictured in Figure 1, the state will incorporate the Adaptive Management Framework into the current structures of the CPRA. The state has identified five key focus areas (program management, planning, research and development, policy and legal, and outreach and engagement) to deliver the program and maximize collaboration, coordination, and communication. Each of the five focus areas is instrumental to the successful implementation of the master plan, and key information “feedback loops” to the master plan and other coastal program efforts are essential.

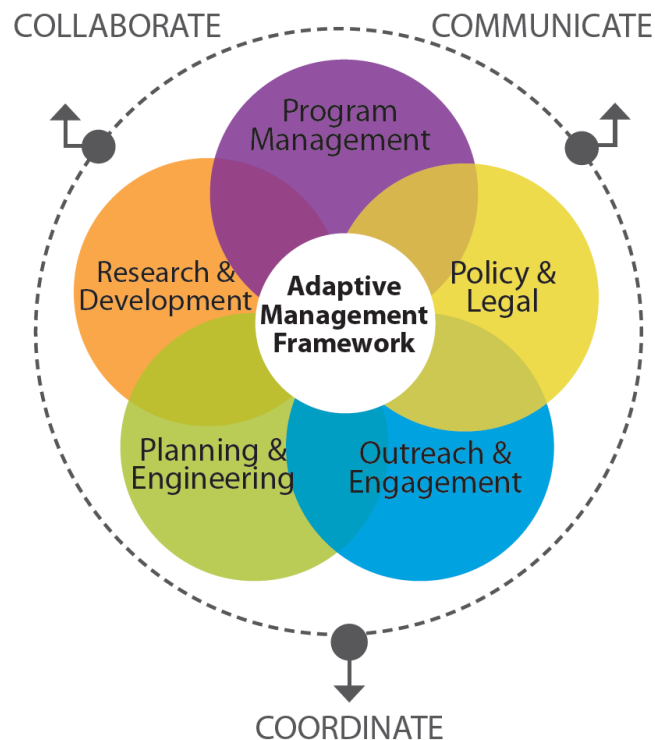


Figure 1: The state will organize the Adaptive Management Framework around the existing structure of CPRA for program management, planning, research and development, policy and legal, and outreach and engagement.

Note: This appendix does not describe all aspects of the fully developed Adaptive Management Framework. Instead, this document provides an overview of discrete actions that will be taken in the near-term towards the actual development and integration of an Adaptive Management Framework. The CPRA intends to develop a more complete and robust framework during the

next 12-24 months. It is envisioned that the Adaptive Management Framework would emulate adaptive management strategies already integrated and thriving in other large programs (e.g., CERP 2006, 2011). The Adaptive Management Framework will apply tenants of the 'best available science' such as those detailed in Van Cleve et al. 2004 in which characteristics of many large programs are described. The team will also consider reviews of large programs to identify best practices that seem to work as well as common pit-falls to beware of (NRC 2010). In its current form, this document represents the starting point for developing the programmatic Adaptive Management Framework. CPRA will continue fleshing out the details needed to support the final framework and it will be released in the near future. Annual updates will be provided in the Annual plans.

1.2 Introduction

To be effective, activities in an adaptive management framework should include the following (Williams et al. 2009):

- Engaging the relevant stakeholders in the decision making process.
- Identifying the problem(s) to be addressed.
- Specifying objectives and tradeoffs that capture the values of stakeholders.
- Accounting for future impacts of present decisions.
- Projecting the consequences of alternative actions.
- Identifying key uncertainties.
- Identifying the range of project alternatives from which actions are to be selected.
- Specifying assumptions about resource structures and functions and resource availability.
- Accounting for legal guidelines and constraints.
- Accounting for limited and widely variable funding sources into the future.
- Measuring the performance of various project alternatives.

The development of flexible alternatives improves the likelihood of success across a broad range of future conditions. By addressing uncertainty in all phases of planning, design, construction, operations and monitoring, built-in flexibility will help ensure efficient and effective restoration and risk reduction (Fischenich *et al* in press).

PRINCIPLES OF ADAPTIVE MANAGEMENT

1. Management flexibility is incorporated into the design and implementation of programs or projects.
2. Scientific information obtained through continued monitoring is used to evaluate and manage uncertainties to achieve desired goals and objectives.
3. Scientific information is introduced into the decision-making process and guides managers during and after project implementation.
4. Projects and programs can be implemented in phases to allow for course corrections based on new information.
5. Interagency collaboration and productive stakeholder participation are key elements to success.

Fischenich *et al.* in press

CPRA views adaptive management as a key component of its overall implementation strategy for the master plan. Adaptive management practices associated with the master plan projects must also be factored in with adaptive management applications for all projects previously constructed in coastal Louisiana. This document details a process to guide system level analysis required for a comprehensive learning environment while moving the coastal program forward, and it details initial tasks that will be used to develop the programmatic Adaptive Management Framework. The programmatic framework will not only focus on the master plan efforts, but will also incorporate all aspects of the broader coastal program in Louisiana, from implementation to policy to outreach and engagement. This approach to adaptive management aims to incorporate lessons learned and feedback loops not only for landscape system response and projects on the ground, but also from social and policy responses to our actions. The programmatic framework will also encompass individual project-level adaptive management actions such as the LCA Small Diversion at Convent/Blind River Monitoring and Adaptive Management Plan (USACE, in prep).

Elements of the Adaptive Management Framework

Adaptive management is a collection of activities (e.g., data gathering, modeling, communicating with stakeholders, etc.) and decision-making criteria that will continue during the near- and long-term implementation of the master plan. Adaptive management addresses three important elements to successfully implement execution of a complex plan that will extend far into an uncertain future.

- **Contingency Planning**: This is intended to systematically address potential challenges for the plan or parts of the plan, and identify actions that can be taken to mitigate limitations to program development. Potential challenges include but are not limited to changing coastal conditions (e.g., subsidence), systems response to multiple projects, and legal/policy constraints or social acceptance that limits our ability to implement the plan.

- **Measurement of Progress:** The implementation of the master plan will require a structured approach to monitor and report on key performance metrics that evaluate whether the master plan is achieving its objectives.
- **Systematic Use of New Information:** The adaptive learning component of adaptive management is science-based and thus also a way to improve learning by understanding how the coastal system, including both environmental and social components, is responding to project implementation. Analytical tools, design criteria, and decision making alternatives by synthesizing and incorporating new information and knowledge into analytical.

Understanding the complexities of the Louisiana coast requires the work of experts and stakeholders from many disciplines, and it requires CPRA to continually monitor its work. Ongoing studies, like the Mississippi River Hydrodynamic and Delta Management Study will provide critical information for this implementation effort. Independent research institutions, such as the Water Institute of the Gulf, in conjunction with other research, academic and engineering institutions could provide a high level of expertise to build the knowledge needed to support quality project performance.

CPRA is committed to developing a programmatic Adaptive Management Framework that will incorporate all aspects of the coastal program to support and enhance master plan efforts as well as the broader coastal program. The overall goal of the Adaptive Management Framework is to ensure that the master plan objectives are achieved by guiding adjustments to planning, policy and implementation over the next 50 years. Details regarding how the Adaptive Management Framework will integrate monitoring, predictive models, research, report cards, stakeholder feedback, and other components to evaluate CPRA's coastal program are forthcoming in later versions of this document.

Key Commitments

The state understands a high level of commitment is needed to be successful with the Adaptive Management Framework. The benefit is a better understanding of the interactions between similar projects, as well as the interactions of restoration and protection projects.

- The state is committed to developing and implementing a programmatic Adaptive Management Framework in coordination with coastal experts, agency personnel and key stakeholders.
- The state is committed to fully evaluating project synergies and conflicts through a systems monitoring and modeling approach.
- The state is committed to investing in a comprehensive repository of modeling tools that can continue to be refined and updated as additional data and information is gained.
- CPRA is committed to both short-and long-term planning efforts to support individual projects (project management support) as well as the program (i.e., support of feasibility studies, nonstructural program development, annual plans, and ongoing master plan efforts).

- The state is committed to providing updates on the Adaptive Management Framework in the CPRA Annual Plans.

1.3 Developing an Adaptive Management Framework

To successfully build an Adaptive Management Framework, input is needed from key experts, partners and constituents. This document represents the beginning stages of that framework, and CPRA proposes to continue refining the framework over the next 12 to 24 months, building on past adaptive management efforts such as the draft adaptive management framework drafted for the Louisiana Coastal Area program (Steyer et al. 2004), and incorporating new aspects of the coastal program to achieve a programmatic Adaptive Management Framework. CPRA intends to sequence development of the framework into two phases: 1) Adaptive Planning and 2) Adaptive Implementation. Adaptive Planning will catalog lessons learned from the development of the 2012 Coastal Master Plan and identify a strategy and budget to move the state to the 2017 Coastal Master Plan. The Adaptive Implementation phase will foster the development and implementation of the Adaptive Management Framework by establishing protocols for integrating adaptive management principles and action items into planning, project management, policy and legal, outreach and engagement and research and development (including monitoring).

CPRA envisions that this cycle of Adaptive Planning and Implementation would be repeated following each 5-year master plan update, though it is envisioned that changes would be made on an as-needed basis and not bound by temporal constraints. The process would include immediate regrouping and cataloging of lessons learned, identifying changes that need to occur or be accounted for, developing a working strategy for CPRA to develop the next 5-year Coastal Master Plan, and completing these tasks during the years preceding the release of the following master plan.

Adaptive Planning

The goal of Adaptive Planning is to improve the decision-making process and increase stakeholder acceptance of the current and subsequent master plans. This phase will focus on evaluating the planning process used to develop the 2012 Coastal Master Plan, incorporate lessons learned, and identify a strategy for developing the 2017 Coastal Master Plan (Figure 2). Stakeholder acceptance will be structured around specific predictions that can be monitored and evaluated; report cards will be an important tool for communicating with stakeholders.

Step 1 of this phase is to evaluate the decision-making process and stakeholder acceptance from developing the 2012 Coastal Master Plan. Stakeholder acceptance will be gauged primarily through the Framework Development Team, Focus Groups, and outcomes of public meetings. Without stakeholder acceptance, implementing the plan becomes a nearly impossible task. Stakeholders may not accept the plan because of uncertainty about the modeling effort, or they may not accept the plan because of a lack of understanding. We first need to evaluate if there is stakeholder acceptance, and if there is not, we need to understand if lack of acceptance is due to technical issues or an outreach and engagement issue. Step 2 (which will occur simultaneous to

Step 1) is to evaluate the tools and models used to formulate the 2012 Coastal Master Plan, and to catalog experiences and lessons learned (e.g., identify what worked and where our knowledge can be expanded, identify key uncertainties within the analysis, etc.). CPRA understands this will be an extensive effort and will need to allot adequate time for completion. Step 3 will incorporate the feedback from steps 1 and 2 and develop a strategy and budget needed for the next four years to address key issues and questions to facilitate improvements for the 2017 Coastal Master Plan, Step 4.

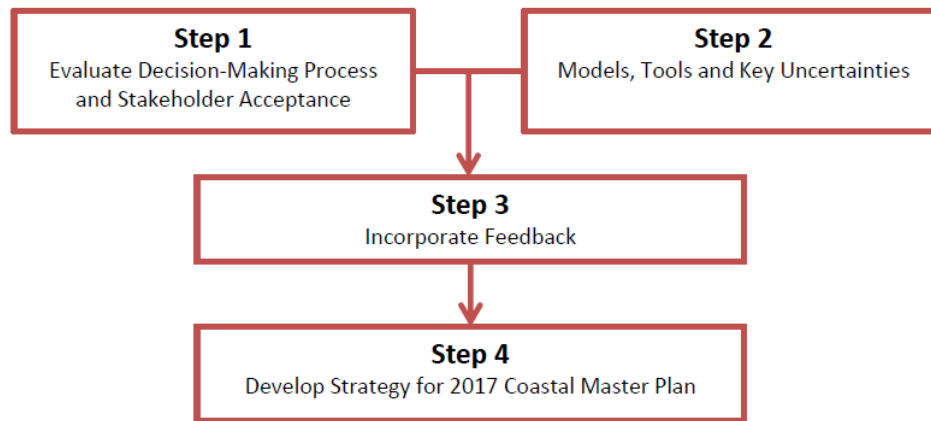


Figure 2. A four-step process will be applied during the Adaptive Planning phase of developing the Adaptive Management Framework.

Table 1 in the Support Document located at the end of this appendix provides a detailed overview of the Adaptive Management Phases and Action Items. Broadly, the steps are listed below. Many of these steps will occur in parallel, but each will have specific feedback points to the on-going efforts of the master plan. Specific actions that will be undertaken as part of this evaluation include, but are not limited to:

- Evaluate acceptance of the 2012 Coastal Master Plan
- Evaluate models, tools, and key uncertainties
- Develop a planning strategy for 2017 Coastal Master Plan
- Develop a budget and priorities for research and development (not shown in Figure 2)
- Identify a governance structure and key roles and responsibilities (not shown in Figure 2)

Details regarding exactly how and when these actions will take place as well as how and when the plan will be adapted to respond to challenges are forthcoming in later versions of this document.

Adaptive Implementation

The second phase of developing the Adaptive Management Framework involves identifying elements that will facilitate program implementation. The goal of the Adaptive Implementation phase is to understand the ability of the master plan projects to meet the objectives when implemented in the coastal system. This phase includes executing activities needed to advance the state toward a sustainable coast, including project monitoring, operational management, expanding on existing monitoring networks, and monitoring system responses to action and inaction. The response of the coastal system and stakeholder acceptance will be key indicators of program success and will ultimately be the most important indicator that the master plan objectives have been achieved. Specific performance measures and a plan for spatial and temporal monitoring will be identified and included in the final Adaptive Management Framework.

Many of the steps listed below will occur simultaneously, but each will have specific feedback points to tie in to the broader coastal program; See Table 1 for a more detailed list of these action items. Specific tasks included in development of the Adaptive Management Framework include, but are not limited to:

- Develop roles and responsibilities
- Develop a panel of experts to guide the Adaptive Management Framework (e.g., Independent Technical Review)
- Catalog on-going monitoring and data collection / identify gaps (appropriate spatial and temporal metrics will be identified in later versions of the Adaptive Management Framework)
- Determine when and where monitoring might dictate adjustments to the planning process and/or project implementation and operations that would result in a change to how projects interact, are sequenced or whether they are removed from the master plan.
- Develop key questions for implementation (e.g., systems approach/synergy effects and project sequencing)
- Prioritize and budget research and development (including monitoring)

1.4 Key Tasks and Responsibilities

Implementing the 2012 Coastal Master Plan will require many simultaneous actions to be managed by multiple divisions and entities to move the program forward. To incorporate lessons learned and provide the institutional knowledge required to advance the coastal program, the Adaptive Management Framework will be implemented through teams structured around the five focus areas (Figure 1) to better manage the work, incorporate lessons learned and provide the institutional knowledge required to advance the program. Clear communication and coordination between teams will be essential to the success of the master plan. For this reason, it is important that the integrated teams be comprised of staff from each focus area to ensure a streamlined flow of project knowledge. For instance, project management staff can provide important constructability information to streamline the planning effort, while also learning

about improving project design through the monitoring efforts of the research and development team.

An Adaptive Management Advisor is a proposed new position in CPRA responsible for ensuring a strategic and program-wide learning process. Specifically, the Adaptive Management Advisor will lead the development and implementation of the Adaptive Management Framework into the entire coastal program. The advisor will facilitate the coordination and collaboration of emerging information among the focus teams on a routine basis. New information and lessons learned from the planning, design, and implementation phases of a project, or as a result of applied scientific research, additional programmatic modeling, or system response monitoring will be vetted and disseminated to the focus teams.

Planning

The planning process includes activities to ensure the program follows certain guidelines on objectives, principles, and analytical tool use to support a consistent and technically-based decision-making process to quickly move projects to implementation. The Adaptive Management Framework will consider multiple projects within a spatial context, synergy, temporal developments, and project sequencing depending on funding, political needs, etc. Adaptive management will ensure that the planning process systematically updates the guidelines for future iterations of the master plan, which is legislatively required to be updated every 5 years, based on cumulative knowledge gained with institutional learning.

Planning staff working at the program level will be responsible for the full development of the Adaptive Management Framework, under advisement of the Adaptive Management Advisor, as well as, effective implementation of the framework. Staff will leverage the work of the 2012 Coastal Master Plan to support the development of other complimentary plans such as the USACE Water Resources Development Act (WRDA) of 2007, Section 7002, Comprehensive Plan and the Mississippi River Hydrodynamic and the Delta Management Study. Short-term planning efforts will focus on project-specific planning phases from concept through design. Additional assessments will take a landscape level / systems approach to capture synergism. The goal of this is to take a broader view and possibly relating to temporally/spatially dynamic ecosystem services.

Research and Development (including Monitoring)

The entire coastal program will be greatly benefited by having a robust and focused research and development team. Expanding collective understanding of the coast is not just a responsibility of CPRA, but numerous collaborative entities across the coast. The research and development team will be comprised of staff of the Louisiana Coastal Engineering and Science (LACES) division, as well as outside experts and entities, such as The Water Institute of the Gulf (see call-out box below). Through the Adaptive Management Framework, CPRA will be responsible for incorporating the latest scientific research and technological developments to address key uncertainties and understand the physical and social response to master plan implementation. CPRA will identify key questions to advance the program and focus research on answering them as well as utilize monitoring to evaluate predictions around critical uncertainties.

Short-term efforts will focus on the technical uncertainties or obstacles identified through the 2012 Coastal Master Plan efforts and by other teams (e.g., additional research needed to improve performance of the predictive models). Activities could include continued development of decision-support tools (models, Planning Tool, etc.), development of new technologies, and managing research problems. For example, how does CPRA design large river diversions to maximize land building while also benefiting the sustainability of the river system for the navigation industry? Key information can be provided through the Mississippi River Hydrodynamic and Delta Management Study and continued development of river realignment plans.

All efforts should be focused on monitoring projects and system responses to implementation of the master plan. Monitoring the physical (e.g., salinity, land, ecosystem services) and social (e.g., demographics, economics, social acceptance) response of the coastal system with or without project implementation will be key to determining effectiveness of the coastal program. This effort will need to take a full evaluation of the current coast wide monitoring efforts (e.g., CRMS, NOAA, BICM, etc.) and those for individual projects (e.g., levee monitoring systems), and identify and prioritize additions needed for these monitoring efforts. For instance, nonstructural projects are being implemented on a local level across the coast, but there is no coast wide monitoring of these efforts. Since the master plan recommends nonstructural projects in every parish, the planning and project management staff will be responsible for developing a nonstructural program, while the research and development team will need to develop the indicators to measure progress of nonstructural projects towards reducing risk. Additional details needed to fully identify and explain these relationships are forthcoming in later versions of this document.

Research and development (including monitoring) supports planning and policy efforts by providing a technically based avenue to address key uncertainties, promote ingenuity in problem-solving, and ensure sound practices. For coastal projects, research and development supports the project management team by providing the most current technical information, supporting engineering and construction problem solving, and conducting project monitoring. To prioritize issues and uncertainties, the research and development team members would be integrated into the project management, planning, and policy and legal teams. The research and development team would manage the work of multiple research institutions to answer the key questions of importance to the coastal program.

THE WATER INSTITUTE OF THE GULF

The vision for the Water Institute of the Gulf foretells of an advanced research-based effort, which will apply scientific and technological solutions to coastal and deltaic problems and allow citizens to live in safe and sustainable communities. The Water Institute for the Gulf will foster science and technological advancements in Louisiana to inform the federal and state's coastal restoration and hurricane protection efforts, building capacity and expertise at a level that does not exist today in the United States or around the world.

The Water Institute of the Gulf will bring together the best scientists in the state and the country, leverage existing public and private resources, and build an industry for coastal restoration and hurricane protection for which Louisiana is uniquely situated. The economic impact of such an effort would be realized not only through building capacity in academic institutions and private industry, but through the application of such knowledge in cutting-edge technologies that can be adapted for use by state and federal agencies or commercialized to advance private enterprise.

Perhaps more importantly, the scientific advancements fostered by the Water Institute of the Gulf will inform the very difficult decisions that elected leaders at all levels will make in partnership with communities and citizens across the state. The very nature of the coastal crisis is both subjective and personal, directly affecting the lives and livelihoods of thousands of Louisiana families—and by extension, the communities and cities where they work and reside. The scientific advancements fostered by the Water Institute of the Gulf will give policymakers and citizens the information and options they need with objectivity and credibility, with a goal of offering solutions not only to a technical problem, but to complex human and social challenges, as well.

Project Management

The Project Management Division of CPRA is the state's lead in implementing projects. The project management team has expertise in project management and moving projects from the planning stage to construction and will be responsible for the timely and cost effective delivery of well-designed projects. However, it is just as important that the project management team develop feedback loops to incorporate lessons learned to streamline future project implementation, as well as utilize real-time monitoring through research and development to improve operations and maintenance of existing structures. Through project management, we can identify the best new technologies, expand engineering capacities and increase construction efficiencies. The project management team is ultimately responsible for the engineering, design

and construction of projects, helping identify lessons learned and incorporating new efficiencies and technologies.

Policy and Legal

There are numerous policy and legal challenges that can delay or disrupt the implementation of the master plan. The policy and legal team will identify state and federal policies that could hinder the successful advancement of the coastal program. This team consists of a collaborative effort between CPRA, as well as many local and federal coordinating agencies. A review of existing state and federal policies related to the program will highlight opportunities to make adjustments to streamline the program. Policies that have an impact on the coastal program and are candidates for review include: NEPA streamlining, permitting, beneficial use of sediments, land use development, and mitigation. Once potential policy changes are identified, discussions will be coordinated to resolve issues, and new language will be proposed for policy revisions, which will then be tracked. Early and frequent collaboration with resource agencies will help streamline this effort.

It is important that policy and legal efforts are adaptively managed in the same manner as project implementation. If the state proposes a new policy that is found not to be based in the latest science and technical information or not feasible, policies must be changed in a nimble manner as additional information is gathered. This may be considered one of the more difficult components of the Adaptive Management Framework as it involves substantial outside coordination with elected officials, regulatory agencies, and inter-state issues (e.g., river diversion or hurricane protection project effects on Mississippi). There may be challenges to implementing the master plan that cannot be overcome, and CPRA will need to make appropriate adjustments.

Outreach and Engagement

The outreach and engagement team is responsible for engaging the public during the development of the master plan and implementation of the coastal program. The team will be comprised of staff from CPRA who work to support the education, outreach and engagement of key stakeholders including elected officials, business and industry leaders and the general public. Public understanding and acceptance is key to success of the coastal program. Any large-scale program needs a unified constituency to be successful and it is the responsibility of the outreach and engagement team to build support. CPRA will utilize collaborations with state and federal agencies, non-governmental groups, community leaders, and educational institutions (e.g., SeaGrant).

Restoration of the Louisiana coastline is a multi-generational undertaking whose accomplishment will require the focused dedication of the citizens of Louisiana and the nation. Achieving a sustainable coast encompasses many difficult decisions and the shared sacrifice of significant financial resources by both the state and the nation. In the short-term, it is of key importance to be able to effectively communicate the results of a highly technical master plan process to a lay audience. We need to evaluate if our approach (i.e., community meetings, fact sheets, website and terminology) was successful in increasing the understanding and acceptance of the master

plan by the public and key stakeholder groups, such as the Framework Development Team, the Science and Engineering Board, local and federal officials, and the Louisiana Legislature. A stakeholder acceptance report card is a useful way to report how various stakeholders responded to the master plan and can illustrate where additional efforts are needed (see example report card in Figure 3). For instance, did a group not acceptance the master plan because of general disagreement or was it a lack of understanding? Once we have identified additional needs and lessons learned from our previous approach, we can make adjustments to our on-going outreach and engagement efforts to support feasibilities studies, implementing projects, policy actions and future master plan efforts.

Example Report Card: Public Acceptance of Louisiana's 2012 Coastal Master Plan

Stakeholder Acceptance Rate	Not Accept	Conditional Acceptance	Accept	Commitment	Action
Louisiana Legislature					
Congressional Leaders					
Federal Partners					
Local Parishes					
Framework Development Team					
Science and Engineering Board					
General Public					

Figure 3. An example of a report card developed for the outreach and engagement efforts. Not Accept indicates an entity or group that does not support the 2012 Coastal Master Plan. Conditional acceptance refers to acceptance of the master plan under certain conditions / revisions. Accept indicates a group that accepts the master plan as the State’s plan, but does not accept the plan as their own plan (i.e., a local government that supports the parish-plan over the master plan). Commitment indicates a group that accepts the plan as their own plan but takes no actions to help implement and Action would take that acceptance one step further to a group or entity that provides funding, in-kind services, or coordination to implement the master plan.

Each group, their acceptance level, and their reasoning needs to be understood. CPRA also needs to know if any nonacceptance would drastically affect the state’s ability to implement the master plan. For example, a community may not accept the master plan because of a lack of understanding. Focusing outreach and engagement efforts on specific concerns may resolve this. In more severe cases, the nonacceptance of a group could lead to failure to implement a project, such as a landowner that refuses to provide land rights. These failures, if unavoidable, could reduce the effectiveness of the master plan and adjustments would need to be made.

In the long-term, an education program must be developed that can adapt to new teaching methods and materials and incorporate emerging ideas in both coastal restoration and risk

reduction technology. Creating such a program will require the state to enter into partnerships with stakeholders at various levels. The development of a robust program will help the public to becoming better stewards of their environment and help to further the restoration and risk reduction of the Louisiana coast. Here, the scope of adaptation is to assess and change the way stakeholders are exposed to better understand the program, as well as adapting the implementation of the program to achieve greater acceptance. Details of how this will be carried out will be included in later versions of this document.

Process Effectiveness

The relative ease of the process to periodically review and adjust the master plan will be critical to the coastal program's success. Is the program learning from the projects and effectively feeding it back? When warranted can the master plan be adjusted with relative ease or are we too constrained by authorizations, partnerships, or expectations? An analysis of the process is warranted when the plan cannot be adjusted easily. To that end procedures will be developed to assess the efficiency of the technical review and analysis process as well as the overall implementation process.

1.5 Summary

In closing, we know we cannot predict with complete certainty how the Louisiana coast will change into the future, but we know we have to be adaptive and agile to deal with the dynamic nature of both the environmental and social systems (e.g., changing demographics, coast-dependent economies, risk variability) of the coast. CPRA is focused on developing an Adaptive Management Framework that is flexible, agile, and based on the best available science and technical information. This appendix described the initial stages of developing a comprehensive Adaptive Management Framework following approval of the 2012 Coastal Master Plan. Prior to the FY14 Annual Plan, the first phase of the full Adaptive Management Framework will be developed.

As the Adaptive Management Framework provides feedback loops for modifying and adjusting the implementation and operation of projects to maximize coastal sustainability, the outreach and engagement approaches will also need to adaptively change and remain in the forefront of new information. The Adaptive Management Framework will integrate monitoring, predictive models, research, report cards, stakeholder feedback, and other tools to evaluate CPRA's coastal program. The Adaptive Management Framework will be facilitated by annual plans and updates to the master plan, which the legislature requires every 1 and 5 years, respectively. These plans will provide opportunities to report on the progress of the Adaptive Management Framework by assessing overall program effectiveness, reviewing stakeholder engagements, and making necessary adjustments.

Planning is an iterative process, and CPRA intends to apply the principles of adaptive management to refine key goals, tools and processes. The Adaptive Management Framework will be a living document that is updated to reflect new understanding and information that should improve the effectiveness and efficiency to implement the master plan and continue to move the

entire coastal program forward. The framework will integrate both restoration efforts and risk reduction measures as it integrates aspects of the broader coastal program: planning, research and development, physical and social response to implementation, engineering, design and construction, policy and legal components, as well as outreach and engagement.

Ongoing studies, like the Mississippi River Hydrodynamic and Delta Management Study will provide critical information for this implementation effort. Independent research institutions, such as the Water Institute of the Gulf, in conjunction with other research, academic and engineering institutions could provide a high level of expertise to build the knowledge needed to support quality project performance.

1.6 Next Steps

Next steps include completing the outcomes, roles, and proposed completion date rows in Table 1 so additional specificity can be included in later versions of this document. Initial ideas for the Table of Contents for the final version of the CPRA Adaptive Management Framework are included below:

- Structure of CPRA Adaptive Management Framework
 - Roles and responsibilities within CPRA
 - Information ‘in-points’ and feedback loops
- Outreach and Engagement
 - Stakeholder acceptance of the master plan
 - Collaborative relationships
 - Report cards
- Technical Uncertainties
 - Monitoring needs
 - Research needs
- Technical Tools
 - Status
 - Next Steps / Needs
- Project Attributes
- Policies / Legal

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1.8 Support Documentation

- Table 1 – Phases of Adaptive Management and Action Items.
- Figure 4. Outreach and Engagement Overview, as applied during the development of the 2012 Coastal Master Plan.
- Figure 5. Linked Models Used to Inform the Development of the 2012 Coastal Master Plan.
- Figure 6. Uncertain Factors were considered by the Predictive Models.

Table 1. Overview Table Detailing the Phases of Adaptive Management, Action Items, Outcomes, Roles, and Proposed Completion Dates needed to build CPRA’s Adaptive Management Framework.					
Phase	Action Item	Outcomes	Roles	Proposed Completion Date	
Adaptive Planning					
	Evaluate Acceptance of the 2012 Coastal Master Plan	Evaluate the Decision Framework applied during the development of the 2012 Coastal Master Plan			
		– Master plan Objectives, including the balance of near- and long-term objectives			
		– Decision criteria			
		– Constraints			
		– Project-level objectives			
		– Planning assumptions (i.e., funding availability, funding allocation, etc.)			
	Evaluate the Outreach and Engagement strategy used during the development of the 2012 Coastal Master Plan. (Figure 4)	Evaluate engagement, understanding and acceptance of key stakeholders, academia, media, elected officials and the general public			
		Evaluate effectiveness of public education strategy (community meetings, public meetings, website, written materials, etc.)			
		Evaluate communications, transparency, and the incorporation of knowledge, experience and feedback from all constituent groups			
	Evaluate and Review Models, Other Tools, and Technical Analyses used during the development of the 2012 Coastal Master Plan	Evaluate effectiveness of the Framework Development Team, the Science and Engineering Board, and the Technical Advisory Committees and determine how to continue building on these collaborations			
		Evaluate acceptance of key federal and local agencies which are necessary for the implementation of the plan			

Table 1. Overview Table Detailing the Phases of Adaptive Management, Action Items, Outcomes, Roles, and Proposed Completion Dates needed to build CPRA’s Adaptive Management Framework.					
Phase	Action Item		Outcomes	Roles	Proposed Completion Date
		Develop a plan for peer review and journal publications			
	Evaluate and Review Models, Other Tools, and Technical Analyses used during the development of the 2012 Coastal Master Plan	Evaluate the full set of models and their ability to answer key questions of the planning process and provide technical support for decision making (Figure 5)			
		Review the model uncertainty analysis to understand the uncertainty of each model and the propagation of uncertainty through the models			
		Catalog and understand uncertainties, vulnerabilities, and assumptions in the models, scenarios, project attributes and Planning Tool that may have affected project selection and 2012 Coastal Master Plan formulation			
		Scenarios - Review the list of key uncertainties (both ecological and risk-related) used to generate future scenarios and revise if necessary (Figure 6)			
		Review the range of values considered for the uncertainty parameters and revise if necessary			
		Project attributes - Reduce uncertainty in cost estimates, design and construction timelines, and assumptions regarding design and construction methods be improved			
		Planning Tool - Revise the decision support methods used, if necessary			

Table 1. Overview Table Detailing the Phases of Adaptive Management, Action Items, Outcomes, Roles, and Proposed Completion Dates needed to build CPRA’s Adaptive Management Framework.					
Phase	Action Item		Outcomes	Roles	Proposed Completion Date
	Develop a Planning Strategy for 2017 Coastal Master Plan	Improve the planning process for the 2017 Coastal Master Plan. Focus on making modifications to the decision framework, outreach and engagement, review and coordination, and the technical analysis.			
	Develop a Budget and Priorities for Research and Development	Develop a prioritized work plan and budget needed to carry out additional research and development actions for completing the 2017 Coastal Master Plan.			
	Identify a Governance Structure and Key Roles and Responsibilities	Assign roles and responsibilities necessary to carry out the actions in the Adaptive Management Framework			
		Develop a governance structure needed to make decisions that could result in modifications to the Master Plan			
		Develop the structure / framework necessary to feed information into the process and incorporate it into each process (Figure 1)			
Adaptive Implementation					
	Form a Panel of Experts to Guide Development of the Adaptive Management Framework	Launch a coordinated effort of federal, state and local agencies, as well as academic and research experts to guide plan formulation and to ensure the state is effectively managing the Adaptive Management Framework			
	Catalog On-Going Monitoring and Data Collection / Identify Gaps	Evaluate the coastal monitoring system(s), determine who is responsible for different monitoring, what variables are being monitored and where the data are being			

Table 1. Overview Table Detailing the Phases of Adaptive Management, Action Items, Outcomes, Roles, and Proposed Completion Dates needed to build CPRA’s Adaptive Management Framework.				
Phase	Action Item	Outcomes	Roles	Proposed Completion Date
	stored			
	Identify major data and information gaps that need to be filled			
	Identify performance measures needed to gauge master plan performance and triggers that would result in plan adjustment. Consider performance measures for restoration and risk reduction for physical / science / engineering, social, political/legal, and economic			
	Develop Key Questions for Implementation	Develop key questions for implementation that will be used to prioritize research and development efforts and fill information gaps. These questions can focus on many aspects of the coastal program (physical sciences, engineering, social, policy, legal, etc.)		
	Prioritize and Budget Research and Development	Estimate funding available to answer key questions		
		Prioritize and implement key research and development needed for the 2017 Coastal Master Plan		
	Develop Feedback Loops, Roles and Responsibilities	Develop a communications strategy to report master plan progress to stakeholders and decision-makers (report cards, CPRA annual plan appendix and master plan updates)		
		Determine who is responsible for assessing and synthesizing the data		
		Coordinate within the coastal program:		
		– Plan for modifications that may be needed due to unforeseen legal and		

Table 1. Overview Table Detailing the Phases of Adaptive Management, Action Items, Outcomes, Roles, and Proposed Completion Dates needed to build CPRA's Adaptive Management Framework.					
Phase	Action Item		Outcomes	Roles	Proposed Completion Date
		policy shifts/disagreements that could occur			
		- Develop a strategy to modify the master plan if we receive more/less funding than we anticipated (or at different time intervals)			
		- Develop a strategy to modify the master plan to evaluate new projects or technologies			

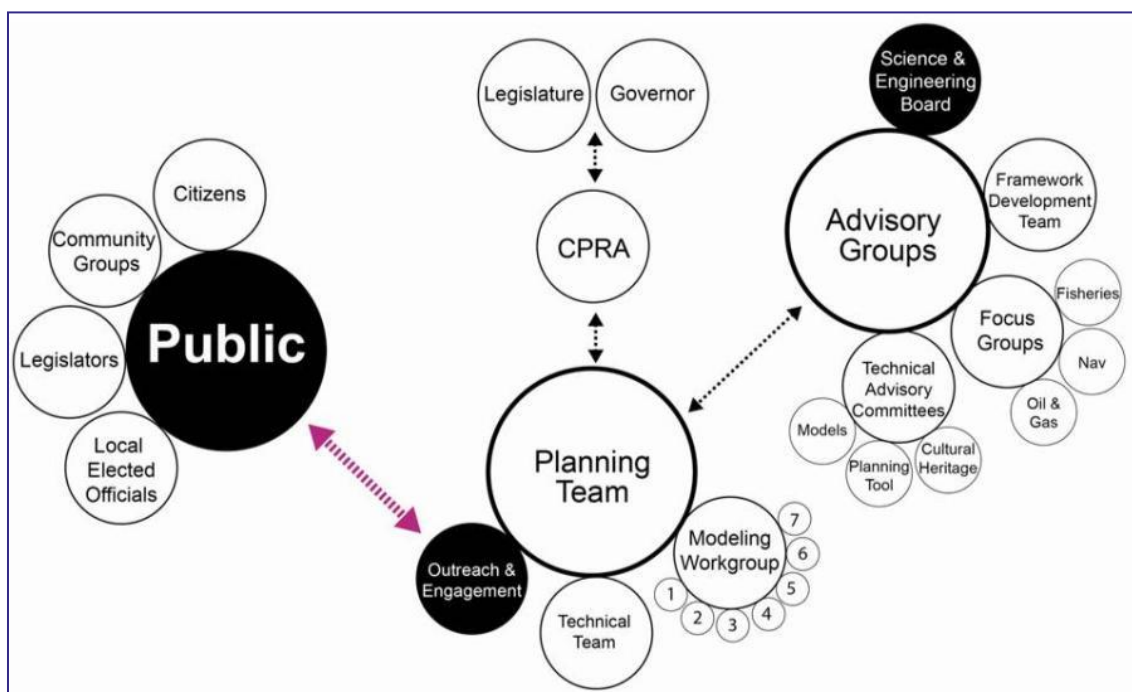


Figure 4. Outreach and Engagement Overview, as it was applied during the development of the 2012 Coastal Master Plan.

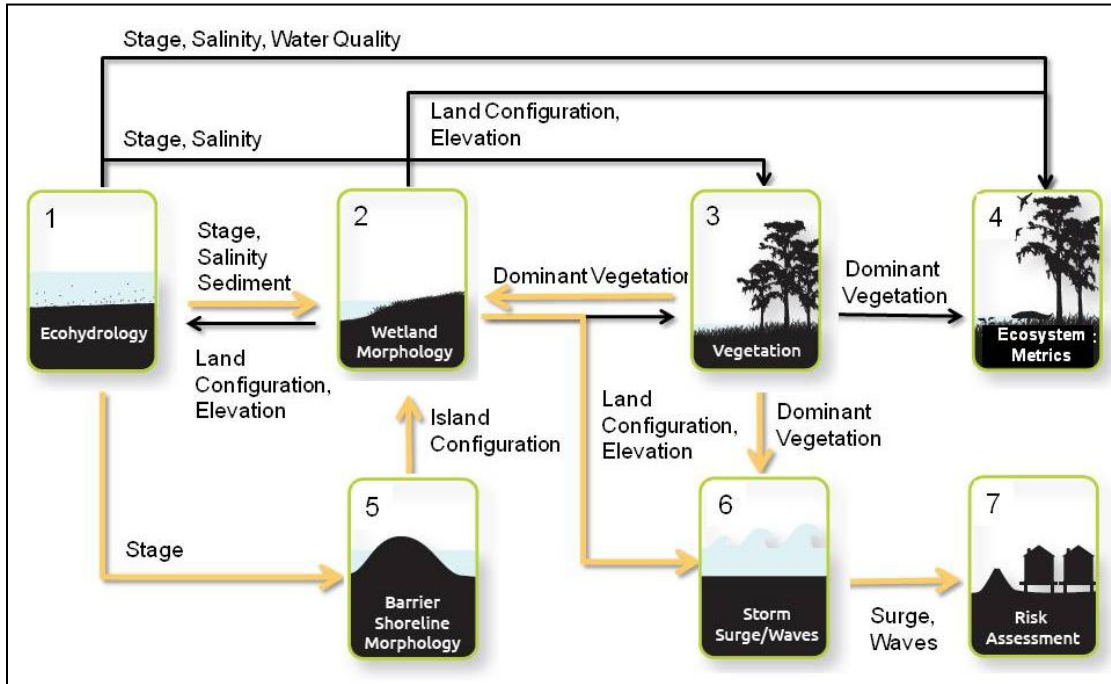


Figure 5. Continued investment and improvements to the linked models used to inform the development of the 2012 Coastal Master Plan is important to foster science-based project assessments.

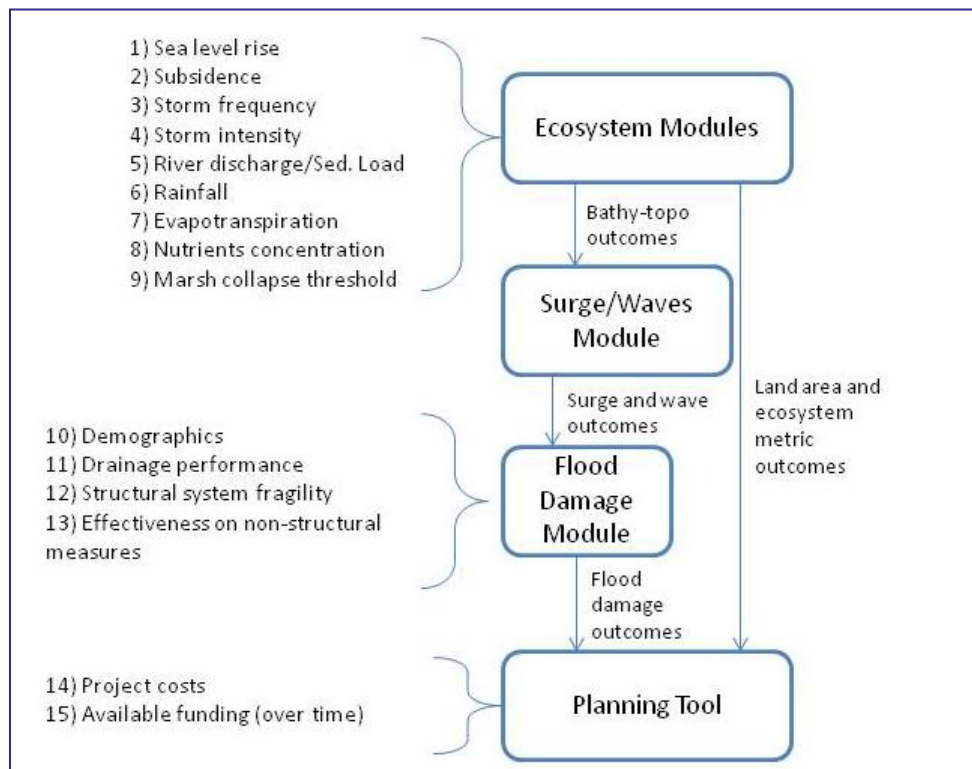


Figure 6. A number of plausible future scenarios were evaluated by using ranges of uncertain factors in the predictive models.

Glossary of Terms (as they relate to the 2012 Coastal Master Plan)

- Adaptive Management - an integrated, multidisciplinary strategy for addressing uncertainties when dealing with natural resources (Walters 1986). It is a way to take in new information, plan for uncertainties, and instate the ability to change course (within Louisiana's coastal program or a particular project) as needed.
- Adaptive Planning - the act of applying adaptive management principles to all aspects of project and program planning efforts (e.g., Which tools are best to use for technical evaluation? How does the state improve the decision-making process and increase stakeholder acceptance of the current and subsequent master plans?).
- Adaptive Implementation - the act of applying adaptive management principles to all aspects of project and program implementation (e.g, How should projects be sequenced over time? How are projects performing? How is the system responding?).
- Adaptive Learning - principle of applying new information to change plans, direction, and/or course of action (e.g., do we need to modify incoming projects based on what we have learned from projects already on the ground?).
- CPRA - Coastal Protection and Restoration Authority - in December 2005, the Louisiana Legislature restructured the State's Wetland Conservation and Restoration Authority to form the Coastal Protection and Restoration Authority. Act 8 of the First Extraordinary Session of 2005 expanded the membership, duties and responsibilities of the CPRA and charged the new Authority to develop and implement a comprehensive coastal protection plan, including both the Master Plan (revised every 5 years) and annual plans.
- Programmatic Adaptive Management Framework - a documented process that will be supported by the state of Louisiana to implement the projects recommended in the 2012 Coastal Master Plan by using procedures or techniques that are flexible, agile, and based on the best available technical, economic and social information. The framework will integrate all aspects of the coastal program: program management, policy and legal, outreach and engagement, planning and engineering, research and development (including monitoring).
- Implementation - execution of the master plan by way of project delivery, monitoring, operations and maintenance, and considerations of legal and policy issues.
- Master Plan Objectives - five points that reflect the key issues affecting people in and around Louisiana's coast. The Master Plan objectives seek to 1) improve flood protection for families and businesses, 2) recreate the natural processes that built Louisiana's delta, 3) ensure that our coast continues to support an array of commercial and recreational activities, 4) ensure that our coast continues to support the cultural heritage of the people and communities, 5) promote a viable working coast in support of commerce and industry.
- Risk Reduction - construction of projects (e.g., levees) or use of nonstructural techniques (e.g., elevating homes) to reduce damage that would occur to coastal assets in the event of a storm flood event. Risk reduction is sometimes referred to as storm flood protection.

- Restoration – construction of projects (e.g., river diversion, marsh creation) with the intent of regaining lost coastal habitat area and function.
- Program Management - section within CPRA; state’s lead in implementing projects.
- Policy & Legal – team collaboration between CPRA and other local and federal coordinating agencies; identify and track policy and legal progress, shifts, and challenges.
- Outreach & Engagement – CPRA staff who work to support the education, outreach and engagement of key stakeholders including elected officials, business and industry leaders and the general public.
- Planning – section within CPRA; ensure projects are designed properly and the program follows certain guidelines on objectives, principles, and analytical tool use to support a consistent and technically-based decision-making process.
- Research & Development (including monitoring) – section within CPRA comprised of staff of the Louisiana Coastal Engineering and Science (LACES) division, as well as outside experts and entities, such as The Water Institute of the Gulf; continued development of decision-support tools (models, Planning Tool, etc.), development of new technologies, and managing research.
- Predictive Models – a set of technical tools used to predict how Louisiana’s coast may change in the future if no additional projects are constructed. These tools are also used to predict how both ecological and risk reduction projects may perform and affect the landscape into the future.
- Planning Tool – a tool that can be used to sort and rank projects based on outcomes of the predictive models (e.g., amount of land built by a project, or the amount of economic risk that a project averts), project costs, and other factors of interest to the state (e.g., how does a project affect navigation).
- Master Plan – a plan to guide the Louisiana’s coastal investments in terms of integrated coastal protection and restoration. It is legislatively mandated to be updated every 5 years.