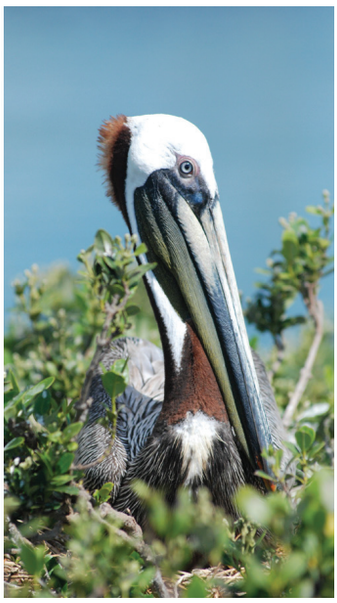
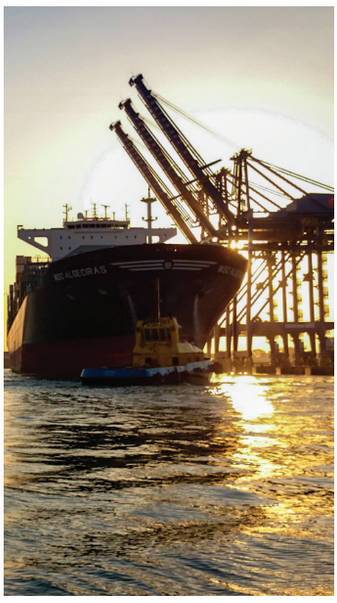
State of Louisiana
The Honorable John Bel Edwards, Governor

Louisiana's Comprehensive Master Plan for a Sustainable Coast

committed to **our coast**







2017 Draft Plan Release

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committed to **our coast**

Coastal Protection and Restoration Authority of Louisiana

Louisiana's Comprehensive Master Plan for a Sustainable Coast

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INVESTING IN OUR CHILDREN'S FUTURE

BUILDING A COASTAL PROTECTION AND RESTORATION STRATEGY FOR THE NEXT 50 YEARS

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Photo courtesy of Lindsey Janies Photography

INTRODUCTION

BUILDING ON OUR COMMITMENT TO PROTECT AND RESTORE OUR COAST

Louisiana's coast is a precious natural, economic, and cultural resource. It is an area rich in ecological abundance that supports world-class commercial and recreational fisheries and is home to an array of waterfowl, migratory birds, reptiles, and amphibians. It is an area that maintains five of the largest ports in the United States. It is a major energy supplier of our nation's oil and natural gas. Above all, the Louisiana coast is home to more than 2 million people – nearly half of the state's population. Our people have a deep and abiding love for their coast and a rich cultural heritage closely connected to the land and water.

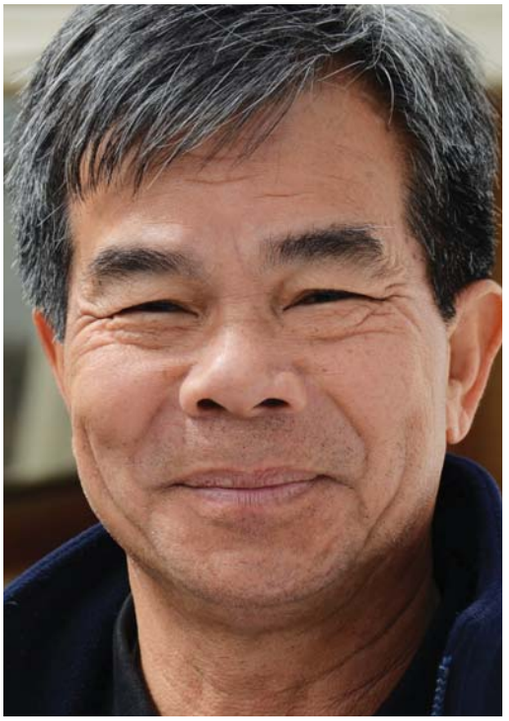
This complex and fragile ecosystem is disappearing at an alarming rate. Between 1932 and 2010, Louisiana's coast lost more than 1,800 square miles of land. From 2004 through 2008 alone, more than 300 square miles of marshland were lost to Hurricanes Katrina, Rita, Gustav, and Ike.[1] The culprits to this land loss include the effects of climate change, sea level rise, subsidence, hurricanes, storm surges, flooding, disconnecting the Mississippi River from coastal marshes, and human impacts.

The 2017 Coastal Master Plan sets an ambitious path to respond to the loss of our coastal land and the threats from storm surge events. The master plan, in its purest sense, is a list of projects that build or maintain land and reduce risk to our communities. For the 2017 Coastal Master Plan, we built on the commitment and knowledge gained from the previous master plans. We used the best available science and engineering to prioritize and sequence projects for implementation. We made it a priority to engage our coastal stakeholders and communities in the planning process, because, in the end, they are part of the solution and the most important reason for preserving this national treasure that is coastal Louisiana.

Photo courtesy of Louisiana Sea Grant

OUR TIE TO THE LAND

A father who remembers fishing in the local bayou wants to continue the tradition with his own children. A town that cherishes its history wants to continue being a place where people work and raise families. People who enjoy coastal Louisiana's birding, hunting, and boating want those activities to remain vital parts of their lives. Such desires show a deep appreciation for the landscape, and a recognition that the coast's value goes beyond simple utility. This recognition is at the heart of our experience as coastal Louisianans, and it is this value we are called to sustain.

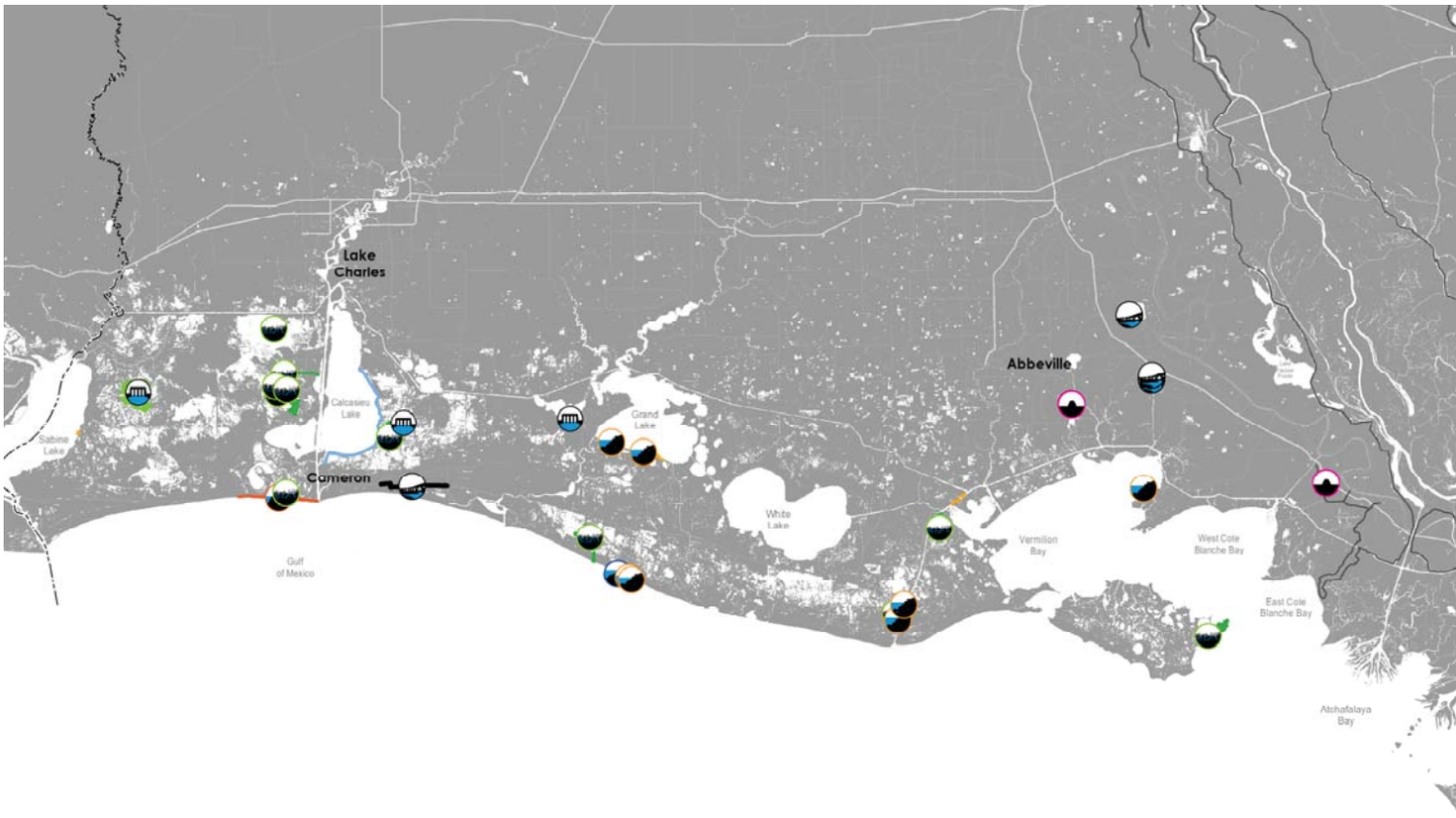


Photos courtesy of Louisiana Sea Grant

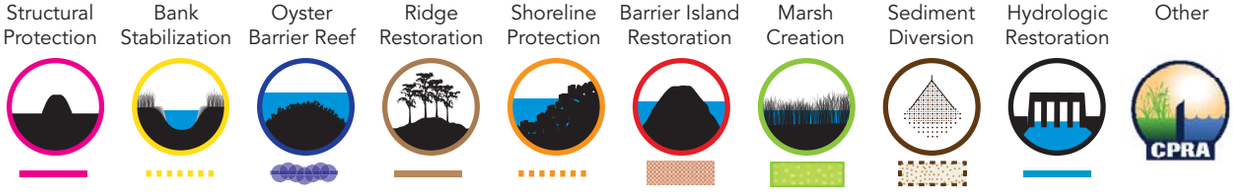
While coastal Louisiana provides the state, region, and nation with important natural resources, here the greatest assets are not oil and gas, fisheries, or sugar cane, but the people.

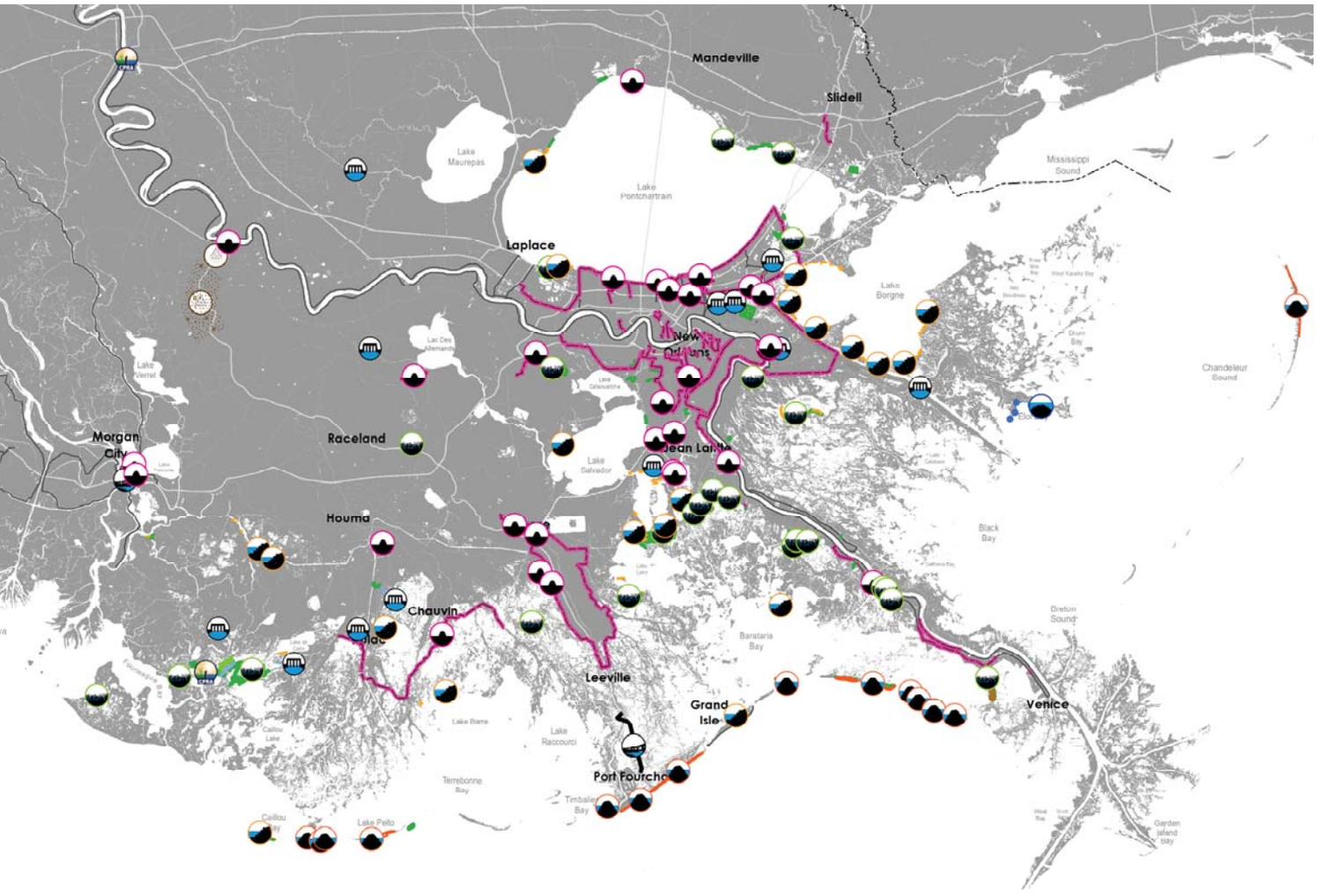
PROGRESS SINCE 2007

PROJECTS COMPLETED OR FUNDED FOR CONSTRUCTION



PROJECT TYPES



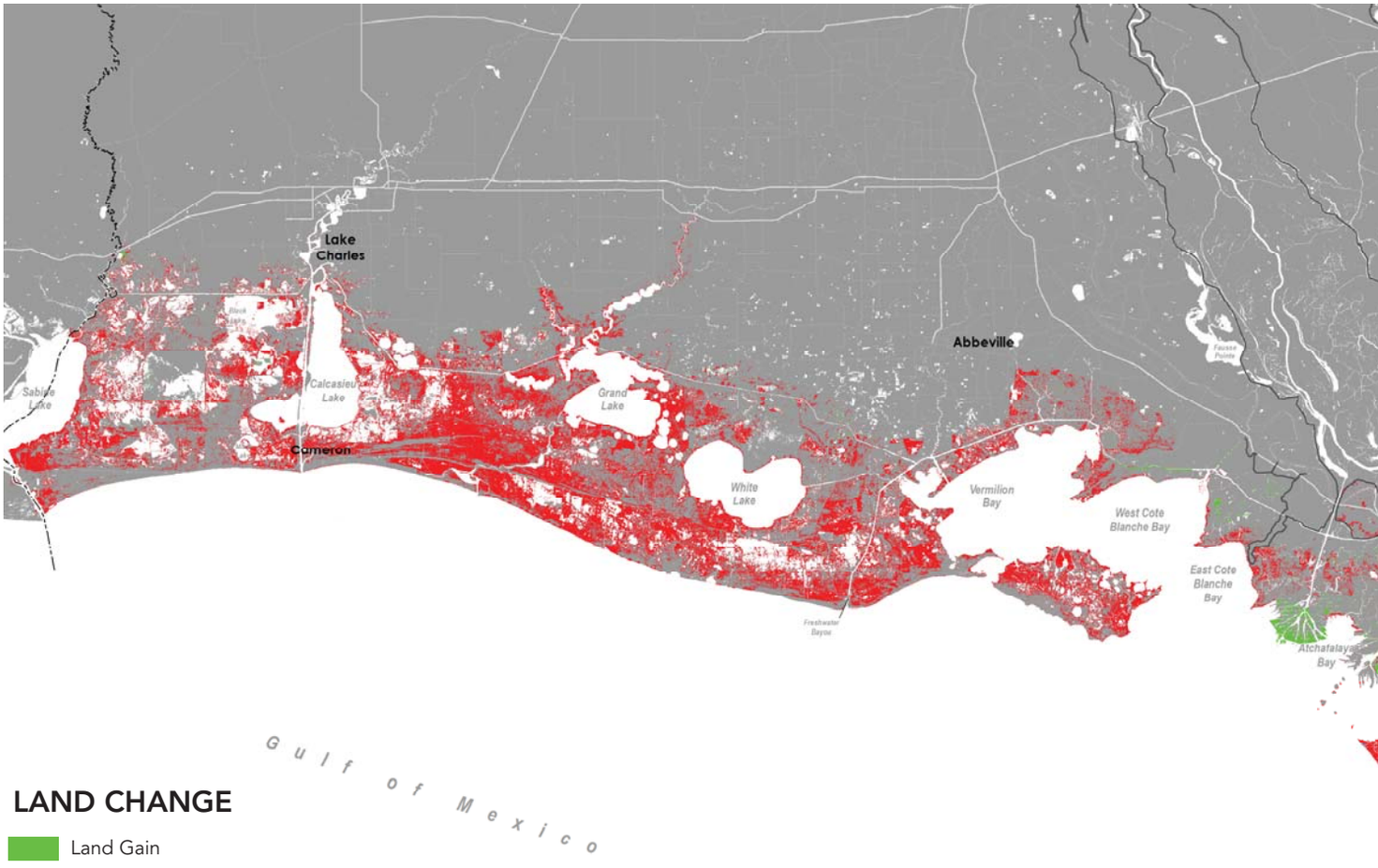


▲ FIGURE ES.1
Projects completed or funded for construction since 2007. Hurricane protection levee segments depicted here represent only those segments that have been built or are funded for construction. Land conservation and vegetative planting and bank stabilization projects are not depicted.

SINCE 2007, WE HAVE COMPLETED OR FUNDED FOR CONSTRUCTION A TOTAL OF 135 PROJECTS, RESULTING IN NEARLY 31,000 ACRES OF LAND BENEFITED, 275 MILES OF LEVEE IMPROVEMENTS, AND OVER 50 MILES OF BARRIER ISLANDS AND BERMS CONSTRUCTED OR UNDER CONSTRUCTION.

A CHANGING LANDSCAPE

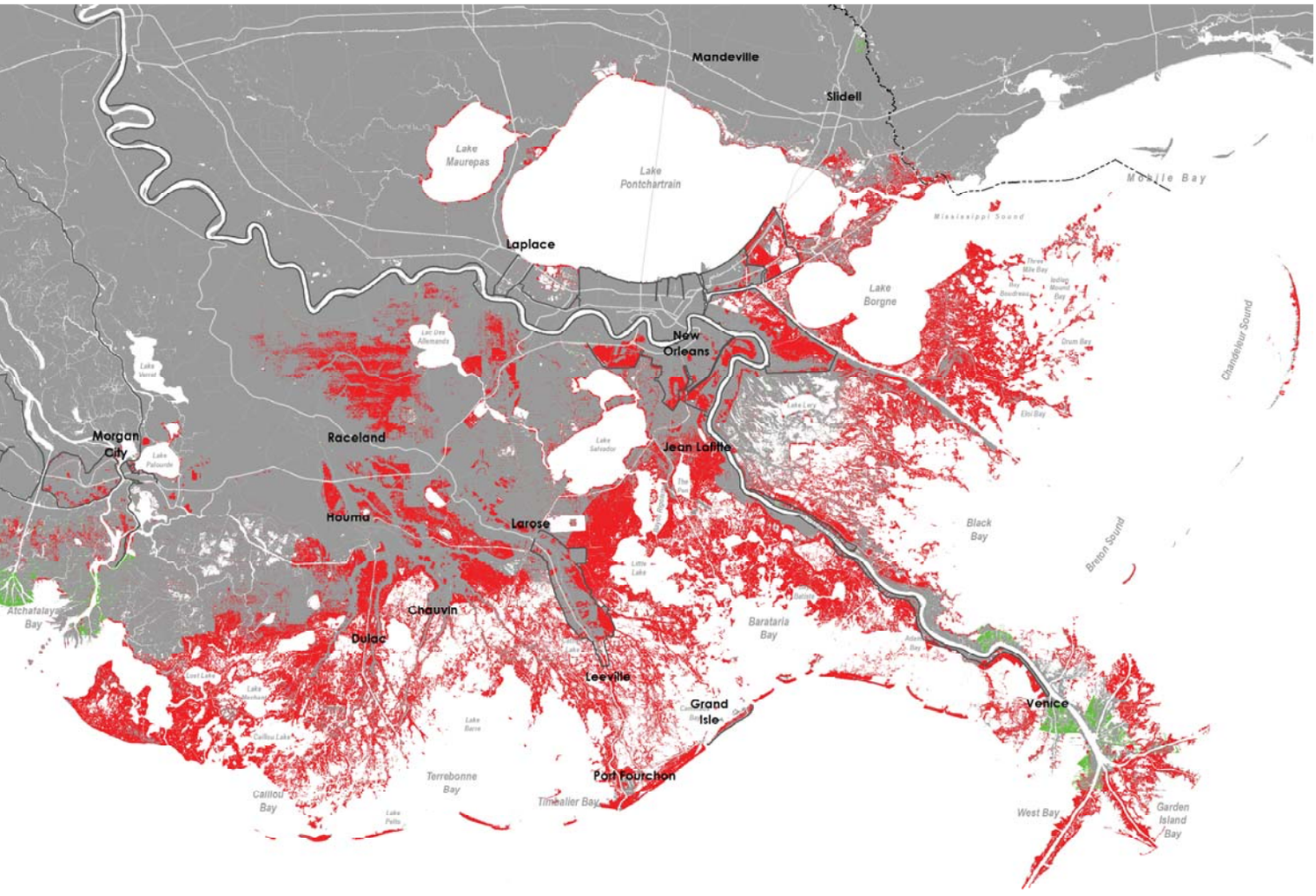
PREDICTED LAND CHANGE OVER THE NEXT 50 YEARS WITH NO ADDITIONAL ACTION



LOUISIANA'S COAST CONTINUES TO CHANGE

Louisiana continues to experience coastal land loss, triggered by both human and natural forces. Levees and flood control structures on the Mississippi River have successfully provided flood control and tremendous benefits to the nation. This approach to river management, however, has also fixed the channel of the Mississippi River and tributaries within its banks, depriving the broader coastal ecosystem of the freshwater, nutrients, and sediment it needs to survive. Dredging canals for energy exploration and pipelines provided our nation with critical energy supplies, but these activities also took a toll on the landscape, altering wetland hydrology and leading to land loss. Navigation canals provided our nation with critical infrastructure but also allowed salt water to invade deeper into coastal basins. Sea level rise, land subsidence, severe storms, and invasive species add further stress.

Land loss reduces shorelines, marshes, and swamps that are a vital barrier and our first line of defense against storm surge and flooding. Coastal flooding has become an all too common occurrence due to powerful storm surges associated with tropical events made worse over the years by subsidence, sea level rise, and coastal land loss.



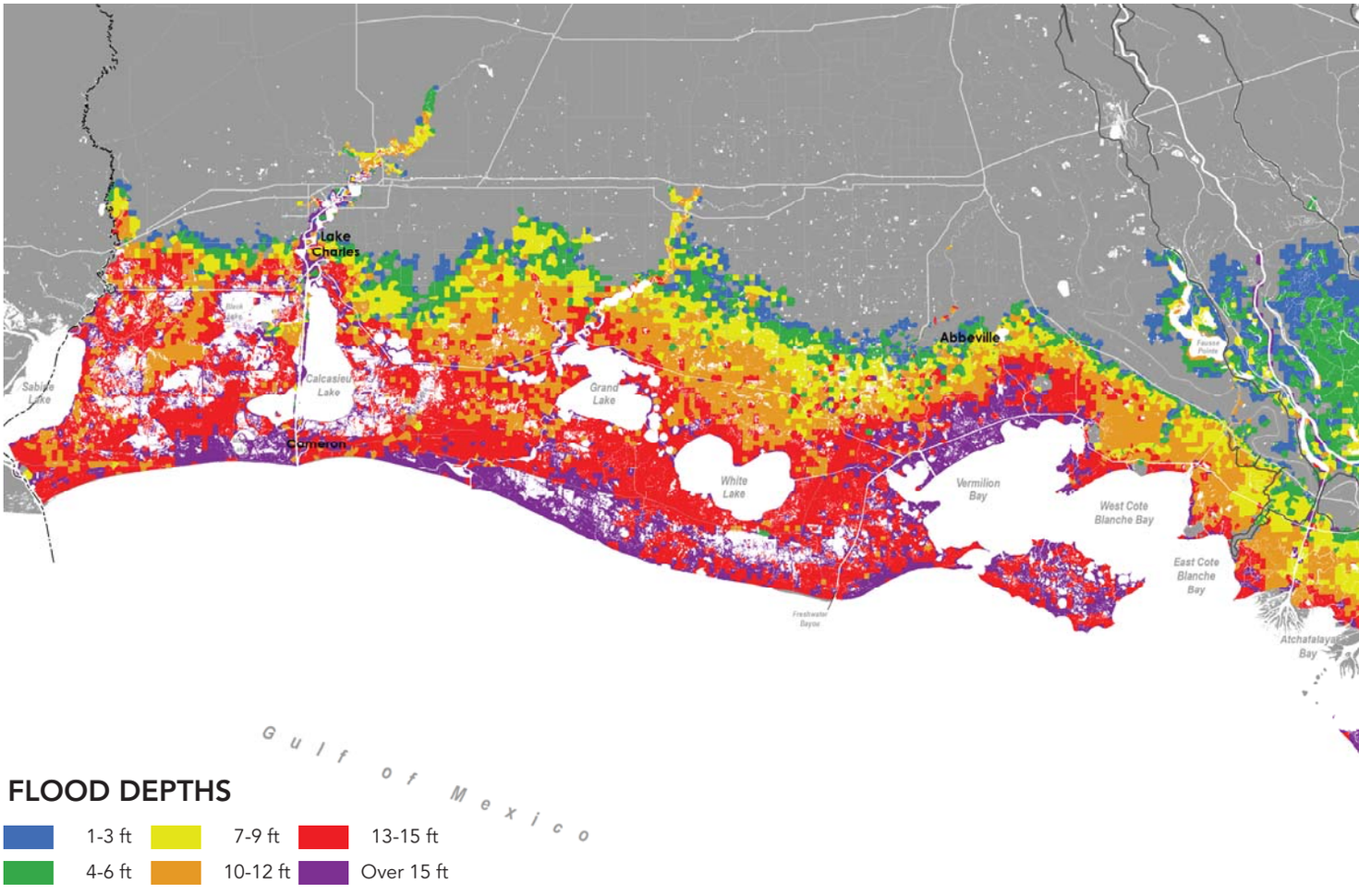
▲ FIGURE ES.2

Predicted land change along the Louisiana coast over the next 50 years under the Medium Environmental Scenario if we take no additional action. Red indicates areas predicted to be lost, and green indicates areas where land would be created.

2,250 SQUARE MILES COULD BE LOST IF WE TAKE NO ADDITIONAL ACTION OVER THE NEXT 50 YEARS.

FLOOD RISK TO OUR COMMUNITIES

PREDICTED FUTURE INUNDATION FROM A 100-YEAR FLOOD EVENT WITH NO ADDITIONAL ACTION

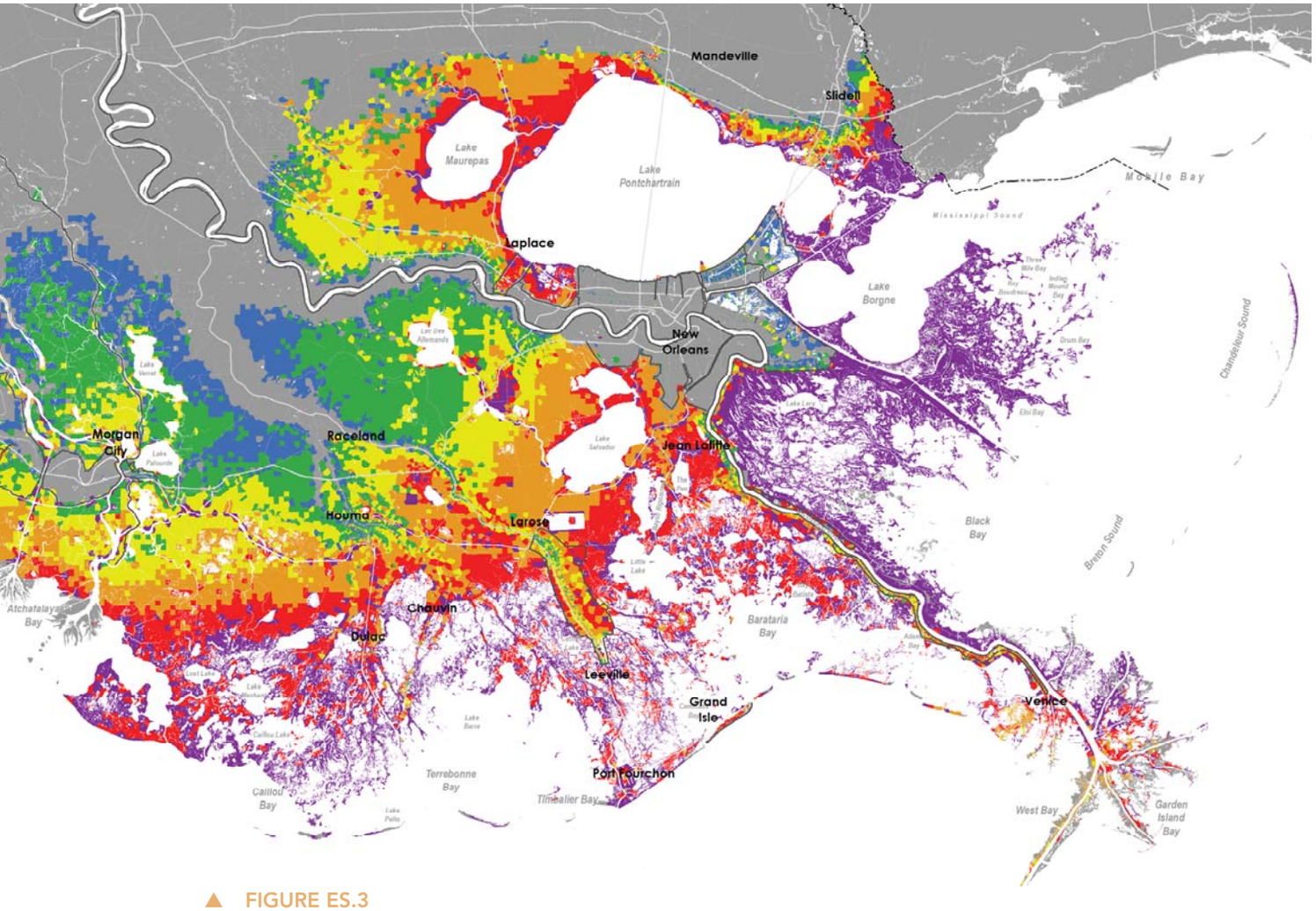


LOUISIANA IS DEVELOPING A BLUEPRINT FOR SUCCESS

In response to continued land loss and increasing flood risk and to improve the sustainability of our coastal landscape, communities, and economic future, Louisiana relies on the master planning process to define and implement projects that proactively address known and anticipated threats. Working in partnership with our local, state, regional, and federal partners, we are building our future together.

The intrinsic value of our coast as home to millions of people, critical infrastructure, and acres of vibrant natural habitats make our coast one of the nation's most unique and valuable landscapes. The challenges we have overcome and continue to face highlight the importance of funding and implementing strategic measures to reduce and mitigate risk and to improve the sustainability of the coast. By doing so, we improve the resilience of our economies, increase protection for Louisiana homes and businesses, improve the health of our coastal ecosystem, and support the future of our unique culture and communities.

The master plan approach that we have established since our first plan in 2007 and the technical tools we have developed can be used as a framework to assist other regions, such as Miami, New York, and the Outer Banks, to implement adaptation strategies.



▲ FIGURE ES.3

Estimated flood depths for a 100-year flood 50 years from now under the Medium Environmental Scenario with a degraded landscape and no additional flood protection. These flood depths represent a broad planning level evaluation of overall future flood risk.

Photo courtesy of Louisiana Sea Grant

OUR CHALLENGES

Every day, the lives and livelihoods of our residents are affected by the challenges and outcomes of land loss in coastal areas. A family may be forced to leave a community their family has called home for generations to move to areas protected by levees or to higher ground out of harm's way. A local business or individual may have trouble obtaining insurance, or an investment may lose value because of uncertainty about the future of our ever-changing landscape.

THE WORKING COAST

VALUING A NATIONAL TREASURE

COASTAL INVESTMENTS HAVE NATIONAL SIGNIFICANCE

Ports, natural habitat for birds and other wildlife, protection for oil and gas infrastructure – there is a substantial amount of documentation describing what the coast provides the region and country.

What sets our statistics apart from other coastal areas? For one thing, it is likely that our numbers understate what coastal Louisiana offers the nation. We do not always have data that captures these benefits. In addition, when assessing the value of this highly managed, intensively used landscape, we need to examine everything from the economic output of oil and gas pipelines to the value of supporting more than 5 million migratory waterfowl.[2] Doing so is complicated and tends to undervalue the combined effect of having so many different assets compressed into a single region.

Experts have tried various ways to put a value on the coast's abundance, more in the spirit of highlighting the incredible gifts of our landscape than out of certainty that these gifts can be perfectly captured in numbers. One of the ways researchers assign value to natural systems is by considering what are known as ecosystem services, meaning the benefits that the environment provides to people. In Louisiana, these benefits range from oyster and shrimp fisheries, to flood reduction, to nature-based tourism.

In 2010, seven independent researchers examined the coast's provision of ecosystem services. Their report stated that the Mississippi River Delta provides at least $12 to $47 billion in benefits to people each year. If this natural capital were treated like an economic asset, its total economic benefit to the nation would be $330 billion to $1.3 trillion per year. Over a 100-year period, the value of the coast's ecological services alone would be between $237 billion and $4.7 trillion.[3] The researchers note that many data gaps remain in our understanding of what the coast provides. As we learn more, our appreciation for the coast's value will likely increase significantly.

Photo courtesy of Louisiana Sea Grant

BRINGING IT BACK HOME

This is our home. Our actions over the next two decades will decide whether Louisiana's coast survives. The decisions are not easy. They require us to change some of the things we do now, but these decisions are ours to make, together. We know the coast is changing in increasingly drastic ways. We have a choice to make. Do we allow the changing coast to dictate our future or do we manage that change to make our future more like what we want it to be?

Can we embrace the need to change, despite the difficulty? Can we keep listening, talking, and learning from each other about the best way to proceed? So far, the people of coastal Louisiana have said yes, they can. This willingness gives great cause for hope.

In view of rising seas and the migration of people away from Louisiana's southernmost parishes, some have asked, "Why not just give up on Louisiana's coast?" The answer is simple: our combination of resources and geography is found nowhere else on earth. The delta of one of the world's great rivers, vast resources, and wetland habitats – these things are all here in coastal Louisiana and they are worth celebrating and protecting.

In fact, the region is growing and jobs are being created because the country needs what flows from Louisiana's coast. Our transportation and energy hubs cannot be replicated anywhere else, nor can our world-renowned culture. Our efforts to protect these assets through science-based coastal planning has spurred new cycles of investment and innovation. As long as people need what our coast gives, we will be here in coastal Louisiana making the Working Coast our home.

AT THE FOREFRONT OF SCIENCE AND INNOVATION

The unprecedented investment in coastal restoration and risk reduction in the last 10 years has put Louisiana at the forefront of using science and innovation to plan a sustainable future for our coastal communities and our valuable ecosystem. Our master plan approach with its long-term view, consideration of climate change, and integration of natural system and community resilience now leads the nation in large-scale ecosystem restoration thinking. The modeling approach, designed specifically to address the needs of the planning process and providing quantitative comparisons of options for action, is used across the world as a model for science-based coastal decision making. The close working relationships we have formed among researchers and practitioners, scientists and design engineers, agencies and academics, enables us to capitalize on years of study to move projects from concept to construction in a few years. This represents a significant workforce opportunity in coastal Louisiana with employment in the water management sector projected to increase 23% over the next 10 years.[4]

▲ FIGURE ES.4
Together, the Louisiana coast and the Mississippi River create billions in economic value.[4,5,6,7,8,9]

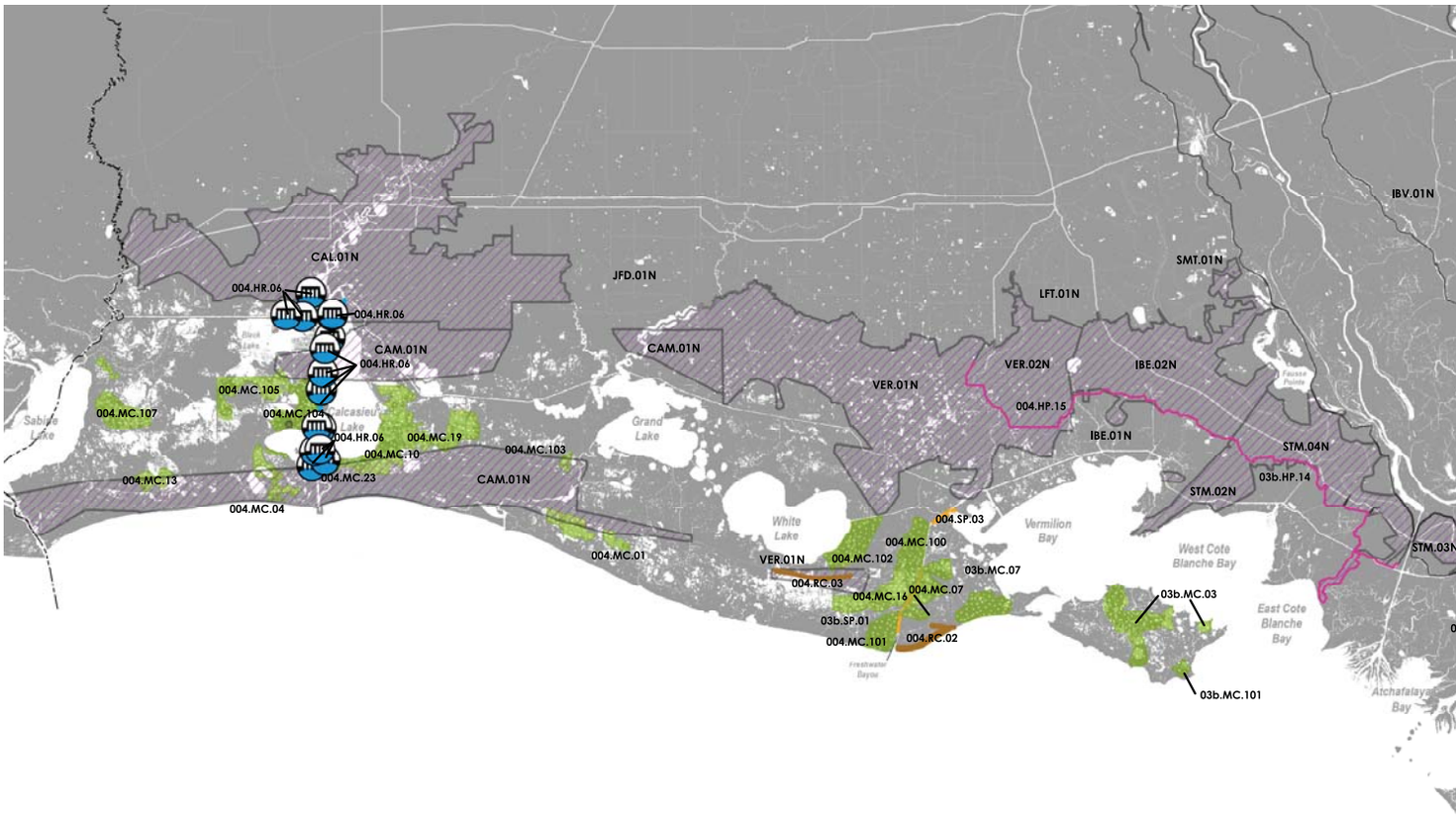
Photo courtesy of Louisiana Sea Grant

Louisiana's wetlands protect valuable infrastructure from storm surge and flooding. These assets include fisheries, oil and gas pipelines, petroleum reserves, and the Henry Hub – a national distribution point for natural gas. The Mississippi River and related ports and navigation channels provide the conduits for sending goods, such as bulk cargo and petrochemical products, north to U.S. producers or south to international markets. In 2014, Louisiana had the second highest commercial fishing landings in the United States (approximately 1 billion pounds).[5] This abundance is only possible because our coastal wetlands provide habitats for these species at varying stages in their lives.

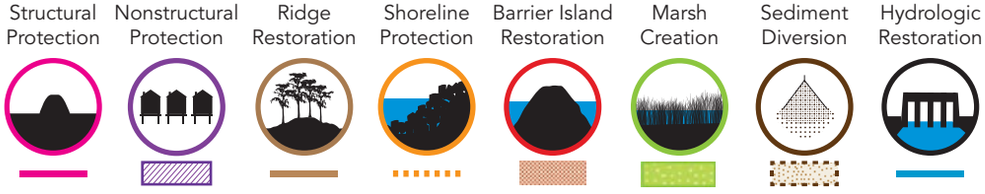
COASTAL LOUISIANA'S CONTRIBUTION TO THE NATION'S ECONOMY RUNS INTO THE HUNDREDS OF BILLIONS OF DOLLARS EACH YEAR, AND OUR COASTAL WETLANDS ARE CENTRAL TO THESE CONTRIBUTIONS. FROM AN ECONOMIC STANDPOINT ALONE, RESTORING THE WETLANDS MAKES SENSE, WHETHER YOU LOOK AT IT FROM THE VANTAGE POINT OF AN ECONOMIST, AN ECOLOGIST, OR A COASTAL RESIDENT WHO KNOWS THE VALUE OF THE LANDSCAPE FIRST HAND.

2017 COASTAL MASTER PLAN

A $50 BILLION INVESTMENT DESIGNED TO BUILD AND MAINTAIN LAND, REDUCE FLOOD RISK TO COMMUNITIES, AND PROVIDE HABITATS TO SUPPORT ECOSYSTEMS



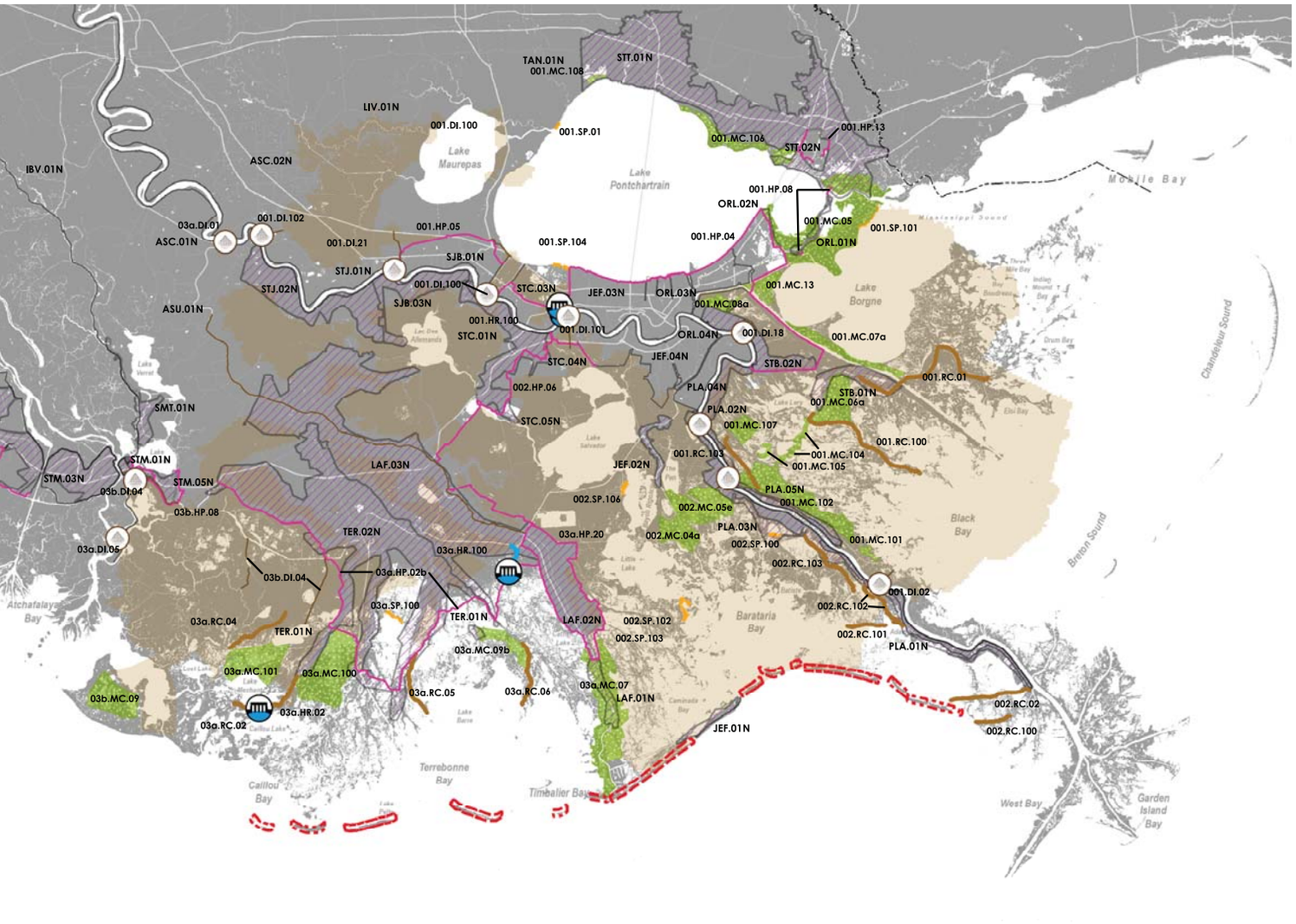
PROJECT TYPES



2017 COASTAL MASTER PLAN PROJECTS

The plan recommends 120 projects that build or maintain more than 800 square miles of land and reduce expected damage by $8.3 billion annually by year 50, or by more than $150 billion over the next 50 years, and are expected to pay for themselves three times over the course of implementing the plan.

The diversity of projects reflects the need to use all tools available to us, and to construct projects that build land and reduce risk in the near term while also investing in projects like sediment diversions and structural risk reduction projects that provide long-term benefits.



▲ FIGURE ES.5

The 2017 Coastal Master Plan includes 76 restoration, 12 structural risk reduction, and 32 nonstructural risk reduction projects that will be implemented throughout coastal Louisiana. Restoration projects build or maintain land and support productive habitat for commercially and recreationally important activities coast wide. Structural risk reduction projects reduce flood risk by acting as physical barriers against storm surge. Nonstructural risk reduction projects elevate and floodproof buildings and help property owners prepare for flooding or move out of areas of high flood risk.

THE PLAN RECOMMENDS 120 PROJECTS THAT BUILD OR MAINTAIN MORE THAN 800 SQUARE MILES OF LAND AND REDUCE EXPECTED DAMAGE BY $8.3 BILLION ANNUALLY BY YEAR 50, OR BY MORE THAN $150 BILLION OVER THE NEXT 50 YEARS.

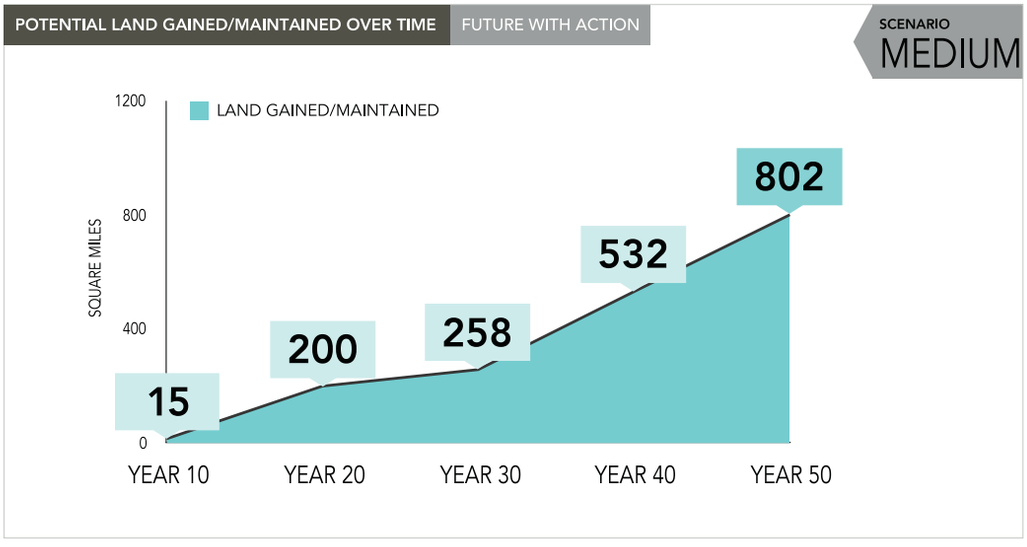
WHAT THE PLAN DELIVERS

BUILDING AND MAINTAINING LAND AND REDUCING FLOOD RISK

- The plan dedicates nearly $18 billion to marsh creation using dredged material, $5 billion to sediment diversions, and more than $2 billion to other types of restoration projects – providing land building benefits of more than 800 square miles, compared to the Future Without Action.
- The plan dedicates $19 billion for structural risk reduction and $6 billion for nonstructural risk reduction; these projects will save more than $8.3 billion in annual economic damage by year 50 as compared to Future Without Action and are expected to pay for themselves three times over the course of implementing the plan.
- The Flood Risk and Resilience Program focuses on proactive investments to make our communities more resilient. It provides for floodproofing of more than 1,400 structures, elevation of more than 22,500 structures, and acquisition of approximately 2,400 structures in areas that are most at risk.
- We know our risk will increase into the future, but through a combination of structural and nonstructural risk reduction projects, we estimate that we can reduce the expected annual damage we would face from storm surge by more than 75% for the Houma, Slidell, Franklin and Charenton, Edgard, Kenner and Metairie, lower St. Mary, and Prairieville and Sorrento regions, and by more than 90% for the Garyville, Ama, Laplace and Reserve, Algiers, Hahnville and Luling, Montz, Donaldsonville, Convent, Vacherie, Larose and Golden Meadow, Morgan City, Abbeville and Delcambre, and Iberia regions.

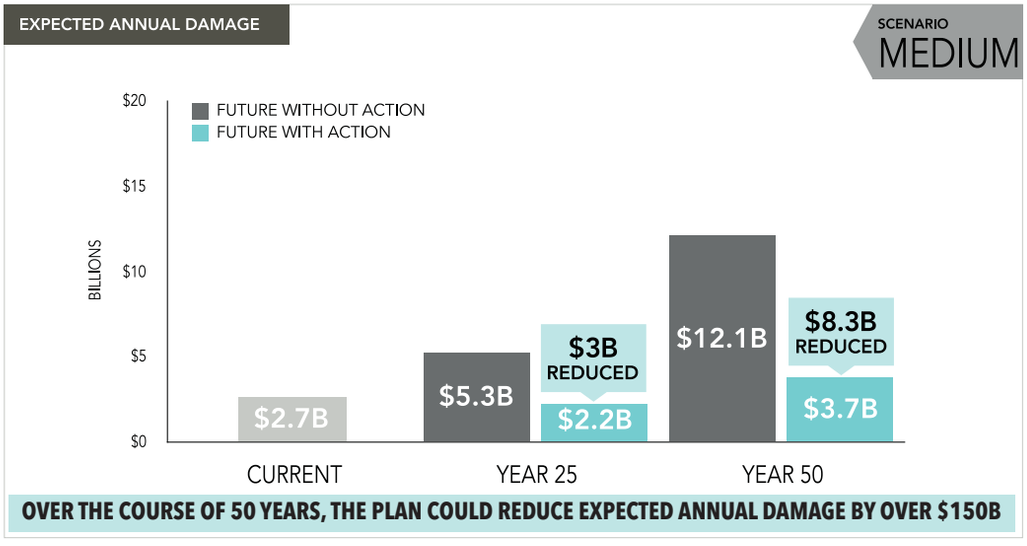
Photo courtesy of Lindsey Janies Photography

By increasing flood protection and building or maintaining land, the plan supports coastal industries, their infrastructure, and the workforce they depend on.



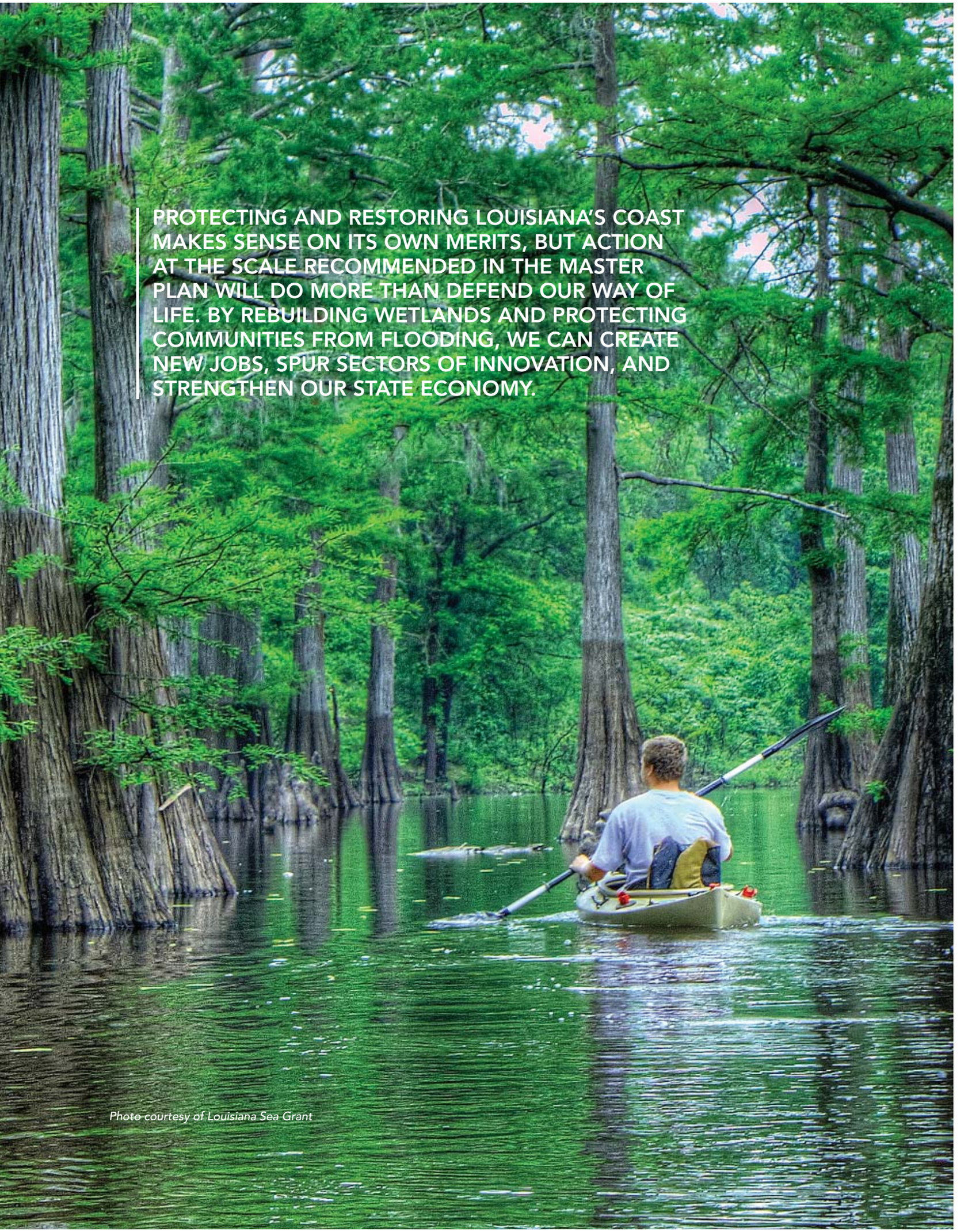
▲ FIGURE ES-6

By the end of 50 years, restoration projects in the 2017 Coastal Master Plan have the potential to create or maintain approximately 800 square miles of land under the Medium Environmental Scenario as compared to Future Without Action. The land building benefits provided by many of the restoration projects will continue beyond 50 years. These long-term benefits will support the key issues affecting people in and around Louisiana's coast.



▲ FIGURE ES.7

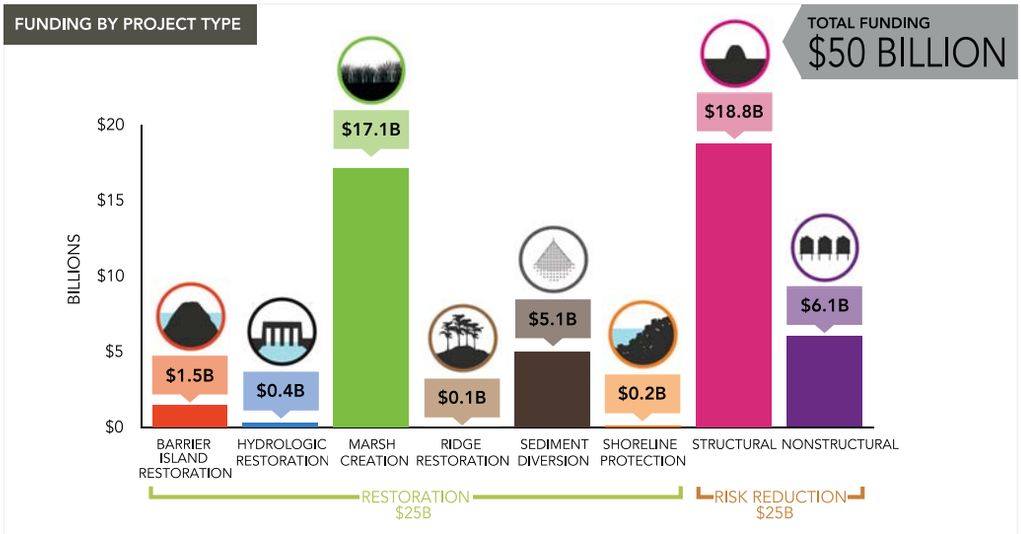
Projects in the 2017 Coastal Master Plan will reduce expected annual damage from flooding throughout Louisiana's coast. Expected annual damage, expressed in dollars, represents the average direct economic damage projected to result from a storm surge flooding event in any given year, taking into account both the expected damage and the overall chance of a storm occurring.



PROTECTING AND RESTORING LOUISIANA'S COAST MAKES SENSE ON ITS OWN MERITS, BUT ACTION AT THE SCALE RECOMMENDED IN THE MASTER PLAN WILL DO MORE THAN DEFEND OUR WAY OF LIFE. BY REBUILDING WETLANDS AND PROTECTING COMMUNITIES FROM FLOODING, WE CAN CREATE NEW JOBS, SPUR SECTORS OF INNOVATION, AND STRENGTHEN OUR STATE ECONOMY.

Photo courtesy of Louisiana Sea Grant

- The ecosystem benefits provided by the plan will support commercial and recreational fisheries and wildlife coast wide, along with other ecosystem outcomes that benefit our communities.
- The plan improves coast wide habitat for wild crawfish, largemouth bass, alligator, and mottled duck, as compared to Future Without Action conditions.
- The plan results in increased suitable habitat coast wide for species like adult bay anchovy and spotted seatrout, small juvenile white and brown shrimp, oyster, and green-winged teal as compared to initial conditions but reduced suitable habitat as compared to Future Without Action conditions at year 50.
- The plan results in similar coast wide suitable habitat for blue crabs, juvenile gulf menhaden, and gadwall at year 50 when compared to initial or Future Without Action conditions.
- The plan provides a blueprint for action that is consistent with and supportive of other efforts like the Mabus Report, the Gulf Coast Ecosystem Restoration Task Force's Regional Ecosystem Restoration Strategy, the Revived Economies of the Gulf Coast States (RESTORE) Act multi-year implementation plan, the Natural Resource Damage Assessment Programmatic Damage Assessment and Restoration Plan, and the mission of the National Fish and Wildlife Foundation. Additionally, the plan positions Louisiana for continued state and federal investment.
- The plan provides tremendous economic development opportunities for Louisiana and its citizens. Our investment in coastal research has spurred the growth of related fields. For example, learning to live with water is central to our wetland restoration and flood risk reduction strategies. The state's interest in this subject has created a welcoming business climate for water managers who help communities reduce flooding and promote effective water management strategies.



▲ FIGURE ES.8

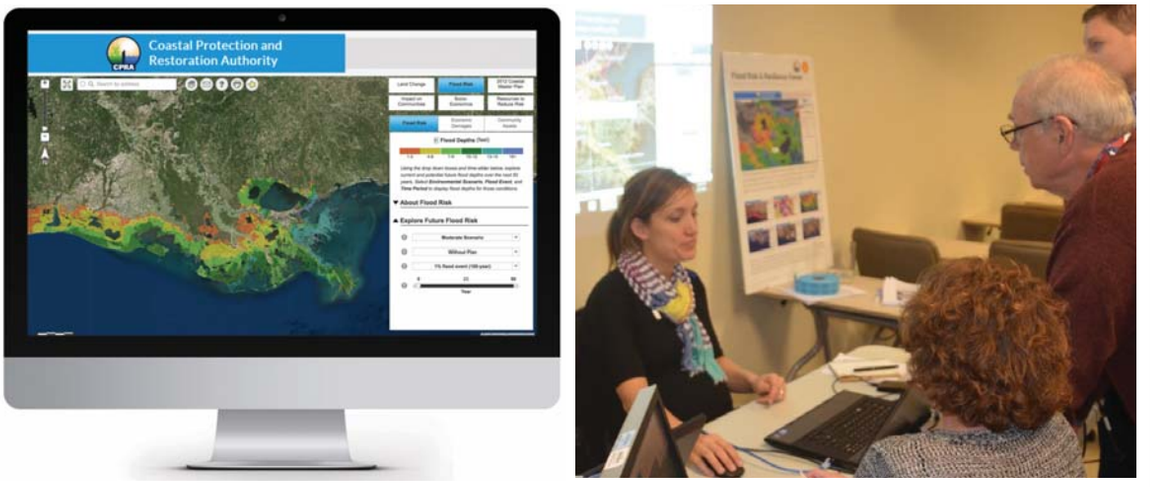
The 2017 Coastal Master Plan includes the nation's largest investment in marsh creation using dredged material and sediment diversion projects, both of which will provide land building benefits for areas in dire need. The diversity of projects reflects the need to use all tools available to us, and to construct projects that build land and reduce risk in the near term while also investing in projects like sediment diversions and structural risk reduction projects that provide long-term benefits.

MASTER PLAN DATA VIEWER

CONNECTING CITIZENS WITH INFORMATION AND MASTER PLAN PROJECTS

The Coastal Protection and Restoration Authority (CPRA) has made public access to information a priority and accessible through its Master Plan Data Viewer. This interactive tool enables coastal Louisiana residents to view potential flood risk to their community or property over time as well as land loss projections and various socio-economic dimensions across the coast. The Master Plan Data Viewer also provides updated information on the implementation of projects to enable citizens to stay connected to our progress. The viewer encourages flood risk awareness and promotes access to resources that can help communities reduce their flood risk.

MASTER PLAN DATA VIEWER



▲ **FIGURE ES.9**

Learn more about how flood risk impacts communities today and in the future, as well as how to make your community safer and more resilient. The Master Plan Data Viewer integrates and displays the results from the master plan along with additional coast wide data that allow for a broad examination of how flood risk impacts communities.

Visit the Master Plan Data Viewer at
http://cims.coastal.louisiana.gov/masterplan/

Photo courtesy of CPRA

TALK TO US

People want to know that their communities are being fully considered as decisions are made about projects and programs. Others worry that a particular project will make their lives difficult. To all of these people we say, "talk to us." We want to hear your concerns.

Our mission is to keep listening, learning, and having conversations with coastal residents. Comment on the master plan. Attend a community forum or request that a staff member from CPRA come and speak to your citizens' group. Email us at masterplan@la.gov.

Chapter 1
CLARITY OF FOCUS

- OUR TREASURED COAST
- OUR STRONG NATIONAL TIES
- WHAT'S NEW IN 2017
- OUR COMMITMENT

Photo courtesy of Louisiana Sea Grant

OUR TREASURED COAST

LOUISIANA'S COAST – A PRECIOUS NATURAL, CULTURAL, AND ECONOMIC RESOURCE

Photo courtesy of Louisiana Sea Grant

Our treasured coast is home to more than 2 million people who live, work, and play in coastal Louisiana just as many of our families have done for generations. Louisiana's diverse residents and visitors feel a bond with the coast that brings a unique quality of life to our communities. This bond derives from long-held cultural and economic ties to the ever-changing interaction of land, water, and people that defines life in the coastal area. Our dynamic landscape is unmatched anywhere in the United States.

Year round, our wetlands and estuaries support breeding, spawning, feeding, and nursery habitat for many fish species. Louisiana is both America's top recreational fishing destination and a primary contributor to the nation's seafood supply. As the #1 provider of shrimp, oysters, blue crabs, crawfish, and alligators in the United States,[10] Louisiana's commercial fishing industry produces 25% of all the seafood in the nation,[11] generating a total annual economic benefit of well over $2.4 billion and more than 26,300 local jobs.[12] Saltwater and coastal freshwater recreational fishing generates a total annual economic benefit of over $3.1 billion and more than 34,000 local jobs.[12]

Our wetlands account for 40 to 45% of all coastal marsh within the United States[11] and are one of our most productive and valued natural resources. Louisiana's wetlands serve as a buffer to protect coastal communities from storm surge, they are vibrant nurseries and habitat for countless plants and animals, and they help filter pollutants from runoff on its way to the Gulf of Mexico and oceans beyond.

The coast is home to a vast array of waterfowl, migratory birds, reptiles, and amphibians, and is a popular destination for wildlife watching and waterfowl hunting. In fact, our wetlands provide winter habitat for more than 5 million migratory waterfowl (an astonishing 20% of the entire continent's water bird population) and offer stopover habitat for millions of other migratory birds. Many of these species are considered Species of Greatest Conservation Need. Of the more than 100 species most in need of conservation action within the state, almost a third depend on coastal habitats for their continued survival.[13]

From hunting and fishing to nature trails and swamp treks, Louisiana's coast draws recreation enthusiasts from far and wide, annually contributing more than $400 million to the state's economy.[11]

Photo courtesy of iStock

Ecosystems are nature's way of contributing to resilient communities, the health and safety of vulnerable populations, and economic prosperity. The 2017 Coastal Master Plan integrates and emphasizes the value and functionality of the coastal ecosystem. This approach informs planning and decision making, preserves and enhances the benefits provided by the ecosystem, reduces the likelihood of unintended consequences, and promotes cost efficiencies and returns on investment. In this way, the 2017 Coastal Master Plan recognizes the interconnectedness of environmental, social, and economic considerations.

OUR STRONG NATIONAL TIES

LOUISIANA'S WORKING COAST IS VITAL TO THE NATIONAL ECONOMY

Coastal Louisiana has strong ties to the entire nation and provides an extensive transportation system for commodity flows to the entire world. Its historic and strategic location at the mouth of the Mississippi River, coupled with the Gulf Intracoastal Waterway and extensive pipeline infrastructure, make Louisiana the #1 export state in the nation. The working coast annually sends more than $120 billion in goods and services to the rest of the United States and exports $36.2 billion internationally.[11] The coast also supports infrastructure that supplies 90% of the nation's outer continental shelf oil and gas, 20% of the nation's annual waterborne commerce, and 26% (by weight) of the continental U.S. commercial fisheries landings.

Louisiana is at the heart of the U.S. petrochemical industry. We are the largest producer of crude oil, the second-largest producer of natural gas, the third-largest producer of petroleum, and the third-leading state in petroleum refining. Our Outer Continental Shelf houses 88% of U.S. offshore oil rigs. Louisiana's 15 natural gas storage facilities have a processing capacity of 18.5 billion cubic feet per day, enabling our coast to provide 20% of all domestic natural gas production. Our six refineries process more than 2.9 million barrels of gasoline per day, the second largest capacity in the United States.[4] Of the annual $747 billion in national refined petroleum production, $71 billion (9.5% of all national production) is attributable to coastal Louisiana.[11] Louisiana also produces 25% of the nation's petrochemicals, with a total value of chemical shipments at more than $14 billion a year, and is home to half of the U.S. Strategic Petroleum Reserves, the largest emergency fuel storage of oil in the world.

The working coast annually sends more than $120 billion in goods and services to the rest of the U.S. and exports $36.2 billion internationally.[11]

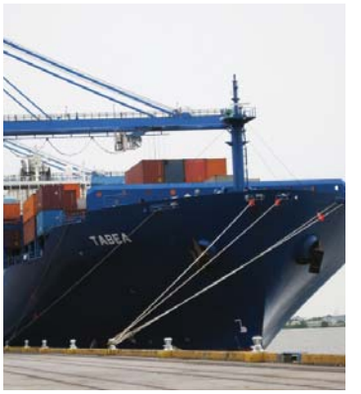


Photo courtesy of Louisiana Sea Grant

Coastal Louisiana has taken an unprecedented approach to tackling flood risk reduction, coastal restoration, and urban water management – and in doing so, catalyzed the development of a burgeoning water sector dedicated to environmental challenges related to efficient water management. Louisiana has created exportable expertise that uniquely positions its water management sector to compete for private and government water management jobs nationally and globally.[13]

NOWHERE IN THE NATION IS THERE A REGION THAT SIMULTANEOUSLY OFFERS GLOBALLY IMPORTANT HABITAT AND THE BREADTH OF ECONOMIC ASSETS AND HUMAN CAPITAL FOUND IN COASTAL LOUISIANA.

The water management sector (which includes construction products and services as well as business services, such as surveying, planning, engineering, and design) employs more than 30,350 workers in coastal Louisiana and is projected to grow 23% over the next 10 years – that's more than 13,600 projected job openings. By the year 2025, job openings for occupations in both water management and energy will reach 24,200.[13]

Additionally, Louisiana actively cultivates an ideal business climate for international trade, fisheries, tourism and cultural heritage, energy, petrochemicals, plastics, aerospace, advanced manufacturing, digital media, biosciences, emerging environmental products and services, and many other emerging industries.[4] The payoffs are clear: in 2015, Louisiana was named a Top 10 Business Climate in five national rankings published by international location marketing firm DCI and several economic development, business facilities, chief executive, and site selection magazines.

Louisiana's coastal habitats directly affect the health and biodiversity of the entire gulf region. In fact, the federal Gulf Coast Ecosystem Restoration Council recognizes our coast as integral to restoring the health and resilience of the entire Gulf of Mexico ecosystem.

Photo courtesy of iStock

DISRUPTION TO THE NATIONAL ECONOMY

Louisiana plays a critical role in providing gateways for national and international transportation of commodities. For example, a 2015 report prepared by Louisiana State University and The RAND Corporation estimated that direct and indirect impacts of land loss in coastal Louisiana put between $5.8 and $7.4 billion in annual output at risk. Similarly, they estimated that increased storm damage could have a total impact on the nation of between $8.7 and $51.5 billion, and increased disruption to economic activity leading to $5 to $51 billion in total lost output, including indirect and induced effects. For these reasons and more, Louisiana is committed to adapting to our changing landscape and combating future risk.[11]

WHAT'S NEW IN 2017

LOUISIANA IS FOCUSED ON PROJECTS THAT BUILD LAND AND REDUCE RISK, WHILE BALANCING DIVERSE OBJECTIVES

AN AMBITIOUS PATH TO IMPLEMENT EFFECTIVE PROJECTS

Developed using the best available science and engineering, the 2017 Coastal Master Plan moves us toward our collective goals of reducing economic losses to homes and business from storm surge flooding, promoting sustainable ecosystems, providing habitats for a variety of commercial and recreational activities coast wide, strengthening communities, and supporting business and industry. In providing a clear path forward, the 2017 Coastal Master Plan builds on past planning efforts from the 2007 and 2012 master plans and incorporates a keener focus on communities and flood resilience, new ideas and information, improved science and analysis, and expanded stakeholder engagement.

AN EMPHASIS ON COMMUNITIES

The goals of coastal restoration and risk reduction ultimately support the people who live and work in coastal Louisiana. More than ever, the 2017 Coastal Master Plan places a greater focus on our local communities. It is important to understand the cost of continued land loss and the potential effects of protection and restoration projects on local communities, local businesses, and regional and national economies. This plan weaves together the story of our coast, reflecting on past efforts but steadily moving forward to protect Louisiana's coastal communities.

How does our master plan relate to Louisiana's coastal residents? Appendix B, *People and the Landscape*, discusses issues of special relevance to people who live and work in coastal Louisiana, with emphasis on explaining the implications of rising sea levels, land loss, insurance issues, population shifts, and new economic opportunities.

FOCUS ON FLOOD RISK REDUCTION AND RESILIENCE

Using all the tools available to reduce communities' flood risk, different types of nonstructural options were explored and policies were refined to help communities become more resilient. As a result, this plan presents a detailed path forward for nonstructural project recommendations, implementation procedures, and policy recommendations. The plan presents a multitude of projects that help to achieve our collective goal of reducing flood risk while increasing our resiliency.

NEW IDEAS AND INFORMATION

The 2017 Coastal Master Plan considers an array of new project ideas not evaluated in 2012, most of which were submitted from across the coast by stakeholders. The result captured local knowledge of areas and problems and broadened transparency and inclusiveness.

IMPROVED ANALYSIS

The 2012 Coastal Master Plan was developed using state-of-the-art analysis, and the 2017 effort builds upon this. The improved project evaluation process reflects a deeper understanding of Louisiana's current coastal environment and the changes expected over the next 50 years. More advanced modeling tools were used to evaluate the projects considered for the 2017 plan. A larger geographic area and a wider range of ecosystem outcomes were incorporated, including additional fisheries and wildlife species. The spatial details of hydrology and flood risk models were increased. Altogether, these efforts establish a solid scientific and technical foundation for the plan now and in the years to come.

EXPANDED PARTNERSHIPS AND COLLABORATION

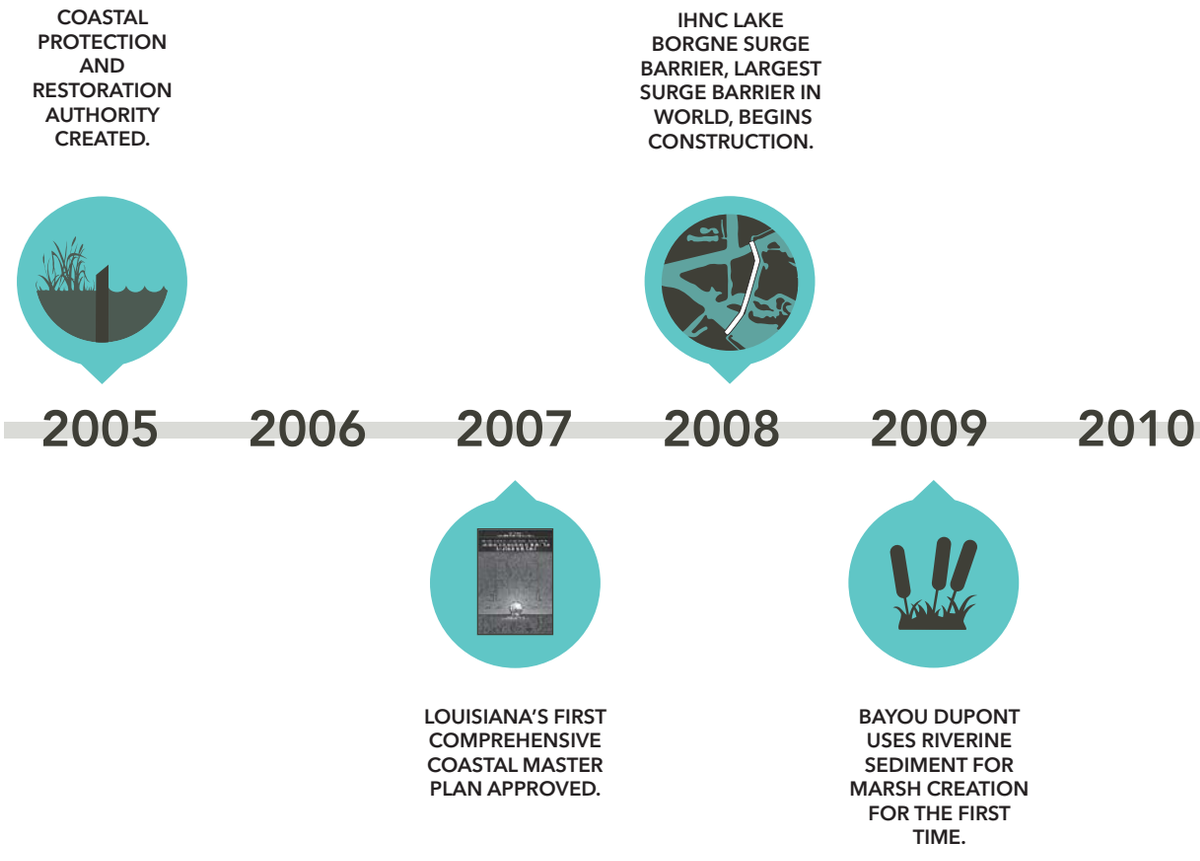
The 2017 Coastal Master Plan builds upon existing partnerships. Input was gathered from a diverse range of coastal stakeholders and extensive dialogue with the public. These partnerships include a coastal stakeholder advisory group as well as focus groups that represent Louisiana's coastal communities, landowners, and commercial activities (fisheries, navigation, energy, and industry). Coastal Protection and Restoration Authority (CPRA) is also coordinating closely with key groups, such as floodplain managers, hazard mitigation specialists, other state agencies, and non-government organizations (NGOs). CPRA continues to reach out to the public in new ways to better share information related to the changing landscape, a community's flood risk, and the solutions to create a more resilient and sustainable coast. In the end, these outreach efforts have strengthened the collaborative spirit, lending to the robust offering of projects in the 2017 Coastal Master Plan that will support our ecosystem and reduce risk for communities and vital economic and cultural resources.

CLEAR PRIORITIES FOR THE FUTURE

The 2017 Coastal Master Plan is more than just a plan. It is the guiding document of the state's collective efforts to maintain and restore the coast, built on a solid foundation of science and engineering. The master plan is not intended to provide any guarantees about the future, but rather it provides clarity and focus that enables Louisiana to build and implement projects that are the the most cost-effective investments for building land and reducing risk. In keeping with the mandate of the legislation that established CPRA, the 2017 Coastal Master Plan sets forth a comprehensive approach that integrates planning for the protection of our communities with planning for the environment to address the needs of the whole coastal system. This plan lays forth the bold strategies that are needed to respond to our ongoing coastal crisis.

OUR COMMITMENT

LOUISIANA'S COMPREHENSIVE, LONG-TERM VIEW INCLUDES LEADERSHIP AND COORDINATION AT LOCAL, STATE, AND FEDERAL LEVELS



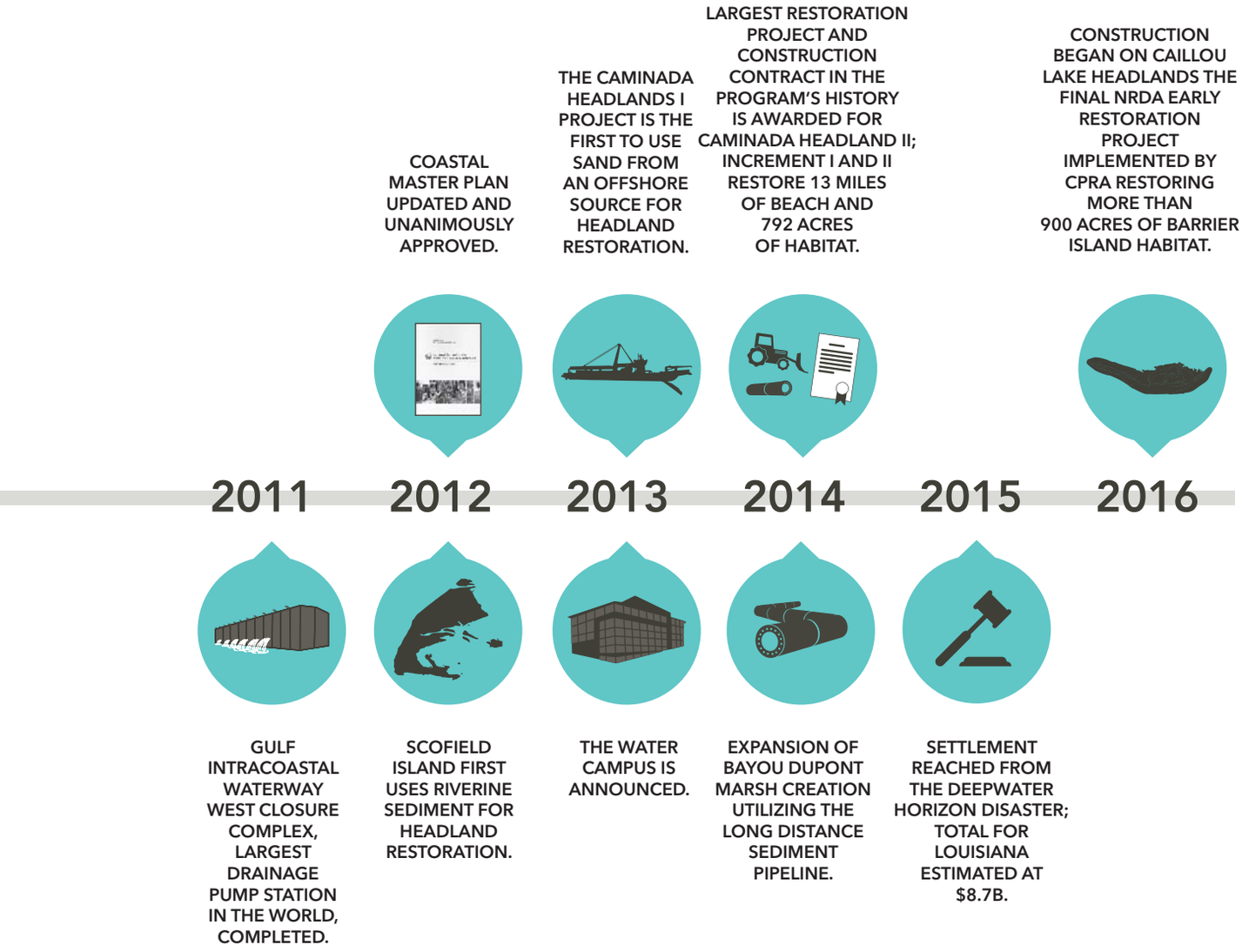
▲ FIGURE 1.1
Since the first Coastal Master Plan was approved in 2007, CPRA and its partners have worked to make comprehensive protection and restoration projects a reality.

COMMITMENT TO FINDING SOLUTIONS

In 2005, following Hurricanes Katrina and Rita, the Louisiana Legislature established CPRA and set in motion the creation of a comprehensive master plan for our coast that would be updated every 5 years with the best available information, and a fiscal annual plan that details the funding and implementation schedules for projects.

Much has changed over the past decade – additional hurricanes have ravaged our coast; we experienced the Deepwater Horizon Oil Spill, the worst environmental disaster in the history of our country; new funding sources are now available; and sea level rise projections have dramatically increased. What has not changed is the state's commitment to identify and prioritize projects that build and maintain land and reduce risk to our communities while balancing the diverse objectives of the master plan – provide flood protection, use of natural processes, build/maintain habitat for commercial and recreational activities, sustain our unique cultural heritage, and support our working coast. That groundwork was laid in 2007, refined and focused in 2012, and for 2017, we are building on those previous efforts to make sure our available funding is invested in projects that pay off now and also provide hope for our children and grandchildren.

Our Long-Term View. The master plan is focused on a long-term view and is a vehicle for coordinating Louisiana's local, state, and federal level responses to land loss and potential threats from hurricanes



and surge events. The master plan provides a list of projects that build/maintain land and reduce risk to our communities that will be refined, planned, engineered and designed, constructed, operated, and monitored.

Louisiana is not alone. If the latest "worst-case" scenarios for sea level rise produced by the scientific organizations participating in the United States' National Climate Assessment prove to be accurate, then coastal communities around the world will face tremendous risks. The approach we have established and the technical tools we have built to develop our master plan can be used as a framework to assist places like New York City, Miami, and the San Francisco Bay Delta, to name a few, as they work to develop and implement adaptation strategies specific to their respective regions.

Our Mission. CPRA's mandate is to develop, implement, and enforce a comprehensive protection and restoration master plan for coastal Louisiana. In partnership with all levels of government (including local levee districts) and other stakeholders, CPRA is working to ensure that the Louisiana coast supports our communities, the nation's critical energy infrastructure, and our bountiful natural resources for generations to come by securing funding, improving flood risk reduction, and creating and maintaining wetland and habitat.

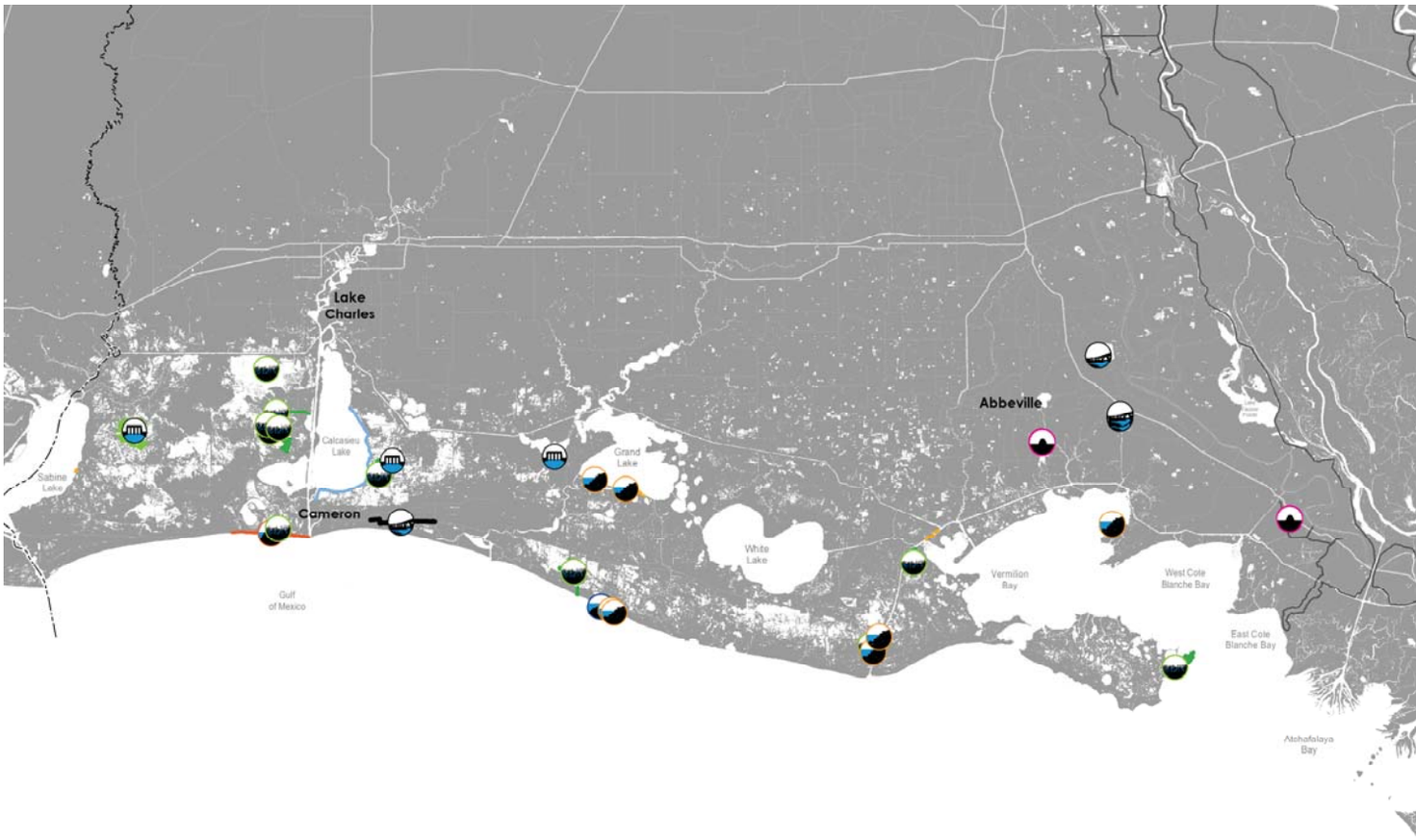
Chapter 2
PROGRESS ON THE GROUND

- PROGRESS SINCE 2007
- PROJECTS UNDERWAY

Photo courtesy of USACE

PROGRESS SINCE 2007

PROJECTS COMPLETED AND FUNDED FOR CONSTRUCTION

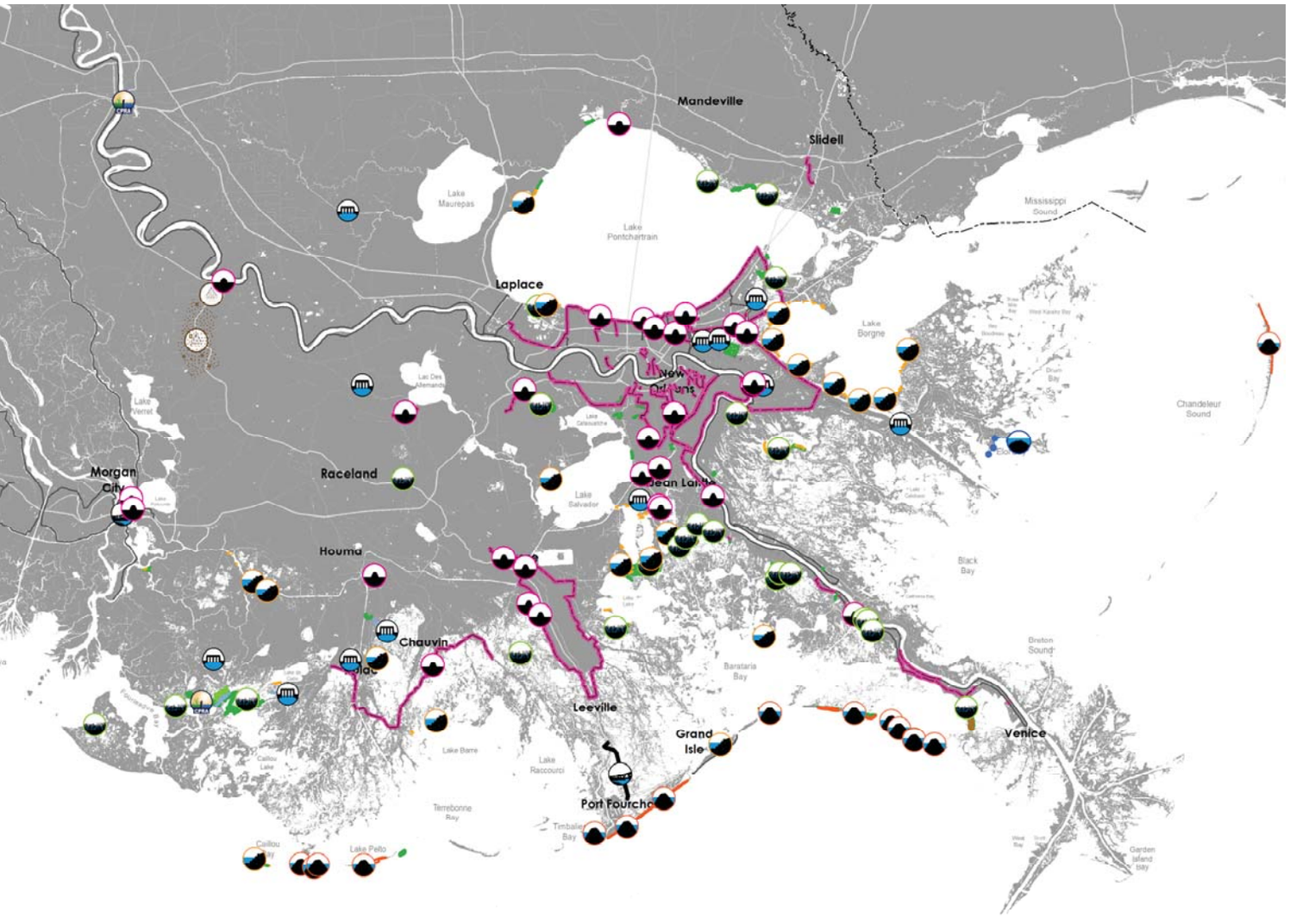


PROJECT TYPES

Structural Protection | Bank Stabilization | Oyster Barrier Reef | Ridge Restoration | Shoreline Protection | Barrier Island Restoration | Marsh Creation | Sediment Diversion | Hydrologic Restoration | Other

TANGIBLE RESULTS

Since the Louisiana Legislature adopted the first Coastal Master Plan in 2007, more resources have been invested in coastal restoration and risk reduction in Louisiana and more progress has been made than in any other period in our state's history. The key to success has been twofold – 1) our ability to get dollars on the ground quickly and efficiently to effect change and continually develop our foundation and 2) the science, the tools, and the people that support this critical work.



▲ FIGURE 2.1
Projects completed or funded for construction since 2007. Hurricane protection levee segments depicted here represent only those segments that have been built or are funded for construction. Land conservation and vegetative planting and bank stabilization projects are not depicted.

SINCE 2007, WE HAVE COMPLETED OR FUNDED FOR CONSTRUCTION A TOTAL OF 135 PROJECTS, RESULTING IN NEARLY 31,000 ACRES OF LAND BENEFITED, 275 MILES OF LEVEE IMPROVEMENTS, AND OVER 50 MILES OF BARRIER ISLANDS AND BERMS CONSTRUCTED OR UNDER CONSTRUCTION.

PROJECTS UNDERWAY

CPRA RESPONDS TO OUR LAND LOSS CRISIS WITH A SENSE OF URGENCY

CPRA and its partners are moving projects forward at an ever-increasing pace to ensure that everything possible is being done to address Louisiana's land loss crisis. In fact, we plan, engineer and design, and construct restoration and risk reduction projects in parallel to expedite our work. Featured below are some of the projects already underway. Progress on additional projects like the Mid-Barataria and Mid-Breton Sediment Diversions and Morganza to the Gulf are discussed in Chapter 5.

LONG DISTANCE SEDIMENT PIPELINE

The LDSP has borrowed and transferred nearly 10 million cubic yards of Mississippi River sediment to support Bayou Dupont Marsh and Ridge Creation projects in Barataria Basin and restoration of the Barataria Landbridge, and remains in place as a permanent pipeline corridor for future project use.

Project planning for the Long Distance Sediment Pipeline (LDSP) began in 2009 with construction beginning December 2013. This innovative approach allows for a sustainable sediment source to be transferred 10 or more miles from the Mississippi River and placed at current and future restoration project sites in lower Jefferson and Plaquemines parishes. This is an expansive area that desperately needs Mississippi River sediment to better protect the communities south of New Orleans and in Plaquemines and Jefferson parishes. The pipeline project itself will create and nourish approximately 542 acres of marsh. This project represents the first time sediment was dredged from the Mississippi River with the sole purpose of creating wetlands. This is important for two reasons. First, it brings in "new" sediment from outside of the coastal system rather than using dredged material from within that system. Second, it is a renewable source of sediment that can be periodically tapped using the permanent pipeline corridor.

BAYOU DUPONT MARSH AND RIDGE CREATION

Bayou Dupont Marsh and Ridge Creation projects have used a combination of marsh creation, ridge restoration, and earthen terraces to create over 1,000 acres of marsh, and over 11,000 linear feet of restored ridge.

Crucial sediment resources have been prevented from reaching this highly degraded area in the Barataria Basin for many years as an outcome of the Mississippi River flood-control levee system. Due to a combination of subsidence, dredging of oil and gas canals, and lack of freshwater and sediment input, between 1956 and 1990, there has been an average per year land loss rate of 2.76% around the project area. Located approximately 15 miles south of the community of Belle Chasse in Plaquemines and Jefferson parishes, the Bayou Dupont Marsh Creation project is a three-phase project that has been underway since before the 2007 Coastal Master Plan. All three projects are part of CPRA's concerted effort to restore marsh that was part of the original Barataria Landbridge. The third and final phase of the project was completed in December 2016. Because they used the LDSP, these projects have also used valuable and renewable sediment resources from the Mississippi River.

The Caminada Headland is over a 13-mile stretch of sandy beach and dune landscape located between Belle Pass to the west and Caminada Pass to the east at the southern end of Lafourche and Jefferson parishes. Over the last 100 years, Caminada Headland has experienced significant shoreline erosion and loss of critical marsh, wetland, beach, and dune habitats including Elmer's Island Wildlife Refuge managed by the Louisiana Department of Wildlife and Fisheries.

The Caminada Headland Beach and Dune Restoration project utilizes valuable sediment deposits from Ship Shoal located approximately 9 miles offshore. This project marked the first time Ship Shoal was used for restoration efforts. Originally part of a barrier island system that was submerged many years ago, Ship Shoal contains over 900 million cubic yards of high quality beach sand. These deposits not only add a tremendous source to the depleting coastal sand budget, but also improve barrier shoreline restoration project integrity and lifespan. Over $200 million in funding was invested in these two projects through the Coastal Impact Assistance Program, National Fish and Wildlife Foundation, and state surplus dollars.

CAMINADA HEADLAND BEACH AND DUNE RESTORATION

Spanning over 13 miles, requiring over 8 million cubic yards of sediment, and restoring nearly 800 acres, the Caminada Headland project is one of the largest restoration efforts CPRA has conducted to date.

Photos courtesy of Patrick M. Quigley and Lindsey Janies Photography

Top: Long Distance Sediment Pipeline Corridor. Bottom: Caminada Headland Beach and Dune Restoration: Aerial images of barrier shoreline restoration efforts along the Caminada shoreline.

CAMERON PARISH SHORELINE RESTORATION

Beach nourishment widened the Cameron Parish shoreline area up to 285 feet along some of the most severely eroded sections of beach, and sand fencing was installed to capture windblown sediment and to build the dune.

Portions of the shoreline along Cameron Parish in southwest Louisiana have been impacted by severe erosion rates, anywhere from 5 to 30 feet per year since 1953. Construction of the Cameron Parish Shoreline Restoration project was completed in early 2014, and the project extends a little over 5 miles westward of Calcasieu Pass along the shoreline to Holly Beach. Along this stretch of shoreline is a portion of Highway 82/27 and approximately 40,000 acres of freshwater marsh that was at a high risk of being permanently inundated with high salinity water if protection measures were not taken to prevent breaching of the shoreline. Field surveys located promising sediment deposits at two sites between 20 and 25 miles offshore from the project site. These deposits contained beach-grade sands that matched that of the historical shoreline and improved overall project longevity. In total, nearly 2 million cubic yards of sediment were dredged from offshore sources to benefit the project area.

Photo courtesy of Coast & Harbor Engineering

Cameron Parish Shoreline Restoration: Aerial view of sediment installation along the project shoreline.

The Town of Jean Lafitte is situated along the Barataria Waterway approximately 13 miles south of New Orleans and has seen a history of flood events from rainfall, tropical storms, and even extreme high tides. One project currently under construction in this area includes 3 miles of floodwall protection for the Fisher Basin that will tie into the pre-existing levee embankment on the east side, providing risk reduction to over 453 acres of zoned residential and non-residential property. The project was funded through a combination of surplus, capital outlay, and statewide flood control funds from CPRA and the Department of Transportation and Development (DOTD). On schedule to be completed by December 2018, the Lafitte Independent Levee District is leading this project and will be handling operations and maintenance after completion.

An additional project currently undergoing engineering and design is Rosethorne Tidal Protection, which will provide approximately 2 miles of floodwall protection and 3.5 miles of improved back levee, resulting in an increased level of risk reduction to 610 acres of residential and non-residential property. CPRA is focused on securing nearly $125 million in additional project funding to complete Rosethorne and future projects; these include tidal protection projects for Crown Point, Paillet Basin, Goose Bayou, and Lower Lafitte resulting in improved flood risk reduction for over 1,500 acres of residential and non-residential property.

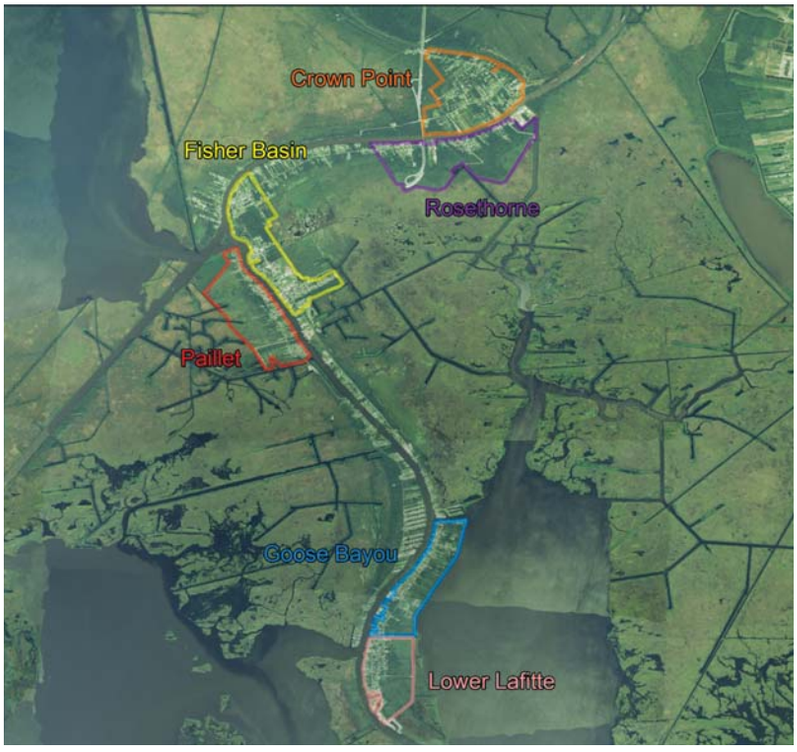


Photo courtesy of CPRA

JEAN LAFITTE TIDAL PROTECTION

High priority projects in the Jean Lafitte area will provide increased risk reduction to over 2,500 acres of residential and non-residential property through floodwall protection, improved back levees, and tidal protection.

CALCASIEU SHIP CHANNEL SALINITY CONTROL MEASURES

This project is expected to reduce land loss by 21,000 acres and includes building structures that will reduce heightened levels of salinity throughout the basin while also maintaining existing levels of flood risk reduction without hindering operations for the Port of Lake Charles. By reducing salinity intrusion from the current channel, the project will also help mitigate damage to fish and wildlife that depend on freshwater inflow inputs to reduce loss of valuable marsh.

The hydrology of the Chenier Plain has been substantially altered by the construction of navigation channels including the Calcasieu Ship Channel, Sabine-Neches Waterway, Gulf Intracoastal Waterway and numerous smaller canals. Saltwater intrusion due to these channels and relative sea level rise are considered to be the largest drivers of wetland loss in the Chenier Plain.

Local outreach efforts have enabled key feedback from commercial and recreational fishermen on their use of important waterways, whereby the design and location of project structures can reduce impacts to their business. The original project concept as included in the 2012 Coastal Master Plan included a navigation lock complex in the lower portion the shipping channel. During the planning phase, CPRA evaluated a range of structural approaches to control saltwater intrusion, including gates, locks and sills to limit entry of saltwater into the Calcasieu Ship Channel, as well as berms to prevent saltwater in the ship channel from passing into the lake and surrounding marshes. Collaboration with the Port of Lake Charles during the project's advanced planning effort helped to gather information on vessel traffic and enable project alternatives to be screened out based on their impacts to port operations.

CPRA received a $16 million grant from the U.S. Department of the Treasury in August 2016 to move forward with engineering and design of this project under the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States (RESTORE) Act, with a target date of 2020 to have the project construction ready.

Following the recommendation of the Increase Atchafalaya Flow to Terrebonne project in the 2012 Coastal Master Plan, a project investigation was initiated in 2013. The concept of the investigation was to design a river diversion along the Atchafalaya River between the Wax Lake Outlet and Bayou Lafourche to divert river water around the Bayou Boeuf Lock where the river intersects with the Gulf Coast Intracoastal Waterway (GIWW). Analysis has shown that navigability can be maintained and substantial wetland benefits derived with a flow of 5,000 cubic feet per second (cfs) over the first 30 years of operation.

Data collection efforts identified an extensive array of oil and gas pipelines crossing the GIWW where dredging was initially planned. Hydrodynamic modeling was used to look at dredging alternatives, which demonstrated that even with reduced dredging, the primary project objective of increasing eastward flow was possible, while minimizing the number of pipeline relocations and reducing costs. Shortening the extent of dredging reduced the amount of material available for beneficial use. CPRA is now examining locations on Avoca Island for marsh creation in place of the GIWW shoreline locations included in the 2012 Coastal Master Plan. Additional dredging will occur along distributary channels near the GIWW to direct flow into deteriorating marshes in southern Terrebonne.

INCREASE ATCHAFALAYA FLOW TO EASTERN TERREBONNE

This river diversion would help reduce salinity levels by allowing more freshwater to infiltrate wetlands that are being impacted by seasonal salinity spikes. The freshwater diversion would also allow fine sediment from the Atchafalaya River to be diverted into the western Terrebonne wetlands to reduce land loss by approximately 13,500 acres.

THE NEED TO BE PROACTIVE

CPRA is working to develop a healthy, resilient coast that is prepared to withstand future storms. In addition to identifying projects to be included in the master plan, CPRA is also working to secure funds for project implementation. Having priority projects identified in the master plan has allowed CPRA to respond more rapidly and effectively when recovery is necessary. For example, because master plan projects were identified, planned, and in some cases, designed with existing funds, those projects were immediately implementable in response to the Deepwater Horizon Oil Spill. CPRA's Flood Risk and Resilience Program was developed with the intent to have a list of shovel-ready nonstructural projects that are recommended for implementation in some of our most vulnerable coastal communities. These projects were also designed to consider future flood depths and environmental conditions so that our communities are planning ahead for changing levels of risk. Additionally, CPRA is developing a plan for barrier islands that identifies sources of sand and addresses environmental considerations so that shorelines can be rapidly restored after a storm event. Another benefit of these types of early planning efforts is that the costs associated with project implementation are generally lower than if the projects were designed and funded after an event.

Chapter 3
DEVELOPING THE MASTER PLAN

- PROGRESS CONTINUES
- OBJECTIVES & PRINCIPLES
- OUTREACH & ENGAGEMENT
- EXPANDED COORDINATION
- PUBLIC ENGAGEMENT
- THE PLAN DEVELOPMENT PROCESS
- PROJECT TYPES CONSIDERED
- PROJECTS CONSIDERED FOR 2017
- ENVISIONING OUR FUTURE COAST
- PLANNING FOR UNCERTAINTY
- FUTURE WITHOUT ACTION
- A CHANGING LANDSCAPE
- FLOOD RISK TO OUR COMMUNITIES
- PLAN FORMULATION PROCESS
- AN INTEGRATED APPROACH
- DECISION POINTS

Photo courtesy of Lindsey Janies Photography

PROGRESS CONTINUES

THE 2017 COASTAL MASTER PLAN STRATEGICALLY BUILDS ON PAST PROGRESS

Photo courtesy of USACE

This depiction of ongoing work at the 17th Street Canal Pump Station is an example of CPRA's continued commitment to New Orleans' Hurricane Storm Damage and Risk Reduction System.

Planning efforts to address risk reduction and restoration in coastal Louisiana have been ongoing for many decades, but it was not until after the devastating hurricanes in 2005 that coastal restoration and risk reduction planning and implementation were integrated through the coastal master plan process led by CPRA. With the 2007 Coastal Master Plan, CPRA defined its strategy to coordinate large-scale, coast wide risk reduction and restoration planning, thereby establishing a focused and effective approach to stakeholder coordination and comprehensive project implementation. Since then, CPRA and its partners have continued to incorporate the latest scientific research, refine modeling approaches, and advance decision-making processes.

This updated plan carries the 2007 and 2012 plans forward by improving the tools used to ensure projects are effectively evaluated and selected to achieve risk reduction and restoration goals. As before, the master plan objectives and principles shape our focus and strategy. We've used a detailed assessment of the future if we take no new action in combination with innovative tools and stakeholder input to identify the highest performing projects and most effective use of dollars. We've used large-scale solutions involving extensive dredging and placement of materials, better management of the resources of the Mississippi and Atchafalaya Rivers, as well as improved hydrology to address root causes of land loss and reduce flooding risk. We have used structural and nonstructural risk reduction measures to help mitigate risk for coastal residents.

EVERY 5 YEARS, THE LATEST ADVANCES IN SCIENCE AND ENGINEERING ARE INCORPORATED INTO CPRA'S DECISION-MAKING PROCESS TO ENSURE WE DEVELOP THE MOST EFFECTIVE PLAN.

OBJECTIVES & PRINCIPLES

OUR MASTER PLAN'S OBJECTIVES REFLECT THE KEY ISSUES AFFECTING PEOPLE IN AND AROUND LOUISIANA'S COAST

Our objectives seek to improve flood protection for families and businesses, harness the natural processes that built Louisiana's coastal landscape, sustain our unique cultural heritage, and ensure that our coast continues to be both a Sportsman's Paradise and a hub for commerce and industry.

Photos courtesy of CPRA, NASA's Earth Observatory, Louisiana Sea Grant, Louisiana Sea Grant, and lotsemann, respectively

Flood Protection. Reduce economic losses from storm surge based flooding to residential, public, industrial, and commercial infrastructure.

Natural Processes. Promote a sustainable coastal ecosystem by harnessing the natural processes of the system.

Coastal Habitats. Provide habitats suitable to support an array of commercial and recreational activities coast wide.

Cultural Heritage. Sustain the unique cultural heritage of coastal Louisiana by protecting historic properties and traditional living cultures and their ties and relationships to the natural environment.

Working Coast. Promote a viable working coast to support regionally and nationally important businesses and industries.

OUR PRINCIPLES REFLECT YEARS OF COASTAL PLANNING AND SERVE AS GUIDELINES FOR FULFILLING THE PLAN'S OBJECTIVES

Urgent Need for Action. The master plan recognizes the urgent need for action. A sustainable system is one characterized by consistent levels of productivity and resilience (the ability to withstand naturally variable conditions and/or recover from disturbances). Creating a sustainable system will reduce the long-term costs of projects, both in terms of energy use and operation and maintenance expenses. The plan relies, to the maximum extent possible, on natural cycles and processes while also keeping limited funding and resource budgets in mind.

Long-Term Solutions. The master plan is charged with providing a sustainable long-term solution for coastal protection and restoration. In keeping with this charge, our projects' tangible effects should be of long duration. For planning purposes, projects were evaluated, prioritized, and integrated using a planning horizon of 50 years. Beyond 50 years, uncertainties about environmental conditions such as sea level rise, project costs, and other factors become too great for the evaluation results to be reliable.

Systems Approach. The master plan was developed using a systems approach to flood risk reduction and restoration, whereby benefits of actions and the most effective portfolio of solutions were identified.

Clear Expectations. Evaluations were made with the understanding that we cannot recreate the coast of the 20th century. Instead, we must seek to fashion a new landscape that will support viable natural and human communities into the future.

Acknowledging Residual Risk. The master plan acknowledges that risk reduction systems (both structural and nonstructural) and restored coastal habitats cannot eliminate all flooding risks, and that some degree of residual storm surge-related risk will be inevitable in coastal Louisiana. The plan supports and promotes close coordination among all jurisdictional authorities to minimize the risk of property damage and inform stakeholders of ongoing residual risk.

Collective Responsibility. The master plan acknowledges the leadership that the state and its federal partners must show in defining the path forward. At the same time, achieving a sustainable coast is a collective endeavor. In addition to effective government action, success will require stakeholders to offer their ideas as planning proceeds and make informed decisions about living and working in south Louisiana. Strong flows of information between agencies and all stakeholders are essential to continued progress.

Providing for Transitions. Louisiana's coastal crisis is currently displacing resources, infrastructure, and communities. As we address this crisis, sensitivity and fairness must be shown to those whose homes, lands, livelihoods, and ways of life may be affected, in the near term and long term, by master plan projects or by continued land loss and flooding.

Participatory Process. The master plan was developed with the participation of the many diverse interests that live, work, play, and own property in coastal Louisiana, along with national interests that have a stake in coastal Louisiana's landscape.

Accounting for Uncertainties. The master plan considers how both financial and scientific/technical uncertainties influence the selection of projects. Although our restoration and risk reduction efforts must be based on sound and robust science, we must also acknowledge that substantial uncertainties remain, especially in regard to climate change. For example, we do not know with certainty the rate of sea level rise we can expect over the life of a restoration project, nor can we fully predict all ecological responses to actions such as sediment diversions. We do know, however, that dramatic land loss will continue unless we act boldly. In many cases, the risk of doing nothing is far greater than the risk of acting with incomplete knowledge. Thus, we used best available science and engineering, while recognizing that the quest for perfect knowledge may be both fruitless and ultimately counterproductive. Calculated risks will need to be taken to accomplish the objectives of the master plan.

Adapting to Changing Circumstances. To accommodate the dynamic nature of coastal processes, reducing flood risks and the restoration of coastal Louisiana is an evolving process. The master plan should lay the groundwork for an effective monitoring and evaluation process that seeks to reduce scientific and engineering uncertainty, assesses the success of the plan, and supports the adaptive management program. The plan will be revisited regularly, as mandated by legislation, and after exceptional events such as hurricanes. The plan will also be refined as necessary to respond to changing economic, social, environmental, and climatic conditions.

Efficient Use of Resources. The master plan was developed in a way that acknowledges the need for efficient use of resources, such as funding and sediment. The plan's analysis seeks to capitalize on synergies among projects, resolve overlaps and conflicts, and promote sound management of resources.

Sediment for Restoration. At present, limited supplies of, or access to, renewable sediment resources constrains the restoration efforts we can undertake. As a result, we have to also consider dredging options if natural processes do not offer us the sediment we need. The master plan recognizes the need to maximize the use of sediment sources outside the system.

Regulatory Effects. Revisions to some laws and regulations may be needed to help the state's coastal program achieve its goals. The master plan highlights where such changes may be needed so that local, state, and federal partners are able to act in concert with the plan.

Role of Private Landowners and Business and Industry. Because the majority of Louisiana's coast is privately owned, close working relationships with private landowners are essential, not only for their support but to gain from their knowledge about private coastal lands. Since Louisiana's is also a working coast, partnerships with businesses and industries are also required for the success of the coastal program. The support of all of these entities is essential for providing coast wide consistency with the master plan's objectives and outcomes as well as innovate approaches to project implementation.

ENSURING CONSISTENCY

Given the emergency facing coastal Louisiana, it is imperative that all government agencies act quickly and in accordance with the master plan. Governor Edward's Executive Order No. JBE 2016-09 highlights the need for the plan to drive and expedite state action across agencies. The same need applies to the state's partners at the local and federal levels, consistent with their mandates and missions. While the master plan provides the blueprint for restoration and planning activities in coastal Louisiana, a coalition of support from the nation will be required if we are to create a more sustainable and resilient coastal Louisiana.

OUTREACH & ENGAGEMENT

THE MASTER PLAN REPRESENTS OUR COLLECTIVE DESIRE TO PROTECT AND RESTORE OUR COAST

The 2017 Coastal Master Plan is a Louisiana plan for Louisiana people – a plan based on science and responsive to the needs of our communities. Given the concentration of industrial development and a large population made up of individuals who each have their own unique stories and sense of place, the master plan must represent a number of diverse groups with varied opinions. By bringing these stakeholders together through consistent engagement and ongoing dialogue, we find common ground in our collective desire to protect and restore our coast for generations to come.

IMPROVEMENTS TO OUTREACH AND ENGAGEMENT

Louisiana engages coastal stakeholders and communities to better understand the challenges facing citizens impacted by coastal land loss, gather their input, and improve integration between state and local activities. The 2017 Coastal Master Plan builds upon extensive engagement networks, offers opportunities for input, and provides information through web-based tools.

Expanding Outreach Groups. To engage communities, Louisiana hosts targeted meetings across the coast for various initiatives. These meetings include an informal open house or use a small group format to facilitate interactions so citizens can ask questions and voice concerns or suggestions. The state works closely with NGOs and community organizations to co-host small meetings focused on providing key information about the master plan and receiving critical feedback and input. Based on stakeholder feedback, new focus groups were established to further engage and incorporate the perspective of community organizations and landowners. In addition, the previous Oil and Gas Focus Group was expanded to become the Energy and Industry Focus Group to better represent the variety of Louisiana's coastal industries. Other efforts to expand engagement include forming the State Steering Committee, which is comprised of more than 20 state agencies that represent a broad range of mandates affected by our efforts to protect and restore coastal Louisiana. In addition, a Parish Floodplain Managers Group was established to gather feedback on the 2017 plan and the Flood Risk and Resilience Program. Lastly, the Flood Risk and Resilience Stakeholder Group was formed, which includes local floodplain managers, parish planners, NGOs, community groups, and researchers/academics, to provide valuable feedback on key areas of the Flood Risk and Resilience Program.

Providing New Tools and Platforms for Engagement. The 2017 plan's outreach program utilized a variety of digital outlets to engage citizens and provide them with resources and information. One of the main tools we used was a more comprehensive website. The CPRA website, **http://coastal.la.gov/**, includes several web-based portals that provide user access to information about master plan and other projects, and a wide range of supporting geospatial data through the Coastal Information Management System (CIMS). The website includes educational resources, such as downloadable documents, webinars, and educational videos that are available in English and Vietnamese, as well as a Frequently Asked Questions page. We used social media platforms, including Facebook and Instagram, to publicize upcoming events, post photos from meetings, and provide other information of interest. To reach a broader audience, CPRA hosts webinars about the technical tools, project selection process, decision-making framework, and Flood Risk and Resilience Program. One of the new tools available to the public is the Master Plan Data Viewer. This interactive tool enables residents to view potential flood risk to their community or property over time as well as land loss projections, potential impacts to communities, infrastructure, and transportation, and various socio-economic dimensions across the coast. The Viewer also provides updated information on the implementation of coastal master plan projects and lets citizens track their progress.

PARTNERS AND ADVISORY GROUPS

A variety of stakeholders serve as key partners and advisors. To provide input throughout the development of the 2017 Coastal Master Plan, we engaged a diverse group of stakeholders to serve as key partners and advisors in helping to determine how best to meet the state's current restoration and risk reduction needs and adapt to future conditions. These stakeholders represent communities, business and industry, federal agencies, non-profits, academia, local organizations, coastal scientists, planning experts, and more. These groups did not formally or informally endorse the master plan; instead, their role was to provide recommendations and guidance as it was developed so that the master plan would ultimately reflect a broad range of perspectives and a world-class technical approach. Appendix G, *Outreach and Engagement*, lists the groups' participants and provides meeting summaries.

The Framework Development Team (FDT) served as the primary collaborative group supporting and providing insight and counsel to the Planning Team. FDT membership included federal, state, and local governments; NGOs; business and industry; academia; and coastal communities. FDT members offered specific guidance on major elements of the 2017 Coastal Master Plan and, as key advisors, they identified, discussed, and reached a common understanding about the tough choices that lie at the heart of protecting and restoring Louisiana's coast. FDT members reached out to citizens, bringing their ideas to the table and, later, reporting back to these citizens about how their ideas were discussed and addressed in the 2017 plan. In this capacity, the FDT served as an important distribution network for early-stage communications.

Focus Groups met regularly with the Planning Team to discuss plan development and implementation as part of CPRA's effort to expand stakeholder engagement and to incorporate their input on an ongoing basis. Large-scale coastal restoration and risk reduction affects communities, businesses, and industry in south Louisiana, the entire state, and even the nation. The Planning Team utilized five focus groups to integrate community, fisheries, landowner, energy, industry, and navigation perspectives. At least one member of the FDT supported each focus group, and results from the focus groups' deliberations were reported at FDT meetings.

The Science and Engineering Board (SEB) includes scientists, engineers, and planners with national or international experience who cover the range of disciplines addressed in the 2017 Coastal Master Plan. The SEB provided independent technical review of plan elements and made recommendations about how the Planning Team could improve the scientific basis and/or planning elements to create the most credible approach.

Technical Advisory Committees (TACs) were small advisory groups made up of nationally known researchers and practitioners who offered insight into specific elements of the master plan process. The 2017 Coastal Master Plan included two technical advisory committees. First, the Resiliency TAC offered working-level guidance and recommendations on the programmatic and policy measures needed to implement a comprehensive Flood Risk and Resilience Program. Second, the Predictive Models TAC advised the technical teams working to improve the analytical tools that assessed how the coastal Louisiana landscape will evolve over the next 50 years and how that may result in changes in risk for coastal communities.

EXPANDED COORDINATION

FEDERAL, STATE, AND LOCAL PARTNERSHIPS HELP BUILD OUR SUCCESS

FEDERAL PARTNERSHIPS

At the federal level, Louisiana is enhancing coordination of structural protection, nonstructural protection, and restoration project activities. Federal agencies are a key partner in the planning and implementation of restoration and risk reduction projects and in the development of other programmatic initiatives. In addition to serving an important regulatory and oversight role, federal agencies are significant stakeholders in Louisiana's various initiatives to reduce flood risk, improve mitigation, and promote healthy ecosystems across the coast.

Louisiana works closely with the U.S. Army Corps of Engineers (USACE) on a wide range of initiatives, including flood risk reduction and large-scale restoration planning. CPRA is the primary local cost-share partner for USACE for levee construction and flood control activities. Along with local levee districts, the state recently assumed the operations and maintenance of many of the components of the greater New Orleans Hurricane Storm Damage and Risk Reduction System. USACE declared the newly upgraded $14 billion levee and flood gates system complete in 2014 and turned responsibility for ongoing levee lifts, maintenance, and operational activities over to the state and local agencies. The Louisiana Coastal Area (LCA) program utilizes a systematic approach to coastal restoration and promotes critical near-term ecosystem restoration projects and large-scale studies and programs to restore natural features and ecosystem processes. CPRA and USACE are working on the LCA Mississippi River Hydrodynamic and Delta Management Study, a $25.4 million study that assesses in-river processes and evaluates restoration opportunities in the adjacent basins. The project's goal is to provide a decision-making framework for the management of a sustainable coastal ecosystem that integrates navigation, fisheries, flood control, land building, and the needs of coastal communities. CPRA is also partnering with USACE for the Southwest Coastal Louisiana Feasibility Study, a 50-50 cost-share project to develop a comprehensive hurricane/storm damage risk reduction and coastal restoration plan for Cameron, Calcasieu, and Vermilion parishes. Louisiana continues to work with USACE to increase the beneficial use of dredged material. Recognizing that rebuilding wetlands depends on increasing available sediment resources, CPRA encourages USACE to use the full extent of its federal consistency authority to promote beneficial use of dredged sediment, especially with material dredged from navigation channels along the Mississippi. CPRA is a member of the USACE Louisiana Silver Jackets Team, an intergovernmental team composed of federal, state, and local agencies with missions pertaining to flood risk, hazard mitigation, emergency management, floodplain management, natural resources management, and conservation.

FEDERAL PARTNERSHIPS, CONTINUED

As recommended in the 2012 Coastal Master Plan, CPRA enrolled in the Cooperating Technical Partners (CTP) program with the Federal Emergency Management Agency (FEMA). Through this process, CPRA will work with FEMA and other CTP partners, including the Department of Transportation and Development (DOTD), the Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP), the Water Institute of the Gulf, and the Louisiana State University (LSU) AgCenter to support FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) initiative. This initiative will improve Louisiana's flood insurance rate maps. CPRA continues to monitor and participate in FEMA's Levee Analysis and Mapping Procedures Program to ensure that levees and coastal features are considered when evaluating local communities' flood risks.

Louisiana partners with the United States Department of Housing and Urban Development (HUD) to implement the Community Development Block Grants (CDBG) funds that are used for flood risk reduction infrastructure projects. Since 2012, $29 million in CDBG funds have been approved for flood risk reduction projects. Recently, CPRA helped the Office of Community Development-Disaster Recovery Unit (OCD-DRU) apply for HUD's National Disaster Resilience Competition (NDRC). By integrating CPRA's analysis of future land change and flood risks, the state received $92.6 million in grants for the Louisiana Strategic Adaptations for Future Environments (LA SAFE) Fund and Isle de Jean Charles Resettlement projects.

CPRA helped develop the National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management's "Sea Level Rise and Coastal Flooding Impacts" viewer, which visually displays data showing the effects of increasing sea level rise (up to 6 feet) on coastal Louisiana. CPRA is a key partner in refining the tool and provides input into the tool's Louisiana's flood protection infrastructure data, technical analysis process, and other data utilized.

CPRA collaborates with the United States Geological Survey (USGS) to obtain new datasets (e.g., LiDAR) to formulate the master plan. USGS helps CPRA manage its data and recently developed the CIMS web-accessible database. CIMS provides users with information about CPRA's protection and restoration projects, Coastwide Reference Monitoring System (CRMS) data, master plan data, and other documents and datasets for download. As part of this initiative, USGS created CPRA's Master Plan Data Viewer. Lastly, USGS is also expanding the Louisiana Sand Resources Database (LASARD), which manages data for sand/sediment coastal restoration.

STATE PARTNERSHIPS

Through the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) Program, CPRA works with five federal agencies - U.S. Environmental Protection Agency, NOAA - National Marine Fisheries Service, National Resources Conservation Service (NRCS), U.S. Fish and Wildlife Service, and USACE - to develop coastal wetlands restoration projects. The program has spent nearly $300 million on restoration over the last 4 years.

The 2017 Coastal Master Plan is Louisiana's plan. Because many state departments and agencies representing a broad range of interests and mandates are involved in coastal protection and restoration, we established a State Steering Committee. The State Steering Committee includes representatives from approximately 30 departments and agencies and provides an opportunity for these individuals to receive regular updates and to share their input in the development of Louisiana's 2017 Coastal Master Plan.

The Flood Risk and Resilience Subcommittee was established to improve cross-agency collaboration. This group consists of CPRA board members, GOHSEP, OCD, Louisiana Housing Corporation, Department of Environmental Quality (DEQ), DOTD, Department of Economic Development, Department of Insurance, local levee board members, and parish representatives who provide specific insight into future nonstructural measures and activities. The subcommittee streamlines, coordinates, and helps to develop individual agency efforts to enhance decision making, focus resources on critical areas, and provide recommendations on policies and procedures for nonstructural implementation.

With an increased focus on the Flood Risk and Resilience Program and developing Louisiana's nonstructural application process, CPRA is improving coordination with GOHSEP and OCD to incorporate lessons learned from other hazard mitigation and nonstructural grant programs and to leverage existing resources and expertise. In addition to developing the 2017 Coastal Master Plan and Flood Risk and Resilience Program, CPRA works with GOHSEP to develop the State Hazard Mitigation Plan. CPRA also works with the Department of Natural Resources Office of Coastal Management (DNR-OCM) and the Louisiana Coastal Resources Program to ensure consistency across all projects in the Coastal Zone.

LOCAL PARTNERSHIPS

At the local level, the state works to increase coordination and collaboration between local levee districts, parish governments, tribal leaders, and community groups. For instance, CPRA works with local levee districts to further structural and nonstructural risk reduction projects and restoration planning and implementation. The CPRA Board includes representatives from Southeast Louisiana Flood Protection Authority East/West, Pontchartrain Levee District and the South Lafourche Levee District. CPRA also reaches out to the Association of Levee Boards of Louisiana to help develop the master plan.

Additionally, CPRA established the Floodplain Manager Group to improve coordination with local parishes and floodplain managers in providing feedback on the 2017 Coastal Master Plan and the Flood Risk and Resilience Program. The group is composed of local coastal zone managers, floodplain managers, emergency preparedness managers, planners, and local officials. The group's input is critical to the development of a comprehensive and holistic nonstructural program that reduces flood risk across the coast.

Louisiana is increasing partnerships with tribal communities and local community advocates through the creation of the Community Focus Group. The focus group helps guide the development and implementation of the master plan and educates and informs other citizens about ongoing coastal protection and restoration activities. Community Focus Group members include tribal leaders from Grand Caillou/Dulac Band of Biloxi-Chitimacha-Choctaw, Pointe-au-Chien Indian Tribe, and United Houma Nation. Other NGOs and community advocates include Bayou History Center, Bayou Interfaith Shared Community Organizing, Catholic Charities of the Diocese of Houma-Thibodaux, Coastal Communities Consulting, Inc., Lower 9th Ward Center for Sustainable Engagement and Development, Mary Queen of Vietnam Community Development Corporation, and Oxfam. The state is also partnering with local NGOs and community groups to communicate with local communities about the master plan.

Local non-profit organizations and foundations also play a vital role in supporting the master plan and in conducting outreach to their respective constituents and communities about coastal protection and restoration activities. Many of these organizations have a pulse on the community, including long-term relationships and direct insight into the needs or concerns of citizens, and serve as a liaison between CPRA and Louisiana's citizens. Public participation and collaboration is vital and the inclusion of various community groups and community advocates will bring local citizen's perspectives to developing and implementing the master plan.

PUBLIC ENGAGEMENT

LOUISIANA'S CITIZENS AND LEADERS PROVIDE KEY INSIGHTS AND PERSPECTIVES

The 2017 Coastal Master Plan public engagement effort combined opportunities to hear from coastal communities in person and online. Our 2017 outreach and engagement efforts began in 2014 as we requested restoration and risk reduction project ideas and concepts from citizens. We received 155 project ideas from 42 project sponsors and used this information to develop the list of projects that were analyzed as part of the master plan effort.

COMMUNITY CONVERSATIONS

During the spring of 2015 and again in the spring of 2016, we hosted a series of community meetings across coastal Louisiana to hear residents' perspectives about successful flood risk mitigation efforts, including what worked well, what could be improved, what prevents them from taking steps to reduce flood risk, and what types of nonstructural projects would be most beneficial.

These community conversations, combined with the development of tools and materials to help communities understand available resiliency measures, have placed coastal citizens and leaders in the unique position of active ownership in their future adaptation decisions. In addition, they provided CPRA with local community perspectives on flood risk and resilience and have empowered individuals in coastal communities to understand their flood risk mitigation options.

During October and November 2016, the Planning Team hosted seven community meetings in partnership with local community organizations. These community meetings obtained feedback on draft lists of potential projects through facilitated discussions. More than 500 individuals participated in these community conversations. The meetings brought out several key issues and themes that were factored into the development of the 2017 Coastal Master Plan.

Photo courtesy of CPRA

Some of the key take-aways from our community conversations are as follows:

Balance. Many attendees recognized the need for balance: short-term and long-term needs, focus on science and people, and a balance between different restoration, structural and nonstructural projects.

Understanding. Citizens sought more details on predicted future land loss and flood risk, specific projects, implementation schedules, and available funding and requested more details be provided when the draft plan was released. Participants also understood there are finite financial resources to implement projects and this was a major concern, especially as it relates to the Flood Risk and Resilience Program.

Coordination and Streamlining. Residents also stressed the need for urgent action along Louisiana's coast and encouraged continued and increased coordination between government and private entities to leverage funding streams and streamline permitting. Others discussed policy details such as mitigation requirements and availability and affordability of flood insurance. Lastly, citizens stressed the need to make decisions based on science and to be transparent in order to build trust and credibility at home and in Washington, D.C.

COMMUNITY CONVERSATIONS

"Focus on the people! Tell the truth! No false hope!"

"Our kids and grandkids won't see the delta; they won't know what a beautiful place this is."

"Why should we give up because of sea level rise? The river can build land."

"People will try to stay with their livelihoods; they'll fight to the end to stay."

"Listen to the communities you are trying to protect."

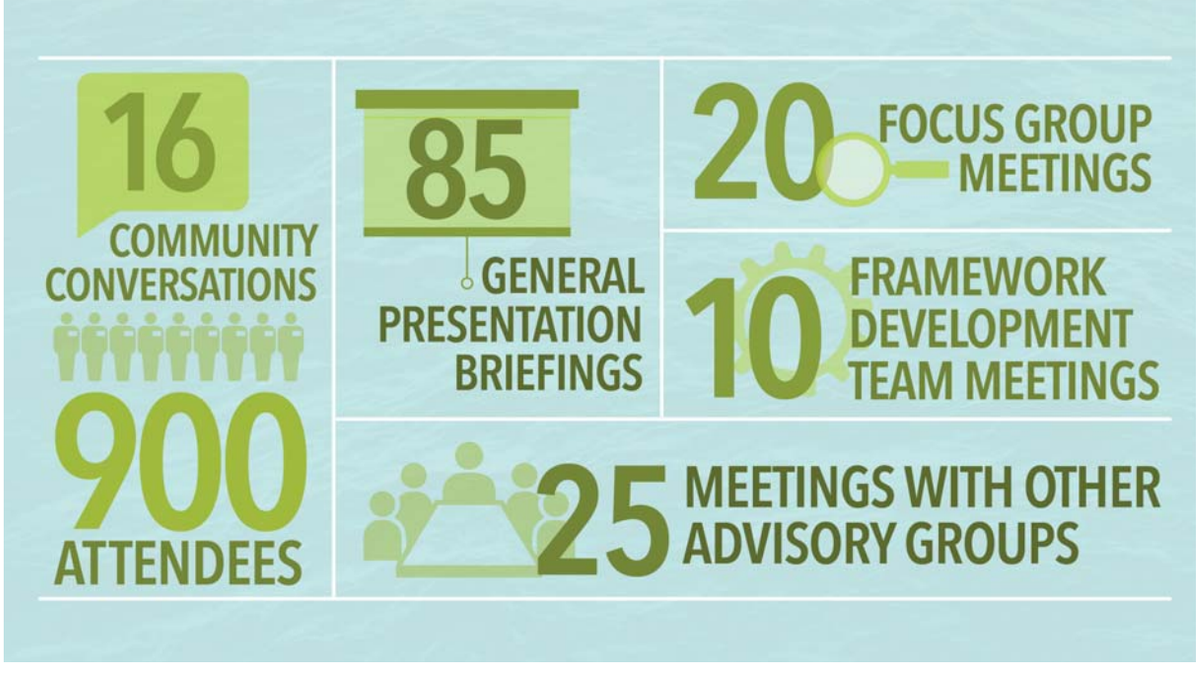
"Make sure that people understand that things are happening and they shouldn't be scared. But everyone will need to be involved."

"It's too good to lose."

BRIEFINGS AND PRESENTATIONS

Throughout the process, we hosted in-person meetings and webinars with the technical community to provide updates on different analytical aspects of the 2017 plan. The feedback helped refine our technical analysis and approach. Additionally, we made available for public review the majority of the technical appendices documenting the models used to evaluate projects and alternatives for the 2017 plan well in advance of its release.

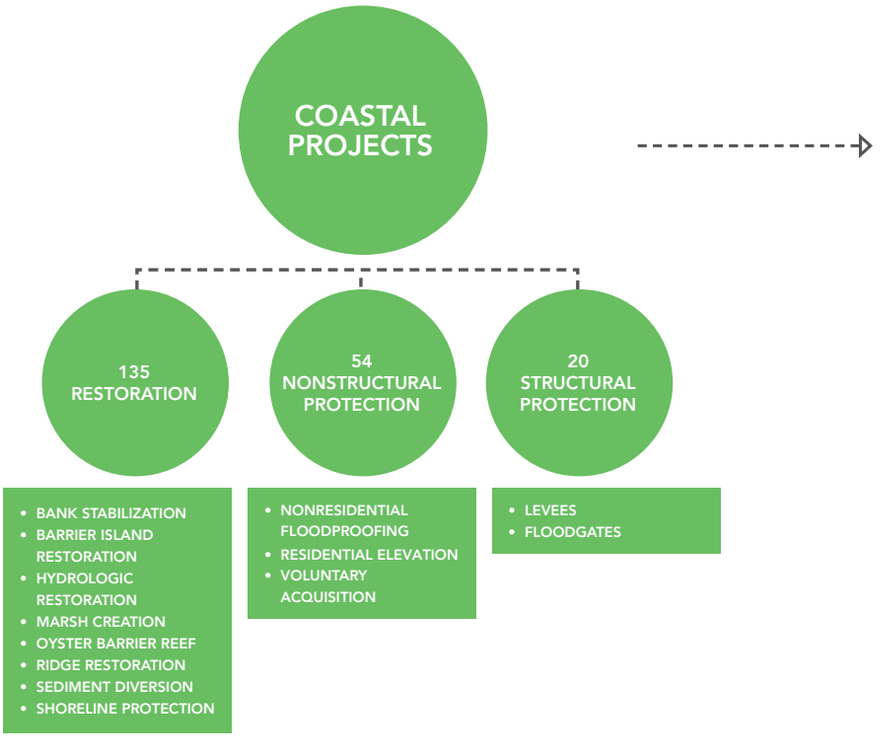
Throughout our planning process, our top priorities were to inform, engage, and receive feedback from citizens and stakeholder groups. We worked with FDT members and other partners to identify industry associations, state task forces, local/regional governmental entities, advocacy organizations and non-profits, and community groups, and citizens. These groups were helpful in identifying existing meetings and avenues at which to present and gain feedback on the master plan effort. In total, we conducted over 100 such briefings. We also created a speaker's bureau presentation and supporting materials that were widely distributed to partners throughout coastal Louisiana so they could help spread the word about the master plan.



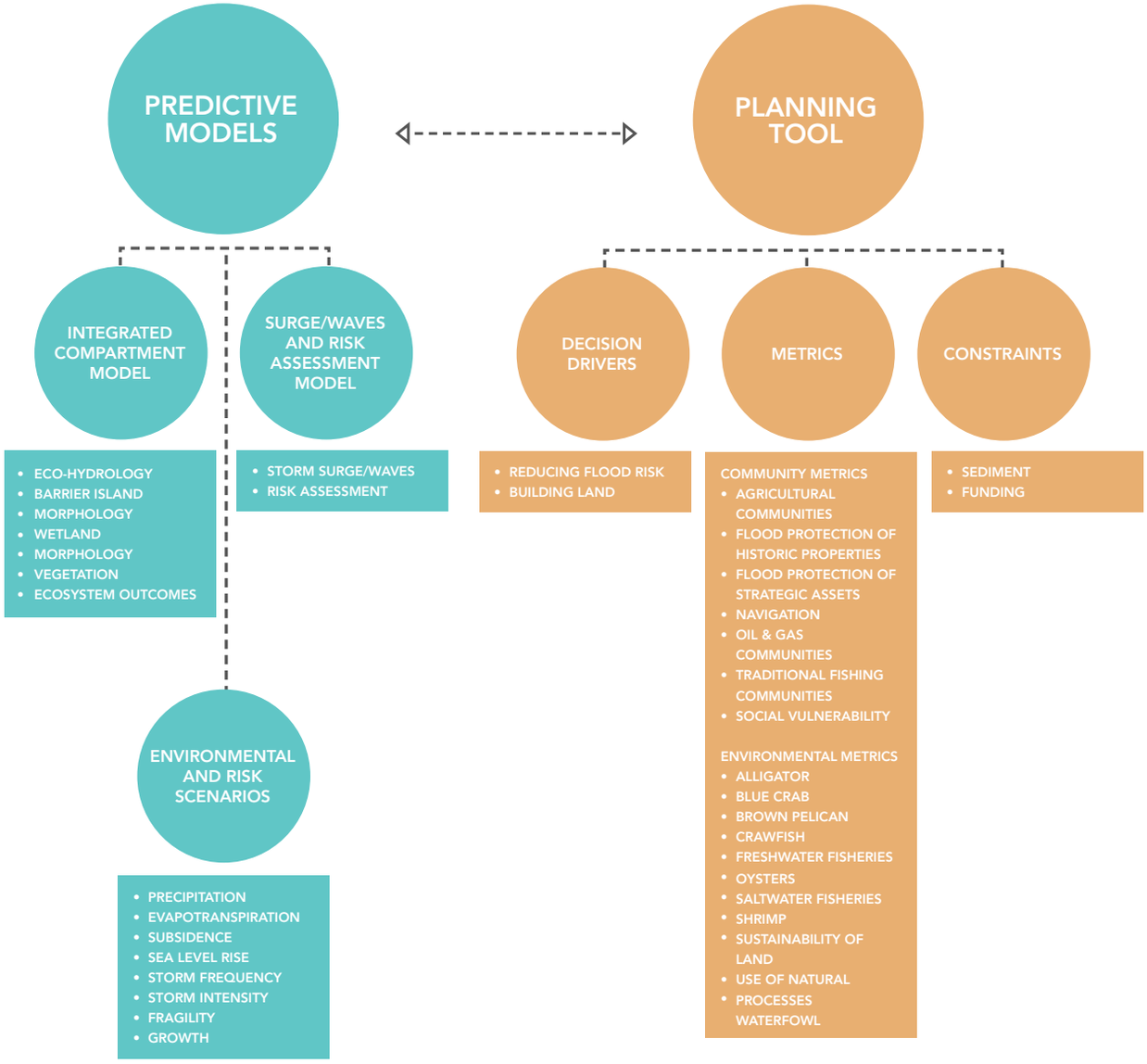
▲ **FIGURE 3.1**
The master plan development process places high priority on collaborative partnerships and public engagement, which in turn offers Louisiana's coastal citizens and leaders active ownership of our future adaptation decisions.

THE PLAN DEVELOPMENT PROCESS

2017 COASTAL MASTER PLAN DEVELOPMENT PROCESS



▲ **FIGURE 3.2**
Projects identified for potential inclusion in the master plan were evaluated by Predictive Models and the Planning Tool. Predictive Models provide insights into the combined effects of physical forces and predicted environmental conditions. The Planning Tool compares these potential project outcomes to help identify the highest performing projects.


PREDICTIVE MODELS
PLANNING TOOL
INTEGRATED COMPARTMENT MODEL
SURGE/WAVES AND RISK ASSESSMENT MODEL
ENVIRONMENTAL AND RISK SCENARIOS
DECISION DRIVERS
METRICS
CONSTRAINTS
• ECO-HYDROLOGY
• BARRIER ISLAND
• MORPHOLOGY
• WETLAND
• MORPHOLOGY
• VEGETATION
• ECOSYSTEM OUTCOMES
• STORM SURGE/WAVES
• RISK ASSESSMENT
• PRECIPITATION
• EVAPOTRANSPIRATION
• SUBSIDENCE
• SEA LEVEL RISE
• STORM FREQUENCY
• STORM INTENSITY
• FRAGILITY
• GROWTH
• REDUCING FLOOD RISK
• BUILDING LAND
COMMUNITY METRICS
• AGRICULTURAL COMMUNITIES
• FLOOD PROTECTION OF HISTORIC PROPERTIES
• FLOOD PROTECTION OF STRATEGIC ASSETS
• NAVIGATION
• OIL & GAS COMMUNITIES
• TRADITIONAL FISHING COMMUNITIES
• SOCIAL VULNERABILITY
ENVIRONMENTAL METRICS
• ALLIGATOR
• BLUE CRAB
• BROWN PELICAN
• CRAWFISH
• FRESHWATER FISHERIES
• OYSTERS
• SALTWATER FISHERIES
• SHRIMP
• SUSTAINABILITY OF LAND
• USE OF NATURAL
• PROCESSES WATERFOWL
• SEDIMENT
• FUNDING

PROJECT TYPES CONSIDERED

NEW PROJECT IDEAS FOR THE 2017 COASTAL MASTER PLAN

CPRA used the New Project Development Program to gather new ideas to be considered for the master plan. Everyone's ideas were welcome and screened according to the project development criteria described below (see Appendix A, *Project Definition*, for additional detail).

New projects could be proposed by any source – citizens, academia, parishes, elected officials, agencies, NGOs, landowners, businesses, and industries were all encouraged to contribute ideas. The proposed projects aimed to help build and/or maintain land, provide significant flood risk reduction, address shifts in the coastal landscape, or confront future uncertainty challenges. Project ideas were screened according to the criteria summarized below.

1. Is this a marsh creation project? If yes, would this project benefit at least 500 acres of marsh? The master plan uses a large-scale, regional approach to coastal risk reduction and restoration.
2. Is this project proposed for a geographic area where natural processes are already producing the desired effects? Areas where natural processes are already producing the desired effects were not considered.
3. Do we have adequate information about this project that will allow it to be evaluated using the master plan models? Sufficient detail must be available.
4. Does this project align with the objectives and principles of the master plan? Projects must clearly contribute to and be consistent with the master plan.
5. Would this project overlap or duplicate another project? Only projects that are significantly different than any project previously analyzed through the master plan process were considered.

For the 2017 Coastal Master Plan, 42 project sponsors submitted a total of 155 project ideas during two public solicitation periods totaling 140 days.

CPRA also considered over 600 project nominees from CWPPRA and Natural Resource Damage Assessment (NRDA) programs, as well as ongoing Mississippi River and diversion studies. These projects were also screened according to the project development criteria.

In total, over 750 new project ideas were considered for inclusion in the 2017 Coastal Master Plan. Fifty-two projects submitted through the New Project Development Program, seven CWPPRA and NRDA projects, and three diversion projects met the project development criteria and were accepted in whole, in part, or in combination with other projects, resulting in 62 new projects considered for inclusion in the master plan.

IN TOTAL, 209 RESTORATION, STRUCTURAL RISK EDUCTION, AND NONSTRUCTURAL RISK REDUCTION PROJECTS WERE IDENTIFIED THROUGH THIS PROCESS AND INCLUDED IN THE FINAL LIST OF 2017 POTENTIAL PROJECTS.

Seventy-nine restoration and structural risk reduction projects recommended in the 2012 Coastal Master Plan were considered as part of the projects considered for inclusion in the 2012 plan. Using feedback from the FDT and other stakeholders, CPRA identified potentially high performing projects that were evaluated but not included in the 2012 Coastal Master Plan, as well as potentially high performing projects located on critical landscape features determined by USACE as necessary for storm surge protection and comprehensive risk reduction. Finally, through the Project Development and Implementation Program, local entities worked with CPRA to develop new alternatives for projects like Upper Barataria Risk Reduction that were not included in the 2012 Coastal Master Plan. All of these projects were reconsidered for inclusion in the 2017 plan if they did not overlap or duplicate another 2017 project and are still feasible to implement.

See Appendix A, *Project Definition*, to read details about CPRA's process for identifying potential projects and the attributes needed to evaluate them.

Photo courtesy of Louisiana Sea Grant

Our choice of projects springs from scientific research but also from listening to coastal residents who have generations of expertise to share.

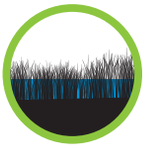
RESTORATION PROJECTS BUILD OR MAINTAIN LAND AND HELP MAINTAIN PRODUCTIVE HABITAT FOR COMMERCIALLY AND RECREATIONALLY IMPORTANT SPECIES

Bank Stabilization is the onshore placement of earthen fill and vegetation planting designed to reduce wave energies and maintain shorelines in open bays, lakes, and bayous, including navigation channels.

Barrier Island/Headland Restoration is the creation and restoration of dune, beach, and back barrier marsh to restore or augment offshore barrier islands and headlands.

Diversions use channels and/or structures to divert sediment and fresh water from the Mississippi and Atchafalaya Rivers into adjacent basins.

Hydrologic Restoration conveys fresh water to areas that have been cut off by man-made features, or prevents the intrusion of salt water into fresh areas through man-made channels and eroded wetlands.



Marsh Creation establishes new wetlands in open water areas such as bays, ponds, and canals through sediment dredging and placement.

Oyster Barrier Reefs are bioengineered to improve oyster propagation and serve as breakwaters to attenuate wave energies.

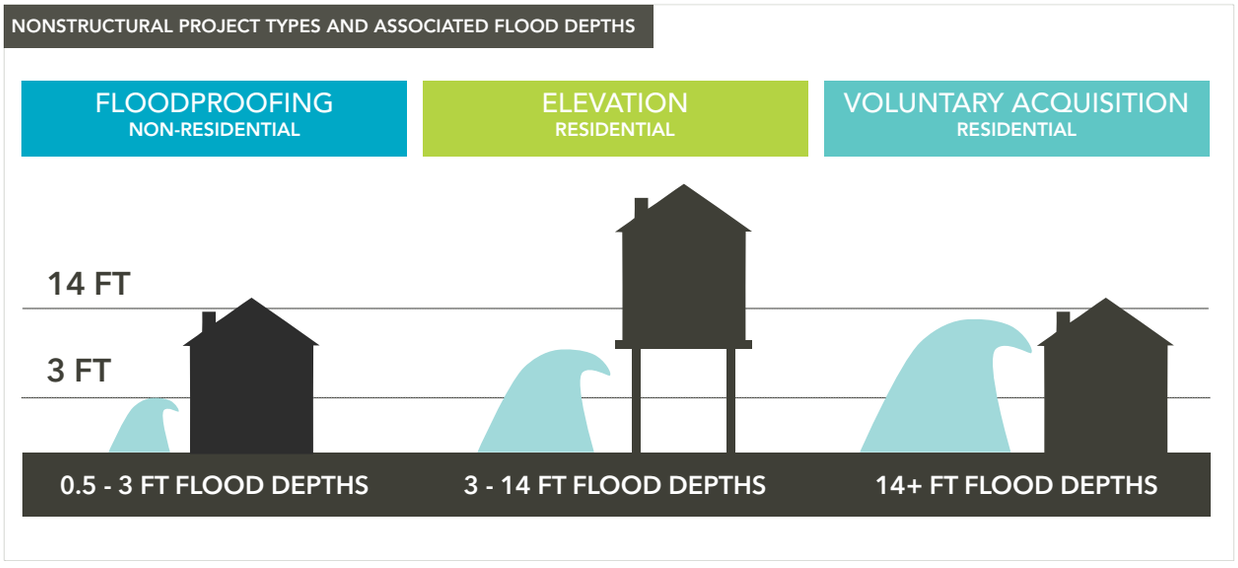
Ridge Restoration uses dredging, sediment placement, and vegetative plantings to restore natural ridge functions in basins.

Shoreline Protection provided by near-shore rock breakwaters reduces wave energies on shorelines surrounding open bays, lakes, sounds, and bayous, including navigation channels.

RISK REDUCTION PROJECTS HELP REDUCE FLOOD RISK AND PREPARE FOR FLOODING CONDITIONS

Structural Protection projects reduce flood risk by acting as physical barriers against storm surge. These systems can include earthen levees, concrete walls, floodgates, and pumping stations.

Nonstructural Protection projects elevate and floodproof buildings and help property owners prepare for flooding or move out of areas of high flood risk.

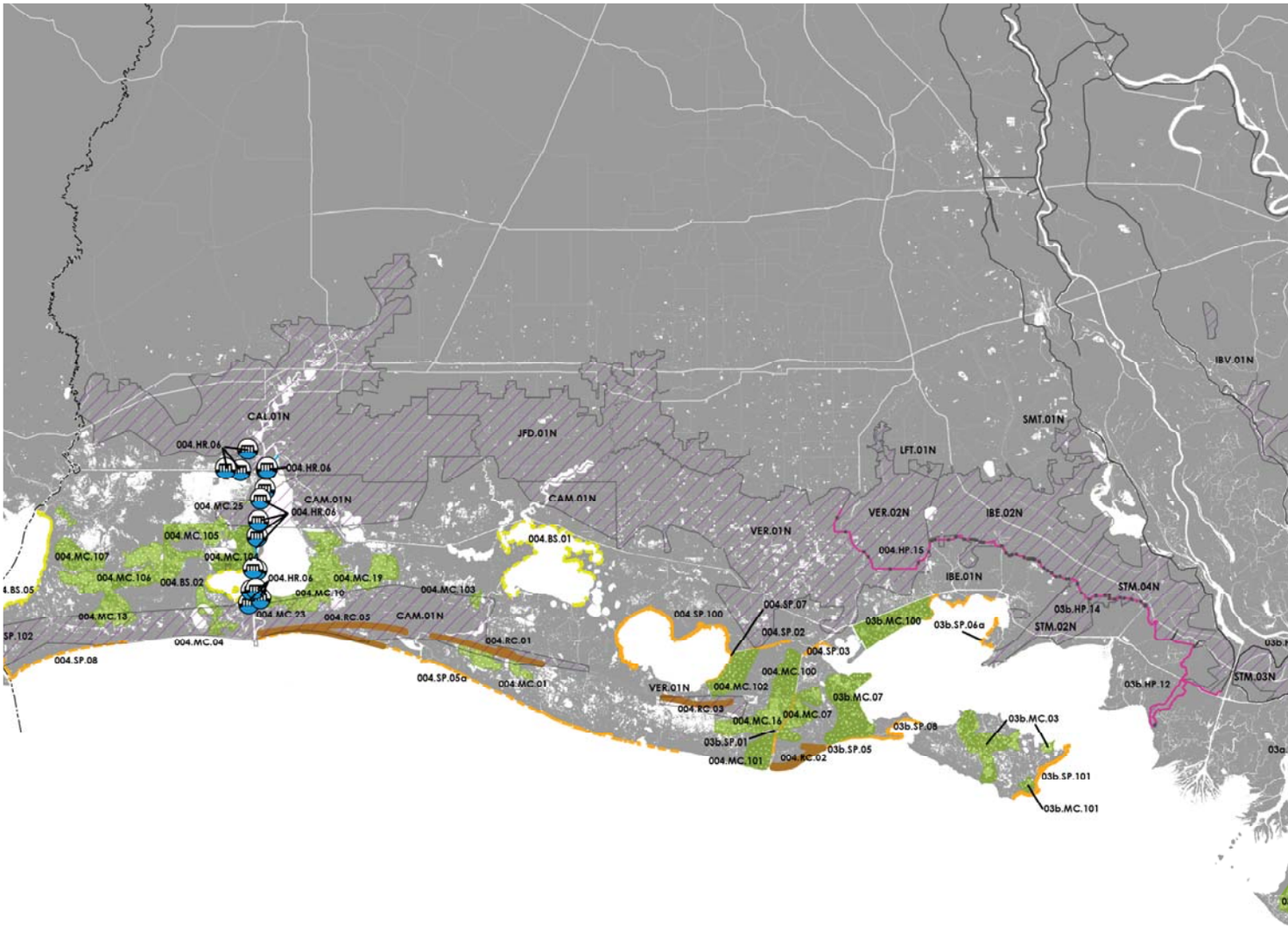


▲ **FIGURE 3.3**

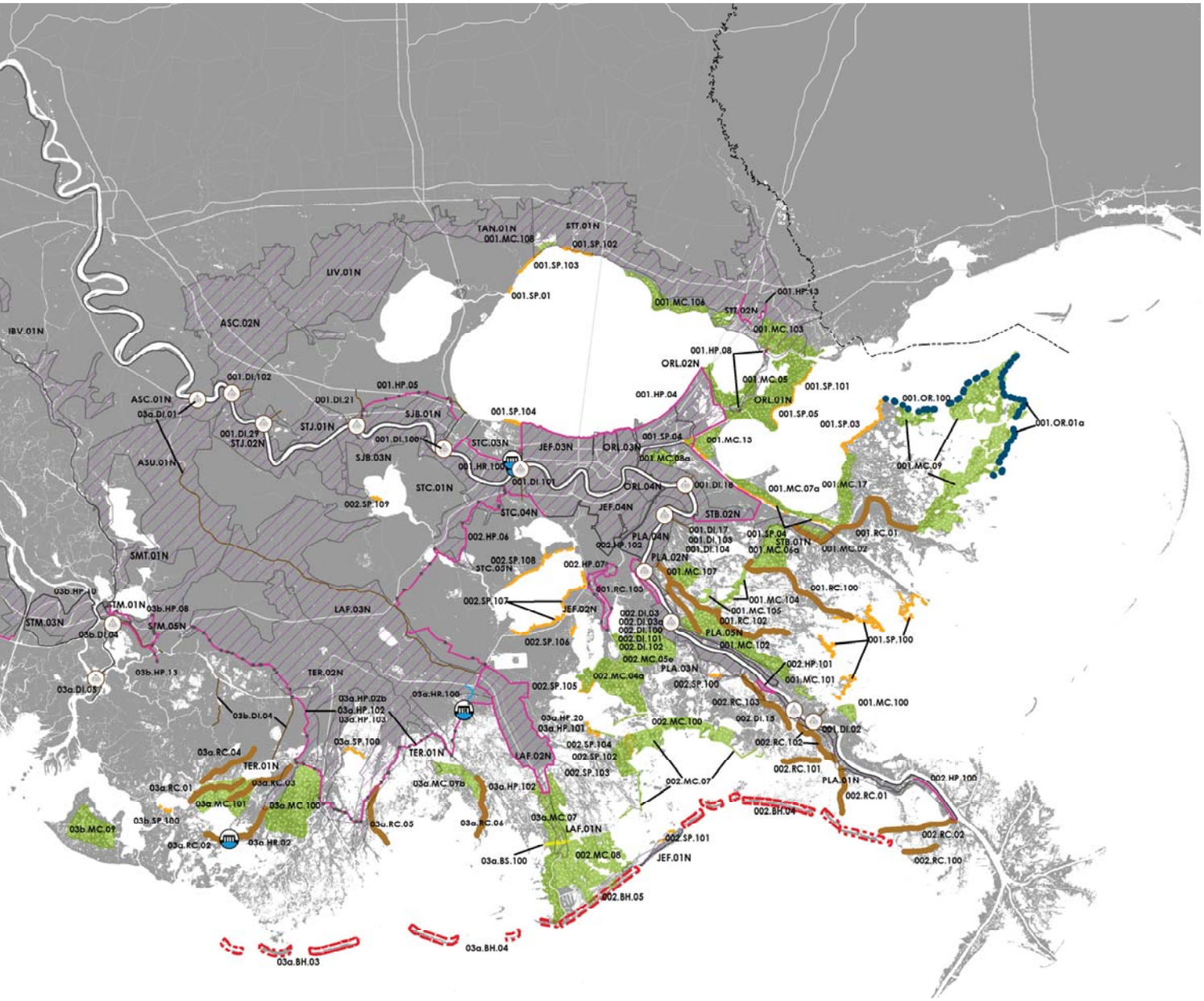
Nonstructural projects include raising a building's elevation, floodproofing structures, and acquiring residential structures. Non-residential structures in areas with projected 100-year flood depths of 3 feet or less are mitigated so they can be resistant to flood damage. Residential structures located in areas with a projected 100-year flood depth of between 3 and 14 feet are elevated so that their lowest floors are higher than projected flood depths. In areas where projected 100-year flood depths make elevation or floodproofing infeasible and where residential structures would need to be elevated higher than 14 feet, residential acquisition is considered. All nonstructural mitigation projects are voluntary.

PROJECTS CONSIDERED FOR 2017

GEOGRAPHIC DISTRIBUTION OF PROJECTS CONSIDERED FOR INCLUSION IN THE 2017 COASTAL MASTER PLAN



PROJECT TYPES



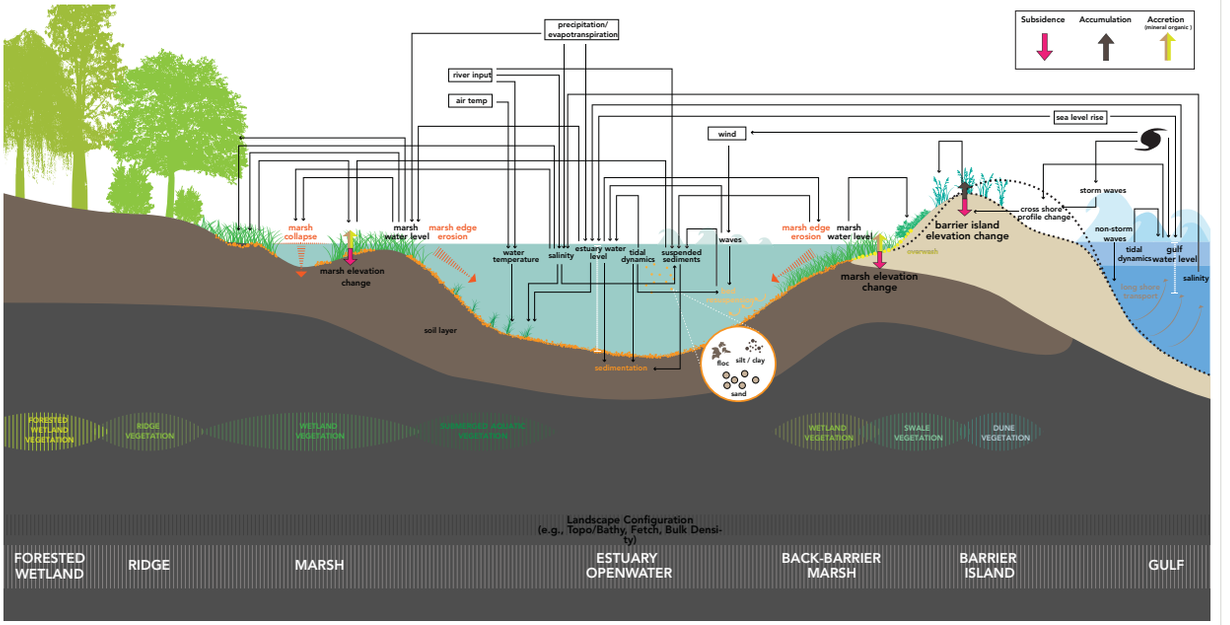
▲ **FIGURE 3.4**
Geographic distribution of projects considered for the 2017 plan.

A TOTAL OF 135 RESTORATION, 20 STRUCTURAL RISK REDUCTION, AND 54 NONSTRUCTURAL RISK REDUCTION PROJECTS WERE CONSIDERED FOR INCLUSION IN THE 2017 COASTAL MASTER PLAN, TOTALING $120 BILLION DOLLARS.

ENVISIONING OUR FUTURE COAST

PREDICTIVE MODELS ANALYZE PROCESSES DRIVING COASTAL LAND AND ECOSYSTEM CHANGE AND ESTIMATE DIRECT ECONOMIC DAMAGE FROM COASTAL FLOODING

CONCEPTUAL OVERVIEW OF THE INTEGRATED COMPARTMENT MODEL



▲ **FIGURE 3.5**

This cross section conceptually illustrates the physical and vegetative processes represented in the model (excluding the influence of changes in the physical environment and vegetation cover on water quality, habitat suitability, and fish and shellfish biomass).

The Integrated Compartment Model (ICM) illustrated above represents natural processes that drive coastal land and ecosystem change. The model analyzes hydrodynamic variables such as salinity and water level, water quality, changes in land area and elevation (including the barrier islands), changes in vegetation location and type, and habitat suitability and community dynamics for various species. Simply put, ICM predicts future landscape and ecosystem conditions and the effects restoration and risk reduction projects have on those conditions.

The Risk Assessment Models evaluate the effects of projects on storm surge and wave heights from tropical events of different sizes and intensities and identify flood depths associated with different frequencies of inundation across the coast (for example, the depth expected for a 100-year coastal flood event). The models then predict how future coastal changes could lead to increased risk of damage from storm surge flooding to residential buildings, vehicles, agricultural crops, ports, transportation infrastructure, and commercial assets (including heavy industrial). The possible failure of structural risk reduction systems is also factored in. Further, the models provide an estimate of direct economic damage from coastal flooding and assess the degree to which potential master plan projects could reduce this type of risk.

We used Predictive Model outputs to evaluate individual restoration and risk reduction projects as well as alternatives or groups of projects under multiple environmental scenarios. The analysis helped CPRA understand project effects on land loss and land gain and how those landscape changes affect coastal habitats and fish and shellfish biomass across the coast over time. The analysis also helped CPRA estimate the effects of groups of projects on flood depths and direct economic damage. Predictive Models work together to provide a holistic view of our coastal environment today and the changes we can expect over the next 50 years.

Where will land, water, and habitat be?

Information derived from the ICM identifies the future locations of land, vegetation, and habitats that will support various fish, shellfish, and wildlife common to coastal Louisiana. CPRA used the ICM as the central landscape and ecosystem modeling platform for the 2017 Coastal Master Plan.

Where will storm surge and waves cause flooding, and how deep?

The coupled ADvanced CIRCulation (ADCIRC) and Unstructured Simulating WAves Nearshore (UnSWAN) model system takes landscape outputs from the ICM and analyzes the effects of storm surge and waves to identify where flooding caused by hurricanes and storm surge will occur.

How deep will flooding be, and what will be the cost of damage?

The Coastal Louisiana Risk Assessment model (CLARA) takes the combined outputs from the ICM and ADCIRC and UnSWAN to identify flood depths both inside and outside of enclosed levee systems as well as behind unenclosed surge barriers, and quantifies the cost of direct economic damage caused by flooding. CPRA used the CLARA model to assess risk.

These Predictive Models were used to evaluate restoration and risk reduction projects across a variety of scenarios at multiple time periods across the 50-year plan outlook. See Appendix C, *Modeling*, Chapter 3, *Modeling Components and Overview*, and associated attachments to read a detailed explanation of CPRA's modeling approach.

HABITAT SUITABILITY & BIOMASS

We evaluated the ability of an area to support blue crab, brown shrimp, white shrimp, Gulf menhaden, bay anchovy, spotted sea trout, largemouth bass, and oysters through Habitat Suitability Index (HSI) and Ecopath with Ecosim (EwE) models. HSI models were also used to evaluate mottled duck, green-winged teal, gadwall, wild-caught crawfish, alligator, and brown pelican; a larger array of fish and shellfish species were evaluated using EwE. Data from Louisiana Department of Wildlife and Fisheries were used to support development of the fish and shellfish HSI models and the EwE model.

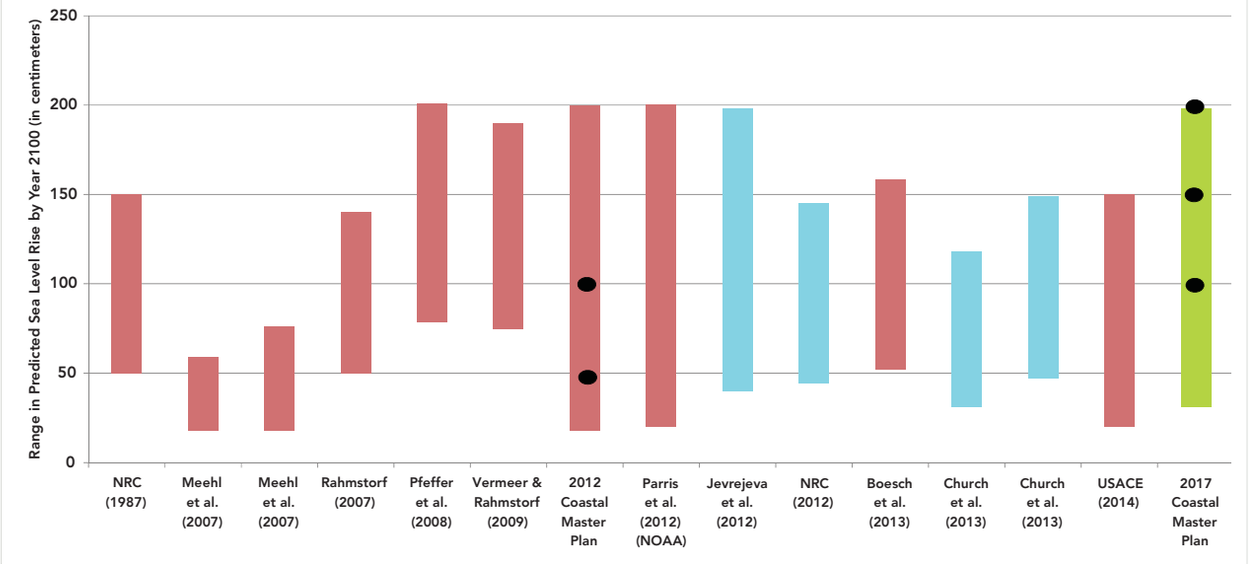
PLANNING FOR UNCERTAINTY

ENVIRONMENTAL SCENARIOS REVEAL HOW ENVIRONMENTAL DRIVERS COULD REDUCE LAND AND INCREASE FLOOD RISK IN THE FUTURE

We know that sea level rise and subsidence, along with precipitation, evapotranspiration, and hurricane frequency and intensity are key environmental drivers that influence our coastal landscape. To make informed decisions pertaining to the master plan, we need an understanding of how these drivers could influence land loss and flood risk over the next 50 years. We used scenarios to explore the effects of different possible future conditions. The scenarios are not intended to represent exactly what will happen. Rather, they are a means of gaining insight into the uncertainty of the future. The best available subsidence and climate change data on sea level rise, precipitation, evapotranspiration, and hurricane frequency and intensity were reviewed to guide development of the scenarios, and three scenarios of potential future conditions were selected for use in the 2017 Coastal Master Plan. These High, Medium, and Low environmental scenarios represent a range of possible future conditions for Louisiana to consider, and the results show an increase in land loss and flood depths over time, with the High Environmental Scenario representing the highest magnitude of land loss and flood risk.

As such, the work is based on a combination of scientific literature, analysis of existing information, input from subject matter experts, and best professional judgment where necessary. See Appendix C, *Modeling,* Chapter 2, *Future Scenarios*, to read a detailed explanation of CPRA's process and methodology for evaluating environmental drivers.

COMPARISON OF SEA LEVEL RISE PREDICTIONS USED TO INFORM THE MASTER PLAN



▲ **FIGURE 3.6**

The relationship between past predictions of sea level rise (red) and regionally adjusted predictive model outputs (blue) were used to establish the plausible range of Gulf of Mexico sea level rise values for use in the 2017 Coastal Master Plan (green). The black dots indicate values used for the 2012 and 2017 Coastal Master Plans. The range of sea level rise values used for the 2017 plan incorporates the available literature through 2014, when analyses for the 2017 plan began. Since 2014, additional information has been published and will be used for future master plan analyses.

How will the impacts of sea level rise, subsidence, precipitation, evapotranspiration, and hurricane frequency and intensity change our coast?

While no one can predict the future, we used the best information available to identify the possible low and high ranges of values for each environmental driver. We tested combinations of values for each of the drivers to see how they impacted the coastal landscape. CPRA then selected three scenarios to help identify high performing projects. Sea level rise and sub-sidence, in particular, are influential environmental drivers for coastal Louisiana. They directly influence risk by changing the level of water relative to the land surface. The projects in the 2017 Coastal Master Plan will help prevent the level of land loss and flood risk predicted in each scenario.

ENVIRONMENTAL DRIVERS AND VALUES USED IN SCENARIOS

SCENARIO	PRECIP	ET	SEA LEVEL RISE	SUBSIDENCE	STORM FREQUENCY	AVG STORM INTENSITY
2017 COASTAL MASTER PLAN						
LOW	>HISTORICAL	<HISTORICAL	1.41′	20% OF RANGE	-28%	+10.0%
MEDIUM	>HISTORICAL	HISTORICAL	2.07′	20% OF RANGE	-14%	+12.5%
HIGH	HISTORICAL	HISTORICAL	2.72′	50% OF RANGE	0%	+15.0%

▲ **FIGURE 3.7**
Drivers and values used in environmental scenarios. Sea level rise is measured in feet per 50 years, and the rate is not linear. Precip = precipitation. ET = evapotranspiration.

RISK ASSESSMENT SCENARIOS ESTIMATE DIRECT ECONOMIC DAMAGE TO PHYSICAL ASSETS FROM FUTURE FLOODING

Risk assessment scenarios provide a potential range of economic damage that could be experienced over the next 50 years triggered by changes in population and asset growth and the fragility of the hurricane risk reduction system. Our evaluation considered the connections between population vulnerability, coastal flooding, and population migration, as well as how the distribution of population and assets might vary with changes to the landscape over a 50-year period.

We selected three scenarios of potential future population and asset growth – Historic Growth, Concentrated Growth, and No Growth – and used them to compare damage reduction estimates of structural and nonstructural risk reduction projects under consideration. The Historic Growth scenario assumed an annual coast wide growth rate of 0.67%, which is equal to the annual rate of population growth from 1990 to 2000. The Concentrated Growth scenario also assumes an annual coast wide growth rate of 0.67%, but it shifts the population away from areas where flood risk and vulnerability increase over time to areas with lower flood depths. Given the potential for population shifts away from the coast as flood risks increase in future years, an annual coast wide growth rate of 0.00% was assumed for the No Growth scenario. This is consistent with post-storm population trends from 2000 to 2010.

Scenarios of levee fragility, or probability of levee structural failure, capture the wide range of uncertainty within risk reduction systems and how they may respond to flood events. The 2017 analysis considers the potential for levee failure through three fragility scenarios that reflect the probability of levee or floodwall failure due to three mechanisms – seepage, slope stability, and overtopping failure.

See Appendix C, Attachment C3-25 *Storm Surge and Risk Assessment,* to read a detailed explanation of CPRA's process and methodology for evaluating risk.

IMPROVED ANALYSIS

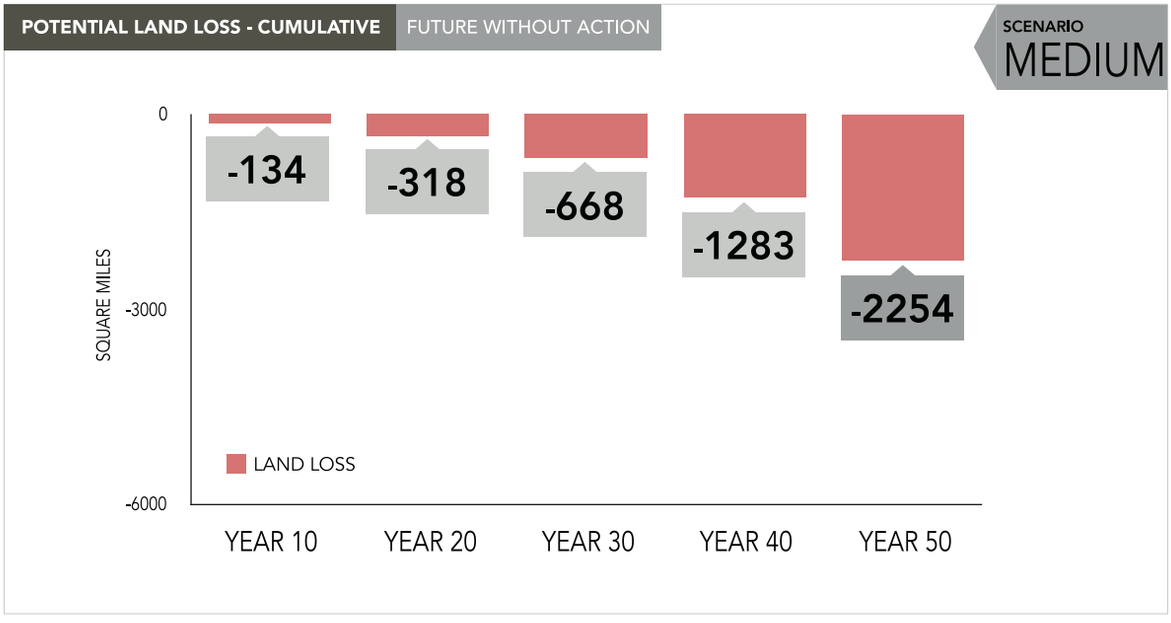
CPRA partnered with 19 organizations and over 75 experts with knowledge of coastal systems and experience working in Louisiana to develop a modeling approach that reflects both the environmental complexity of the coast and our appreciation for the natural resources we share. The 2017 Model Improvement Plan helped to further advance the state-of-the-art models used in developing the 2017 Coastal Master Plan. Key improvements include development of new process-based algorithms for sediment distribution, integration of landscape and ecosystem model codes into a single common framework, and increased resolution of model grids for eco-hydrology and risk assessment.

FUTURE WITHOUT ACTION

WHAT THE FUTURE WITHOUT ACTION ANALYSES REVEAL

Because Louisiana's coast is a dynamic, ever-changing system, the conditions 50 years from now will be different from those today. In addition, many projects included in the master plan will not be implemented for several years, or even decades, as further design is undertaken and funding is obtained. Given these uncertainties, the most accurate way to predict the effects of projects in the master plan is to compare them against the future landscape that would occur without the plan. To capture this comparison, we investigated what we called "Future Without Action" conditions for the next 50 years, meaning conditions that would be present throughout coastal Louisiana if we do nothing further to protect and restore the coast.

To estimate Future Without Action conditions, our models included projects that are already constructed, as well as projects that will be built in the near future because they have received construction funding. See Appendix A, *Project Definition*, and CPRA's Annual Plan to learn more about how CPRA tracks projects that have been built or will be built soon, and how that information is incorporated into the models.



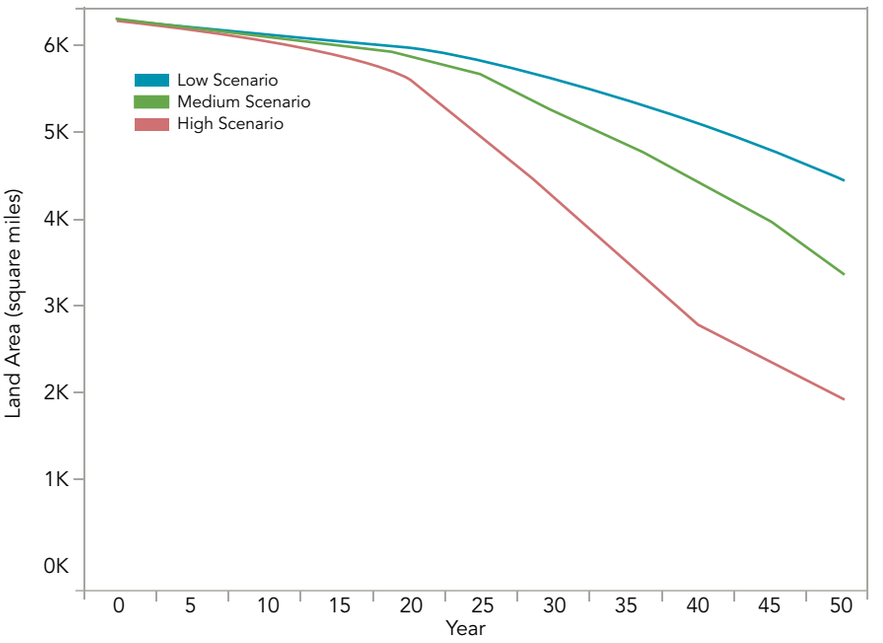
▲ **FIGURE 3.8**
This chart depicts how many square miles of land loss coastal Louisiana could experience over the next 50 years under the Medium Environmental Scenario if we take no additional action.

A CHANGING LANDSCAPE

PREDICTED LAND CHANGE OVER THE NEXT 50 YEARS WITH NO ADDITIONAL ACTION

Land gain continues where our large rivers are connected to the basins. While land loss is occurring in most of coastal Louisiana, the Atchafalaya River delta, Wax Lake Outlet, and areas near Fort St. Philip and West Bay along the lower Mississippi River provide evidence that coastal landscapes can be created in the face of rising sea levels and subsidence. For example, while the overall land area of the Atchafalaya Delta has fluctuated over the years, from 1932 to 2010, the basin gained about 17 net square miles. Additionally, wetland areas around the delta experience some of the lowest rates of loss along our coast. These locations are analogs for the power of nature and the natural processes CPRA seeks to restore through restoration efforts. The 2017 Coastal Master Plan includes diversion projects that aim to mimic these land building and maintaining processes.

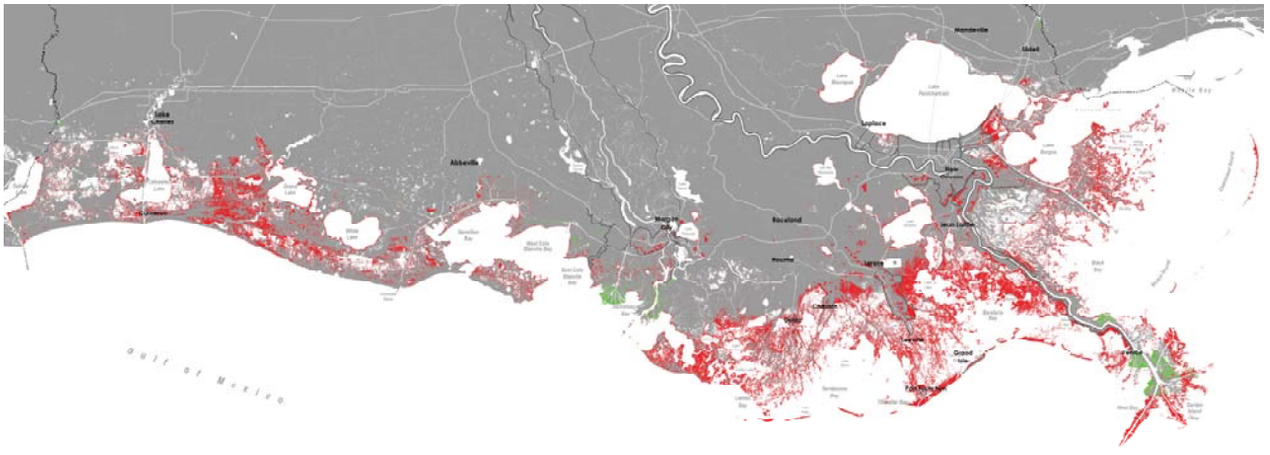
POTENTIAL LAND LOSS OVER THE NEXT 50 YEARS



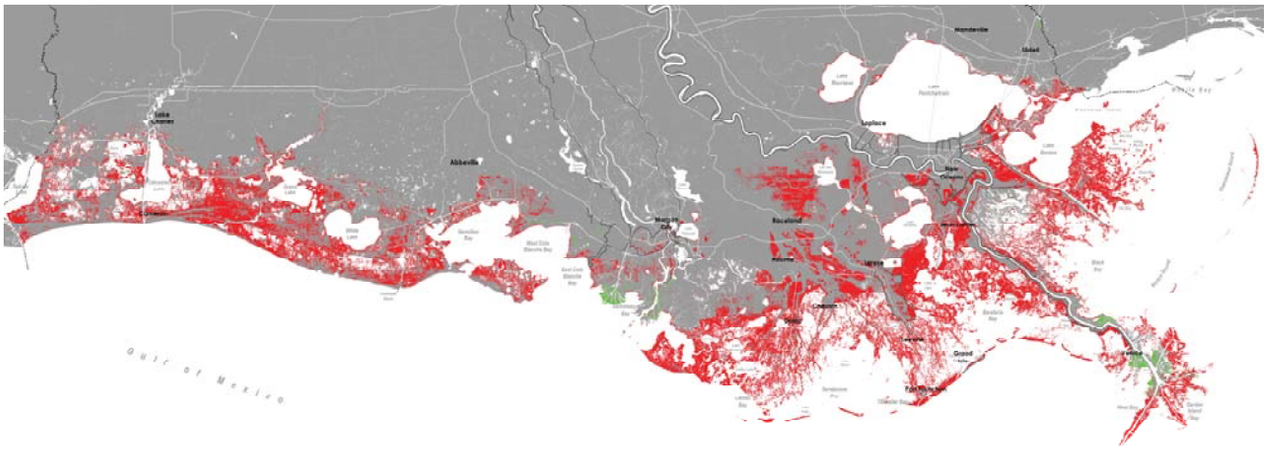
▶ **FIGURE 3.9**
This graph shows the range of total land loss coastal Louisiana could experience over the next 50 years if we take no additional action. Under the Low Scenario, 1,207 square miles could be lost over 50 years. Under the Medium Scenario, 2,253 square miles could be lost. Under the High Scenario, 4,123 square miles could be lost. This predicted land loss adds to the nearly 1,900 square miles of land area lost between 1932 and 2010.

▶ **FIGURES 3.10, 3.11, & 3.12**
Shown here is land change 50 years from now under the Low, Medium, and High Environmental Scenarios if we take no additional action. Red indicates areas predicted to be lost, and green indicates areas where land would be created.

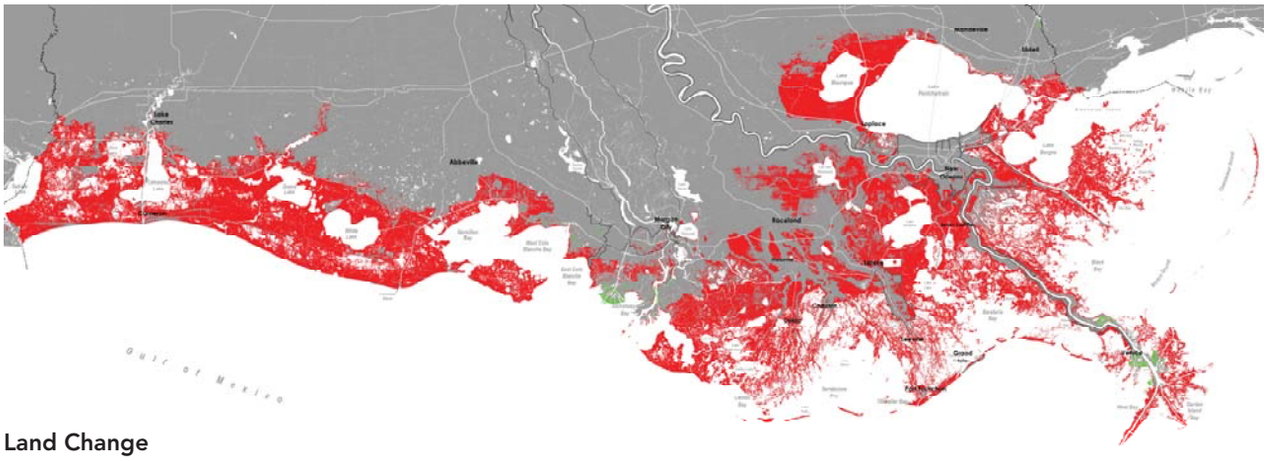
LOW SCENARIO



MEDIUM SCENARIO



HIGH SCENARIO



Land Change

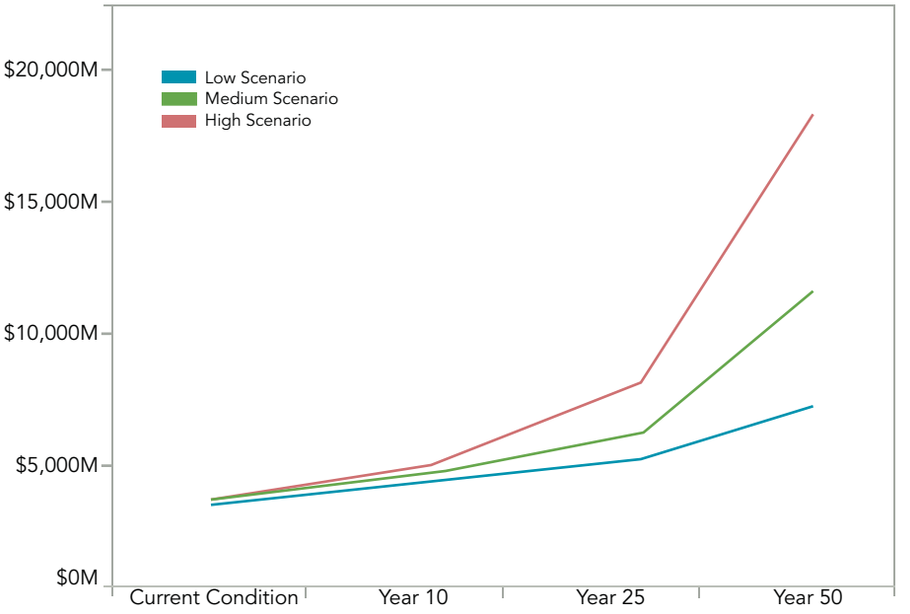
Land Gain
Land Loss

FLOOD RISK TO OUR COMMUNITIES

PREDICTED FUTURE INUNDATION FROM A 100-YEAR FLOOD EVENT WITH NO ADDITIONAL ACTION

Flood depths increase in the future as we lose our natural defenses. While many of our major urban centers such as metro New Orleans, the Northshore, and Lake Charles are projected to undergo significant increases in flood depths, it will be the low-lying areas of the coast which see the most pronounced changes. For example, in 50 years, the City of Houma could see 5 to 9 feet of flooding; Lafitte could see 10 to 15 feet of flooding; and Cameron could see over 15 feet of flooding from a 100-year flood event.

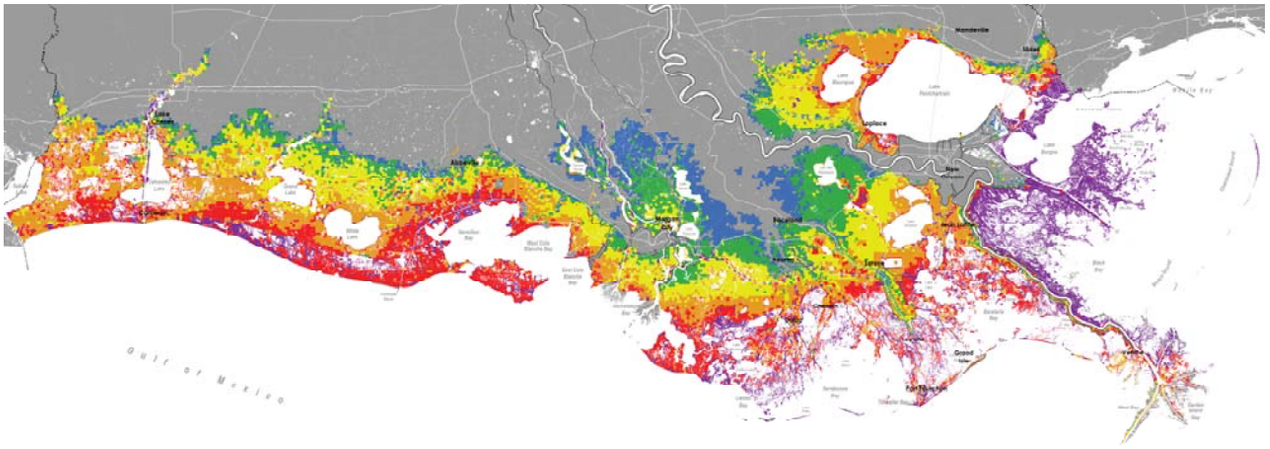
EXPECTED ANNUAL DAMAGE FROM FLOODING OVER THE NEXT 50 YEARS



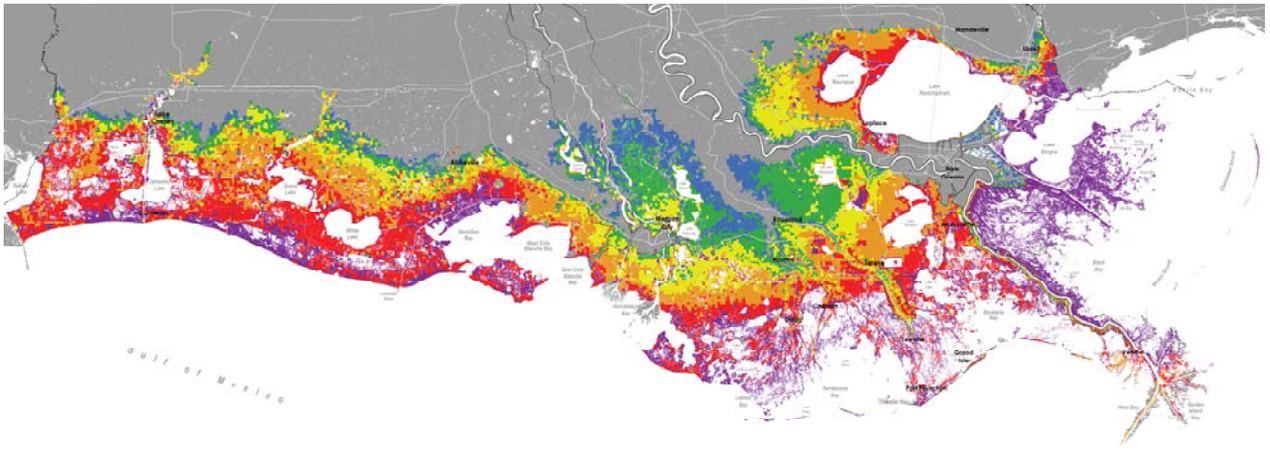
▶ FIGURE 3.13
This graph shows the range of direct economic damage from flooding coastal Louisiana could experience over the next 50 years if we take no additional action. Expected annual damage under initial conditions are approximately $2.7 million. In 50 years, coast wide expected annual damages could reach approximately $6.7 million under the Low Flood Risk Scenario, $12 million under the Medium Flood Risk Scenario, and $19.9 million under the High Flood Risk Scenario.

▶ FIGURES 3.14, 3.15, & 3.16
Shown here are flood depths 50 years from now under the Low, Medium, and High Environmental Scenarios if we take no additional action. Expected annual damage from storm surge-based flooding events could be over seven times greater in the future if nothing else is done.

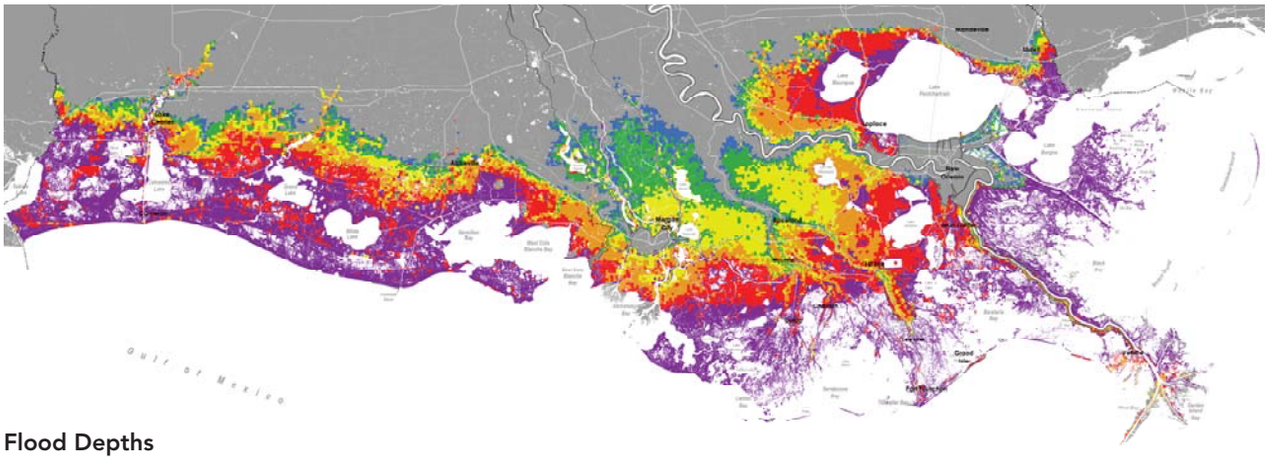
LOW SCENARIO



MEDIUM SCENARIO



HIGH SCENARIO



Flood Depths

1-3 ft	7-9 ft	13-15 ft	
4-6 ft	10-12 ft	Over 15 ft	

COMMUNITY FLOODING IMPACTS

Low-lying Louisiana communities are affected by flooding that comes from weather fronts and high tides many times a year, impacting roads, homes, and businesses. These events are expected to increase as our coast degrades and sea levels rise.

25-year time horizon. Ten communities will be particularly vulnerable to flooding in the next 25 years, assuming a Future Without Action, a Medium Environmental Scenario for sea level rise, and not counting the effects from future hurricane damage. These communities include Cocodrie; Delacroix; Grand Isle; Isle de Jean Charles; Kraemer, Lafitte, Crown Point, and Barataria; Leeville; Lower Point aux Chenes; Paradis; and Venice.

50-year time horizon. Eleven communities are expected to be dramatically changed by flooding in the next 50 years, assuming a Future Without Action and a Medium Environmental Scenario for sea level rise, and not counting the effects from future hurricane damage. These communities include Cocodrie; Delacroix; Dulac; Grand Isle; Isle de Jean Charles; Kraemer; Lafitte,Crown Point, and Barataria; Leeville; Lower Point aux Chenes; Paradis; and Venice.

For those communities that decide to move, we will all have to work together—residents, state and local agencies, and funders—to decide how relocation should happen. For example, CPRA can share detailed information on risk through its Master Plan Data Viewer and meet with communities to explain what our projections tell us about future trends.

Photos courtesy of Louisiana Sea Grant, Jocelyn Augustino, and Louisiana Sea Grant, respectively.

EVEN WITH THE BEST AVAILABLE DATA, THERE ARE LIMITATIONS TO PREDICTING FUTURE CONDITIONS

PREDICTING FUTURE CONDITIONS

CPRA and its partners base analyses on the best available data for sea level rise, subsidence, and other environmental drivers. It is important to note that no one can predict with absolute certainty how these environmental drivers may change in the future. Therefore, the scenarios and Future Without Action analyses are not meant to be absolute predictions and are not meant to capture extreme or unforeseen events or tipping points. Rather, they provide a comparative baseline for assessing the relative benefits of projects considered for inclusion in the master plan across a range of different environmental futures.

For example, we do not know how Mississippi River flow and sediment loads will change in the future and what the effects will be on our coastal landscape. We also do not know when and where storms will impact barrier islands.

Further, the risk assessment model estimates direct economic damage to physical assets along the coast, but does not consider effects on the local, regional, or national economy from coastal storms. Risk assessment scenarios also provide a high-level assessment of how critical infrastructure assets could be affected by flooding. The scenarios do not, however, include damage to critical infrastructure, address the functionality of critical infrastructure systems during storm events, or estimate supply chain impacts or broader effects on the regional and national economy.

Our ability to estimate economic damage is limited by the accuracy of the structural inventory data. In order to estimate economic damage from flooding in future years, it would be necessary to predict the number and location of future economic assets. There is, of course, tremendous uncertainty surrounding such long-term projections, which can be influenced by a wide range of factors including changes to the national and regional economy, changes to the coastal landscape itself, other population trends, and the potential for future uncertainties.

INDIVIDUAL PROJECT MODELING AND ALTERNATIVE MODELING

As part of the development of the 2017 Coastal Master Plan, modeling data from individual projects were used to assess the effects of each restoration and risk reduction project on Louisiana's coast over the next 50 years.

Combinations of potentially high-performing projects were also evaluated to predict their combined effects. In some instances, we found that modeling an individual project resulted in lower project outcomes than modeling the same project working in concert with other projects. For example, the Calcasieu Lake Marsh Creation project did not provide enduring benefits when considered alone, but when modeled as part of a group, including hydrologic restoration and salinity control structures, the project did provide benefits. These types of analyses helped us determine which projects to recommend in the master plan.

Our modeling analysis also demonstrated that in some instances, levees and wetlands, when implemented together, can increase a project's effectiveness and can play an important role in a large-scale flood risk reduction system. The degree of risk reduction varies with the project type and storm size, but the benefits of marsh creation are important considerations in future levee system planning.

PLAN FORMULATION PROCESS

CPRA'S 2017 DECISION-MAKING FRAMEWORK COMBINES ANALYSES FROM THE PREDICTIVE MODELS AND THE PLANNING TOOL

Predictive Models were used to analyze the effects of individual projects over the next 50 years for multiple future scenarios. Results from the models served as inputs to the 2017 Planning Tool, a computer-based decision support software system, along with information on the project costs, and constraints on sediment and funding availability. The Planning Tool allowed us to compare projects on a level playing field with respect to land area built or maintained, risk reduction, effects across various metrics, and costs. It was then used to select groups of projects (or alternatives) that would build the most land and reduce the most flood risk given the constraints, while also allowing the planning team to examine how alternatives affected each metric. These alternatives, in turn, were analyzed by the predictive models to identify project synergies over the next 50 years leading to positive cumulative effects as more projects are placed on the landscape.

The Planning Tool presents the results of analyses through interactive visuals, which helped support deliberations among CPRA and its partners and coastal stakeholders as the 2017 Coastal Master Plan was developed and refined. It is important to note that the Planning Tool is an analytical computer program that synthesizes information so that CPRA can make the most informed decisions about which projects should be included in the master plan.

THE PLANNING TOOL SUPPORTS PROJECT COMPARISON, THE FORMULATION OF ALTERNATIVES, AND THE SELECTION OF PROJECTS IN THE 2017 COASTAL MASTER PLAN.

The tool does not make decisions, but instead reports information about the extent to which projects and alternatives meet one or more of the master plan objectives. The Planning Tool helps answer these questions:

- What is the greatest land building benefit that can be achieved given our constraints?
- How are alternatives affected by emphasis on different metrics or different funding allocations?
- Which projects are high performers under different environmental scenarios?
- Which projects or alternatives are the best performers in the near term versus the long term?

PLANNING TOOL FUNCTIONS

Comparing Projects. Compare and rank projects based on ecosystem and risk outcomes.

Formulating Alternatives. Define sets of projects to implement over 50 years that best meet Louisiana's goals for land building and risk reduction, subject to funding and sediment constraints.

Evaluating Alternatives. Evaluate key differences among alternatives and define a range of possible investment strategies consisting of near-term investments and alternative longer-term investments best suited for future conditions.

Supporting Deliberations. Present key results of Planning Tool analyses using interactive visualizations for use in deliberations with CPRA and its partners.

See Appendix D, *Planning Tool Report*, to read more about how the tool works and is used in decision-making processes.

LAND AREA AND FLOOD RISK REDUCTION BENEFITS ARE PRIMARY DECISION DRIVERS FOR THE MASTER PLAN

Land area and flood risk reduction decision drivers are used within the Planning Tool to filter and select the set of projects that best build and maintain land and reduce flood risk, both in the near term and long term. CPRA uses land area and flood risk reduction as decision drivers because they are key requirements of CPRA's mission, are well understood, and simplify analysis while allowing flexibility for refining the plan.

Projects that build or maintain land area focus on restoring the landscape and the ecosystem. Examples include marsh creation, sediment diversions, and ridge restoration. These projects may have an added benefit of reducing flood risk, but their success is measured by how much land has been built and maintained in the near term and long term.

Flood risk reduction projects seek to reduce the impacts of flooding to communities. Examples include structural protection projects, such as levees, and nonstructural projects, such as raising homes. These projects are evaluated by how well they reduce expected annual damage for a particular area. Expected annual damage measures the average damage anticipated to occur from a storm surge flooding event from a Category 1 or greater storm in any given year, taking into account both the expected damage and the overall chance of such a storm occurring.

Photo courtesy of Louisiana Sea Grant

DECISION DRIVERS

Land area built and maintained and flood risk reduction are used within the Planning Tool to filter and select the set of projects that are the highest performers, both in the near term and long term. Determining the benefits of projects in both the near and long term through these two measures is the fundamental basis of how projects are selected. Essentially, CPRA uses decision drivers to help answer these questions:

1. How well do potential restoration projects build new land or maintain the land we already have?
2. How well do potential risk reduction projects reduce flood risk?

METRICS

CPRA used metrics as criteria for evaluating the effectiveness of potentail projects as well as understanding how benefits differ between projects. Metrics align with the 2017 Coastal Master Plan objectives and take into consideration flood risk reduction benefits to coastal communities, as well as the ability of projects to support habitats and enhance natural processes. Metrics are derived by combining model outputs together in different ways to more directly show how projects and alternatives link to the master plan objectives. See Appendix C, Attachment C4-11, *Metrics Report*, for details on how the metrics were calculated.

Flooding costs are not just about dollars and cents. When a home or business floods, people suffer. They lose family treasures, they lose sleep, and they lose precious time trying to get back to a starting point that is threatened by each new flood. Even when there is a respite from disaster, coastal residents must live with the question of whether they and their homes will be safe in the long run.

METRICS PROVIDE CRITERIA FOR IDENTIFYING PROJECTS THAT MEET THE MASTER PLAN'S DIVERSE OBJECTIVES

Sustainability of Land considers both progress toward building land and the long-term trajectory of land building.

Support for Navigation considers the potential effects of projects on navigability of shallow and deep draft federally authorized channels.

Support for Traditional Fishing Communities considers the potential of projects to reduce damage to non-residential, residential, and infrastructure assets within a traditional fishing community, and the availability of habitat for the representative species needed by the community.

Support for Oil and Gas Activities and Communities considers damage to non-residential, residential, and infrastructure assets within an oil and gas community and land area within the region.

Support for Agricultural Communities considers damage to non-residential, residential, and infrastructure assets within agricultural communities and potential for continued agricultural practice.

Use of Natural Processes considers the degree to which a project type establishes natural process connections within the coast, the use of sediment from outside the coastal system, and the degree to which a project impedes existing natural process connections.

Flood Protection of Historic Properties considers the ability of projects to improve flood risk protection for archaeological sites and historic properties, historic sites, and historic districts.

Flood Protection of Strategic Assets considers the proportion of locally and nationally important assets protected by a project.

Social Vulnerability considers the presence and location of socially vulnerable groups and how projects may impact these populations.

Ecosystem Metrics consider the ability of projects to create or maintain suitable habitat for various species, as well as the effects of projects on biomass for fish and shellfish communities across the coast over time.

CONSTRAINTS

In addition to the decision drivers and metrics that helped CPRA evaluate projects, constraints also influenced which potential projects could be included in the 2017 Coastal Master Plan. The 2017 Coastal Master Plan is constrained by the availability of sediment and funding over the next 50 years. Some projects require dredged sediment for construction, but only so much sediment is available from each borrow area. Mississippi River-based sources of sediment are renewable approximately every 5 years, while other borrow areas are not considered renewable. All projects require funding to plan, implement, operate, and maintain into the future. Therefore, funding constraints represent assumptions about future funding streams for risk reduction and restoration projects across multiple project implementation periods. CPRA takes into consideration both the availability of sediment and funding over a 50-year period when evaluating and selecting potential projects.

TIMELINE/PROJECT SEQUENCING

The 2017 Planning Tool helps determine the order in which projects should be implemented over the next 50 years by answering the questions:

- What projects are most effective in the near term versus long term?
- How should projects be sequenced to maximize near-term and long-term benefits?

The Planning Tool evaluates the effects of projects and alternatives over a 50-year period – from initial conditions to 50 years into the future. In this way, the Planning Tool identifies optimal restoration projects to implement during the first 10 years, the next 20 years, and after 30 years have passed, as well as optimal risk reduction projects to implement during the first 30 years, and the 20 years that follow.

RESTORATION PROJECT IMPLEMENTATION PERIODS

Implementation Period 1: Years 1 to 10
Assumes projects will begin engineering and design in year 1 and accrue costs from that year forward.

Implementation Period 2: Years 11 to 30
Assumes projects will begin engineering and design in year 11 and accrue costs from that year forward.

Implementation Period 3: Years 31 to 50
Assumes projects will begin engineering and design in year 31 and accrue costs from that year forward. Assumes sufficient sediment left to construct IP3 projects.

RISK REDUCTION PROJECT IMPLEMENTATION PERIODS

Implementation Period 1: Years 1 to 30
Assumes projects will begin engineering and design in year 1 and accrue costs from that year forward.

Implementation Period 2: Years 31 to 50
Assumes projects will begin engineering and design in year 31 and accrue costs from that year forward.

SETTING A BUDGET

When setting a budget constraint for the master plan, CPRA used the Planning Tool to analyze funding scenarios to examine how changes in the amount of funding and its timing affected the amount of land that could be built or the amount of risk reduction that could be achieved over the 50-year planning period. Budgets of $40 billion, $50 billion, and $60 billion were investigated. While increasing the budget from $40 billion to $50 billion improved land building and risk reduction outcomes, increasing the budget to $60 billion did not result in a commensurate increase in land building or risk reduction. The analysis showed that for the set of projects examined, the most beneficial and cost-effective projects were selected with a budget of $50 billion. As a result, the $50 billion budget was used to constrain the selection of projects for the 2017 plan.

For the 2012 Coastal Master Plan, funding was allocated equally over the 50-year period of analysis; however, for 2017, the budget was front-loaded for the first 30 years because the near-term funding picture has become clearer since 2012 and, more importantly, because there is an urgent need for action. Consequently, the majority of funds were allocated to the first and second implementation periods with a 50-50 split between restoration and risk reduction project funding.

Since the state will not possess all $50 billion at once, projects are prioritized to implement the most cost-effective projects first while continually advocating for additional funds to implement additional projects. Although the master plan is estimated to cost $50 billion in present-day dollars, it will cost more over the full 50-year period. Operations and maintenance costs associated with projects include an inflation rate of 2.5% annually over the project's lifespan. By utilizing this methodology, analyses can equitably compare, select, and sequence projects over time despite uncertain revenue streams and environmental and economic scenarios. CPRA acknowledges that future investments will be needed from federal, state, and local authorities to fully fund the master plan over the coming decades.

RESTORATION/RISK REDUCTION BALANCE

When it comes to establishing a balance between restoration and risk reduction projects, CPRA splits the $50 billion budget equally with $25 billion going to restoration projects and $25 billion going to risk reduction projects. Restoration and risk reduction budgets are divided equally since these two decision drivers are equally weighted within the Planning Tool. Within this framework, there is a further breakdown that seeks to establish a balance between near-term and long-term project effects under both restoration and risk reduction. The master plan seeks to satisfy principles of sustainable and long-term solutions while also recognizing the urgent need for action. Some near-term projects, such as dredging or shoreline armoring, offer immediate benefits in the near term but might not be on the landscape for the long term. Some long-term projects, such as diversions that build land over time, may take several years to realize their benefits. The projects selected first are those that maximize both near-term and long-term benefits.

CPRA also seeks to establish a cost-effective balance between structural and nonstructural risk reduction. For certain areas where assets are concentrated, structural risk reduction, involving the construction of large structures, such as levees, pump stations, or flood gates, at the municipal or regional level may be the best solution. Nonstructural risk reduction at the local level involves the mitigation of damage to homes and businesses whether to floodproof, elevate, or acquire structures. Nonstructural risk reduction can be an effective solution regardless of urban or rural setting.

SELECTING PROJECTS FOR AN UNCERTAIN FUTURE

In addition to considering the sequencing of projects based on near-term and long-term benefits and the funding constraint, CPRA uses the Planning Tool to understand the predicted outcomes of projects under the Low, Medium, and High Environmental Scenarios. This analysis, in turn, helps CPRA identify which environmental scenario to use in developing master plan.

A matrix was used to compare outcomes from the individual project analysis using the Planning Tool across the Low, Medium, and High Environmental Scenarios. This analysis is valuable since all scenarios could plausibly occur in the future. Since we do not know which scenario will occur, we needed to weigh the implications of anticipating one possible future, but experiencing another. By comparing outcomes across each scenario, the matrix analysis revealed that there are tradeoffs in benefits if we plan for one scenario but a different scenario actually occurs. The results of the preliminary analysis shown on Figure 3.17 molded our view that it is prudent to conservatively plan for unfavorable conditions, and hope for a more favorable future. Our belief in planning for severe conditions in the future is founded on trends we have observed in the global scientific community's predictions on sea level rise: with each new release of predictions, anticipated sea level rise rates increase. Figure 3.17 was based on Planning Tool analysis to select projects that maximize land area across scenarios and budgets, and it also served as one step in a larger process used to inform scenario selection (of High for plan formulation). By using the High Environmental Scenario to guide decision making, the 2017 Coastal Master Plan includes projects that will perform well even if the High Environmental Scenario is realized.

Once near-term funding and the optimal scenario to plan for became clear, we focused our efforts on selecting and sequencing projects both for the near term and over the next 50 years. Funding for many restoration projects may be available through the allocation of Deepwater Horizon Oil Spill funds; therefore, the certainty associated with this and other near-term funding sources was an important factor in CPRA's decision-making process. Many projects included in this analysis are already in feasibility planning or engineering or design and will continue moving forward in the first 10 years of the master plan. Refer to Chapters 4 and 5 for discussion of projects included in the 2017 Coastal Master Plan and how they will be implemented.

MATRIX OF LAND OUTCOMES PER SCENARIO WITH $25 BILLION INVESTMENT IN RESTORATION PROJECTS

Environmental Conditions Actually Experienced

Environmental Scenario Planned For	Low	Medium	High
Low	0	49	260
Medum	75	0	281
High	310	210	0

Land loss outcomes in square miles

▲ **FIGURE 3.17**

As shown in this matrix, conservatively planning for the most unfavorable of cases evaluated (the High Environmental Scenario) and experiencing something more favorable, results in 50 square miles more land than if the reverse was true (planning for the Low Environmental Scenario and seeing something more unfavorable in the future). Formulating for the High Environmental Scenario yet facing the Medium or Low Environmental Scenarios could also lead to relatively high regret.

AN INTEGRATED APPROACH

FINDING SYNERGIES AND OPTIMIZING PROJECT SUITES

CPRA used the Planning Tool and discussions among the Planning Team to identify alternatives that would build and maintain the most land and reduce the most flood risk given the funding and sediment constraints while also benefiting other metrics. Key questions from CPRA and stakeholders were used in the Planning Tool analysis to select alternatives that emphasize different coastal conditions. These questions included the following:

- Which projects are always selected across different funding and environmental scenarios?
- How does project selection change across funding and environmental scenarios?
- How much can future land loss be reduced under different environmental and funding scenarios?
- How much 50-year risk can be reduced under different environmental, risk, and funding scenarios?

Once alternatives were identified, the Planning Team reviewed the alternatives along with various stakeholder groups and discussed the outcomes and tough decisions that would need to be made before implementing each alternative. This process of alternative formulation was iterative with each new set of analyses, providing important information about how coast wide outcomes would change based on the group of projects included in each alternative. The team used the Planning Tool to identify a variety of alternatives. Numerous alternatives were examined to develop the draft master plan and two of those are briefly discussed below.

Maximize Risk Reduction and Maximize Land Area Alternatives. This first set of alternatives provided CPRA with estimates of how much risk could be reduced and how much land could be built or maintained across different funding levels and environmental scenarios and helped CPRA focus on a single funding level ($25 billion for risk reduction projects and $25 billion for restoration projects) and one environmental scenario (High) for subsequent alternatives.

Modified Maximize Risk Reduction and Maximize Land Alternatives. Based on the results of the previous set of alternatives, CPRA developed this modified set of alternatives to reflect ongoing CPRA activities. For example, diversion projects that already have funding allocated for planning or engineering and design were designated for implementation in the first period. This recognizes the urgency to make progress on large-scale restoration solutions in the near term. A similar approach was taken for risk reduction projects that have a federal authorization.

Improvements to the predictive models and adjustments to the operations of some diversion projects occurred in parallel with early alternative formulation. To ensure that all project results were considered, the Planning Tool was used to develop additional alternatives based on these new project results.

DECISION POINTS

WE USE SCIENCE AND PUBLIC INPUT TO INFORM THE MASTER PLAN

Stakeholder feedback and policy considerations are important parts of the master plan's development process and ensure that each aspect of the master plan will address real world situations and will be informed by stakeholder feedback. Additionally, programmatic guidelines create efficiency in decision making for situations where uncertainty is high and the tools, data, and timing available for analysis are limited. Programmatic guidelines enable CPRA to guide and define future master plan investments.

Ultimately, the master plan is limited to actions the state and its partners can perform and oversee now. With each iteration of the master plan, CPRA is dedicated to expanding Louisiana's ability to develop innovative strategies that assist communities in addressing flood risk and maximize the effectiveness of the master plan.

POLICY CONSIDERATIONS

CPRA uses information from the Planning Tool to determine the degree to which restoration and risk reduction projects build and maintain land and reduce risk in the near term and long term. The individual projects are then combined into alternatives based on how well they perform under constraints for each scenario. Following is a summary of considerations used to select restoration and risk reduction projects for the master plan.

Overall Funding. Budgets of $40 billion, $50 billion, and $60 billion were analyzed to observe whether break points existed based on allowable expenditures. The analysis showed that, for the set of projects examined, the most beneficial and cost-effective projects were selected with a budget of $50 billion.

Funding Split. The balance of funding between projects designed primarily for risk reduction versus projects designed for coastal restoration was analyzed. An equal split of $25 billion each for restoration and risk reduction was determined to provide the appropriate balance.

Scenario. The composition of alternatives developed by the Planning Tool changed depending upon which scenario was being considered, and CPRA reviewed the different sets of projects included in each alternative and the estimated land area and risk reduction benefits of each alternative. Formulating alternatives based on the High Environmental Scenario and experiencing something better results in less regret than if the converse was true. As a result, alternative formulation was based on the High Environmental Scenario.

Near-Term Versus Long-Term Results. Projects were analyzed to determine which would build the most land in the near term and long term, placing equal emphasis on each term.

Policy Adjusted Alternatives. In some cases, project implementation periods were designated to ensure that progress continues on projects that have funding and are underway. Under some alternatives, the project was selected in the second or third period, but was designated for the first so that work could continue.

PROGRAMMATIC CONSIDERATIONS

In any planning process, there are often limitations to the tools and data available at the time when analyses are performed. In other cases, the timing or magnitude of future environmental or geomorphic uncertainties, such as hurricane events, cannot be accurately predicted. These situations often require programmatic guidelines to foster efficient assignment of funds to projects and programs. The discussion below is intended to detail several CPRA programmatic decisions that will guide and define future state investment.

The Future of Barrier Islands. Louisiana has spent hundreds of millions of dollars over the past two decades restoring its barrier shoreline and plans to continue to invest in these features. The progress we have made in recent years in restoring our barrier shorelines has allowed us to begin consideration of transitioning from a focus on construction to a focus on strategic maintenance. Unlike the 2012

Coastal Master Plan, which specified barrier island chains to be restored, the 2017 Coastal Master Plan recommends funding Louisiana's barrier island program, which CPRA is currently developing. Rather than recommending specific barrier island/headland projects and assigning them to a certain implementation period, given the uncertainty of events like hurricanes, CPRA intends to have plans for restoration of the Terrebonne and Barataria barrier shorelines ready so that when future hurricanes do impact these areas, we can react quickly to restore the impacted barrier shoreline. This decision was informed through the 2017 modeling effort; model results indicated that, under the High Environmental Scenario, recently restored barrier islands and headlands were surviving in some manner. This informed our decision to take $1.5 billion from our $25 billion restoration budget before project sequencing and set it aside to fund the barrier island program.

Lake Charles Flood Protection. The Lake Charles area is Louisiana's fastest-growing industrial corridor and is strategic not only to the state, but also to the nation for its petrochemical facilities. It is the location of ongoing investments in industrial infrastructure. As was similarly described in the 2012 Coastal Master Plan, modeling results indicate that Lake Charles could experience increased future flood risk without restoration of coastal features and potential future flood risk reduction projects. Our analysis indicates that under the Medium Environmental Scenario the Cameron and Calcasieu regions could be exposed to $293 million in expected annual damage by year 25 and $460 million in expected annual damage by year 50 if no action is taken. We are continuing to examine how best to achieve risk reduction, whether it be through structural risk reduction projects, nonstructural risk reduction projects, or a combination thereof, while considering the views and findings of the local stakeholders and recently completed studies such as the Southwest Coastal Louisiana Feasibility Study conducted by USACE.

Projects with Local Benefits. CPRA often receives project submissions for local Hydrologic Control Structures, Oyster Reef Establishment and Nourishment, Wetland Assimilation, and Conservation Partnerships. We have historically supported these efforts as evidenced through our Coastal Forest Conservation Initiative or through ongoing projects, such as the Central Wetlands Assimilation Project.

While they often can satisfy our objectives of creating or maintaining land and reducing flood risk, projects such as local flap-gated culverts for salinity control, invasive species control, wetland assimilation, or oyster seed ground maintenance are project types whose effects cannot be accurately captured in our current models. Therefore, we do not have these specific project types captured in the 2017 Coastal Master Plan; however, CPRA plans to continue to strategically analyze the merit of these projects on a case-by-case basis.

Bankline Stabilization of Navigation Channels. In 2011, CPRA adopted by resolution an official state policy that restoration funds would not be authorized for use in federal navigation channel bank stabilization. This resolution was adopted into the master plan guidelines. The resolution states that the legal obligation for maintaining the banks of navigation channels rests with USACE. CPRA will continue to support the funding of bank stabilization measures through operation and maintenance budgets and evaluate projects involving bank stabilization on a case-by-case basis. The policy has become part of the Master Plan Consistency Guidelines that no more than 25 percent of the overall cost of a project receiving state funding may be composed of bank stabilization or shoreline protection features on navigation channels.

COMMUNITY LESSONS INCORPORATED INTO PLAN

Our choice of projects for the 2017 Coastal Master Plan was developed from scientific research and from listening to coastal residents who have generations of expertise to share. We incorporated the following lessons when selecting projects for the master plan.

Make it practical. The master plan must recommend projects that build land and reduce flooding, both now and in the long term.

Certain projects are key. We have to use sediment diversions to build land in certain parts of the coast, or we risk ecosystem collapse. In the same way, levees have a place in reducing flood risk.

Use a mix of tools. Levees are not the only way to protect communities. In some areas, raising homes and floodproofing businesses are more effective strategies. Similarly, the master plan's sediment diversions are located near the Mississippi or Atchafalaya Rivers. Other regions require different approaches to land building. In all, the plan uses 10 types of projects to build land and reduce flood risk.

We cannot fix everything. Some coastal residents will be able to live, work, and play in and around the coast for the foreseeable future. Communities in particularly hard hit areas, however, will have to adapt, with support from CPRA and its partner agencies.

Photo courtesy of Lindsey Janies Photography

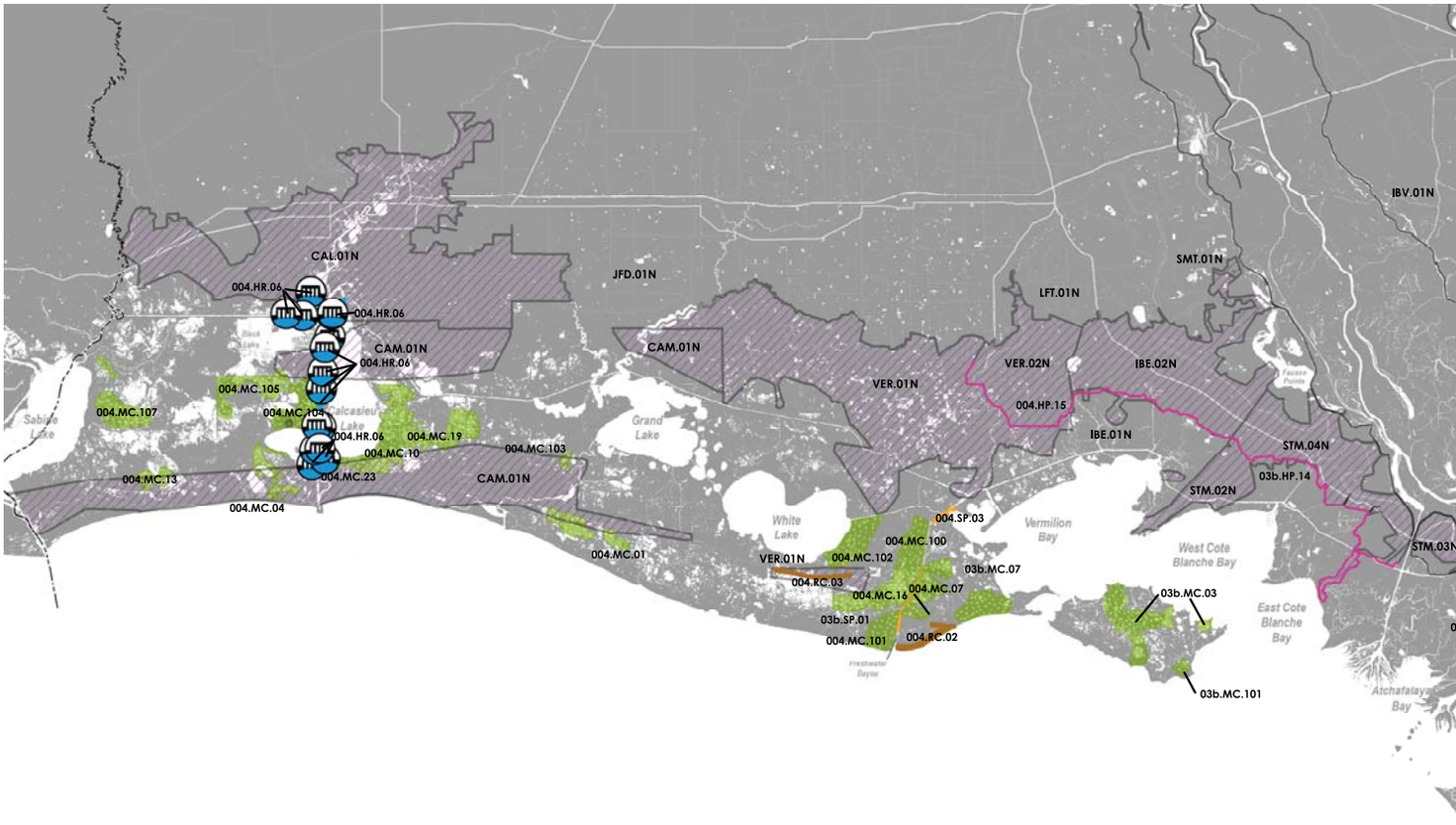
Chapter 4
2017 COASTAL MASTER PLAN

- 2017 MASTER PLAN PROJECTS
- LAND BUILT OR MAINTAINED
- COAST WIDE LAND BENEFITS
- FLOOD RISK REDUCTION BENEFITS
- COAST WIDE RISK REDUCTION
- WHAT THE PLAN DELIVERS
- HIGH SCENARIO BENEFITS
- SOUTHWEST COAST PROJECTS
- CENTRAL COAST PROJECTS
- SOUTHEAST COAST PROJECTS

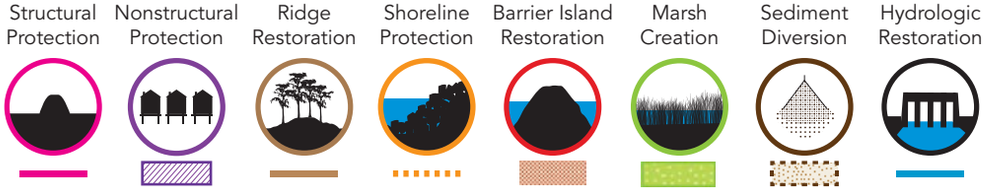
Photo courtesy of Lindsey Janies Photography

2017 MASTER PLAN PROJECTS

A $50 BILLION INVESTMENT DESIGNED TO BUILD AND MAINTAIN LAND, REDUCE FLOOD RISK TO COMMUNITIES, AND PROVIDE HABITATS TO SUPPORT ECOSYSTEMS

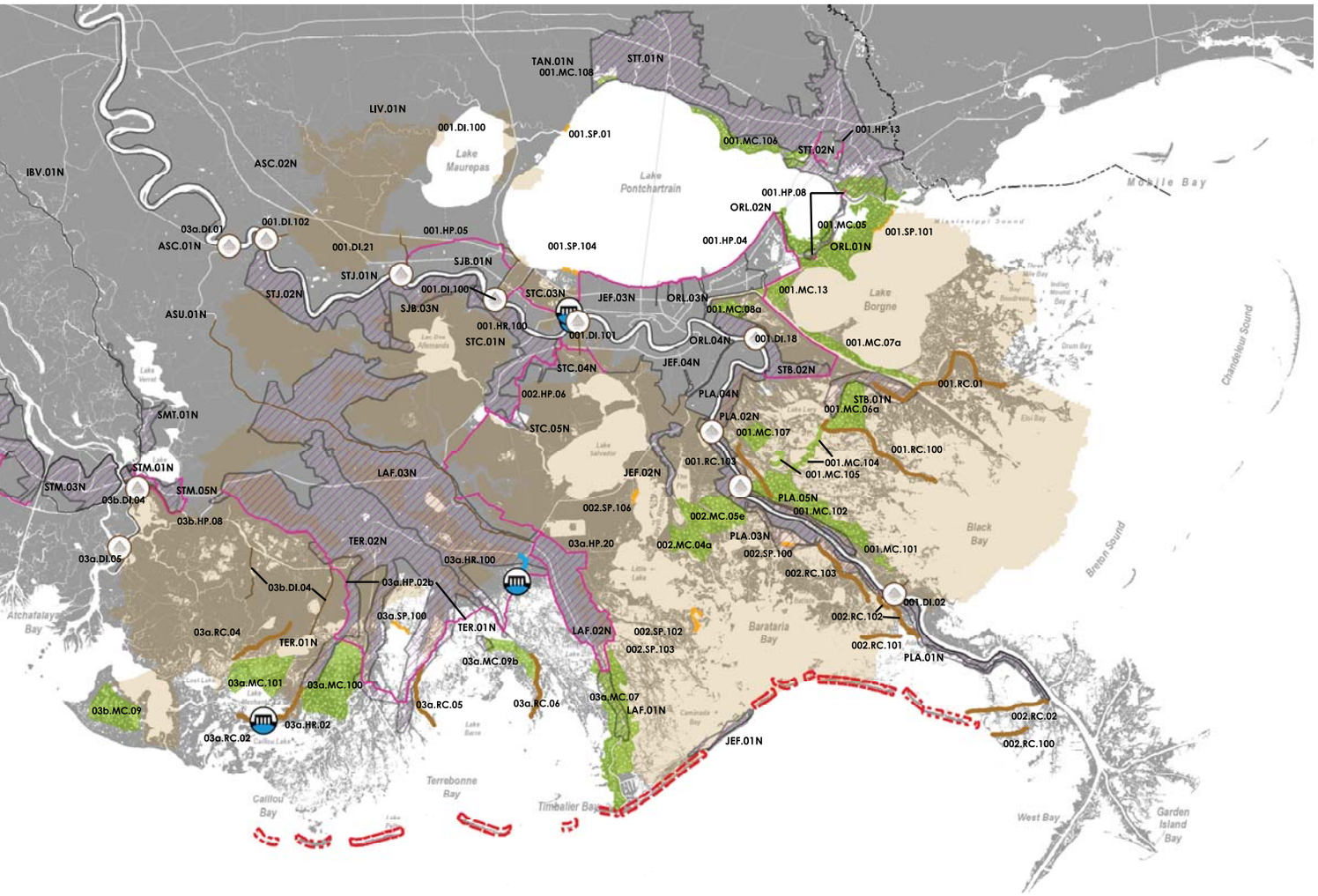


PROJECT TYPES



2017 COASTAL MASTER PLAN PROJECTS

The 2017 Coastal Master Plan identifies projects designed to build and maintain land, reduce flood risk to our citizens and communities, and provide habitats to support ecosystems. These projects were selected with a comprehensive, long-term focus and commitment to balancing the diverse objectives of the master plan. Beyond the projects, the master plan acknowledges that our coast is dynamic and additional adaptation will be required by individuals, businesses, and government if we are to continue to live and work in coastal Louisiana. The plan provides a foundation for coordinating local, state, and federal responses to our coastal land loss crisis and potential threats from storm surge events.



▲ FIGURE 4.1

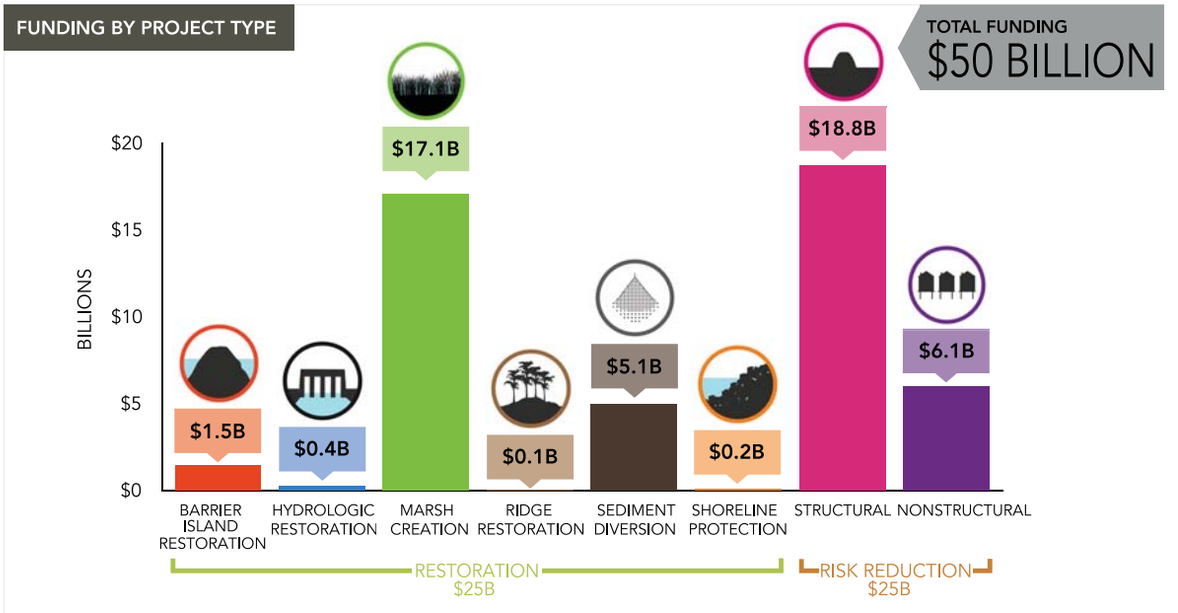
The 2017 Coastal Master Plan includes 76 restoration, 12 structural risk reduction, and 32 nonstructural risk reduction projects that will be implemented throughout coastal Louisiana over the next 50 years.

THE PLAN RECOMMENDS 120 PROJECTS THAT BUILD OR MAINTAIN MORE THAN 800 SQUARE MILES OF LAND AND REDUCE EXPECTED DAMAGE BY $8.3 BILLION ANNUALLY BY YEAR 50, OR BY MORE THAN $150 BILLION OVER THE NEXT 50 YEARS.

FUNDING ALLOCATION ACROSS PROJECTS

Our plan represents a step forward in our understanding of Louisiana's coastal ecosystem and the restoration and risk reduction projects necessary to reduce coastal flood risk, promote viable ecosystems, provide habitats, strengthen communities, and support businesses and industries.

Equal funding of $25 billion is allocated to restoration and risk reduction projects, and project selection is based on a project's effectiveness in providing near- and long-term land area or risk reduction benefits within the available funding. More than half of the investment in restoration is directed to marsh creation projects, while structural projects receive the largest investment of risk reduction funds.



▲ FIGURE 4.2

The 2017 Coastal Master Plan includes the nation's largest investment in marsh creation using dredged material and sediment diversion projects, both of which will provide land building benefits for areas in dire need. The diversity of projects reflects the need to use all tools available to us, and construct projects that build land and reduce risk in the near term while also investing in projects like sediment diversions and structural risk reduction projects that provide long-term benefits.

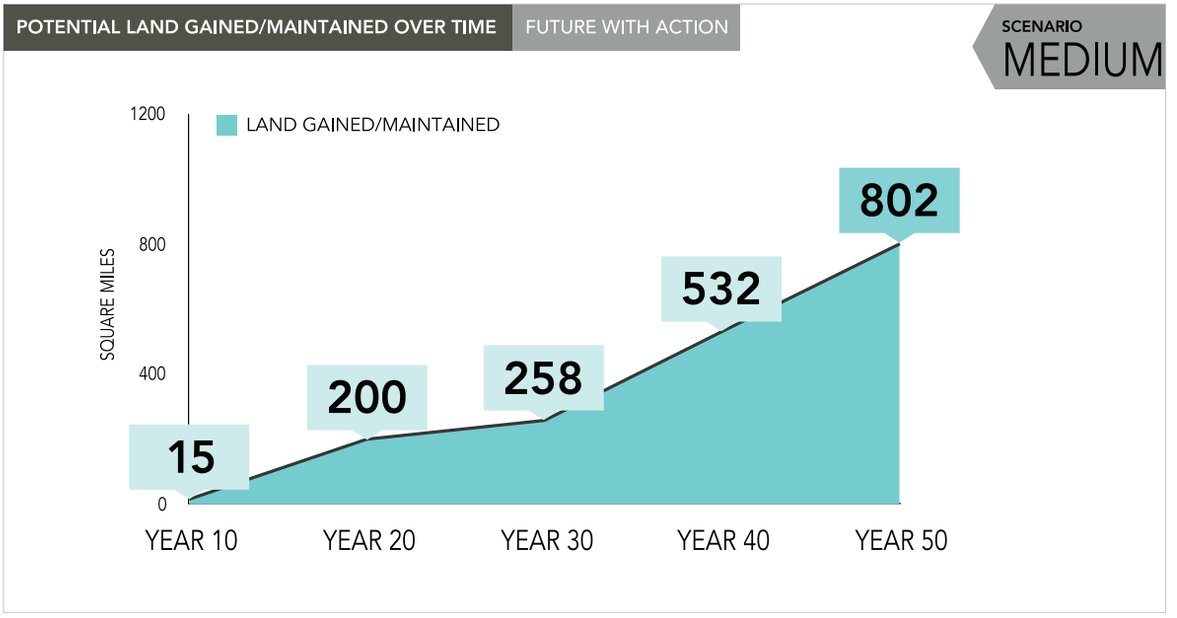
Photo courtesy of Lindsey Janies Photography

Coastal Louisiana faces one of the highest land loss rates in the world, which puts our homes, businesses, communities, and national energy and transportation infrastructure at risk. If this trend continues, the economic, social, and environmental impacts will be severe. Our problem is complex, and it cannot be solved simply by building more levees. That is why CPRA integrates a mixture of restoration, structural, and nonstructural mitigation options in the 2017 Coastal Master Plan.

LAND BUILT OR MAINTAINED

MASTER PLAN RESTORATION PROJECTS BENEFIT 800 SQUARE MILES

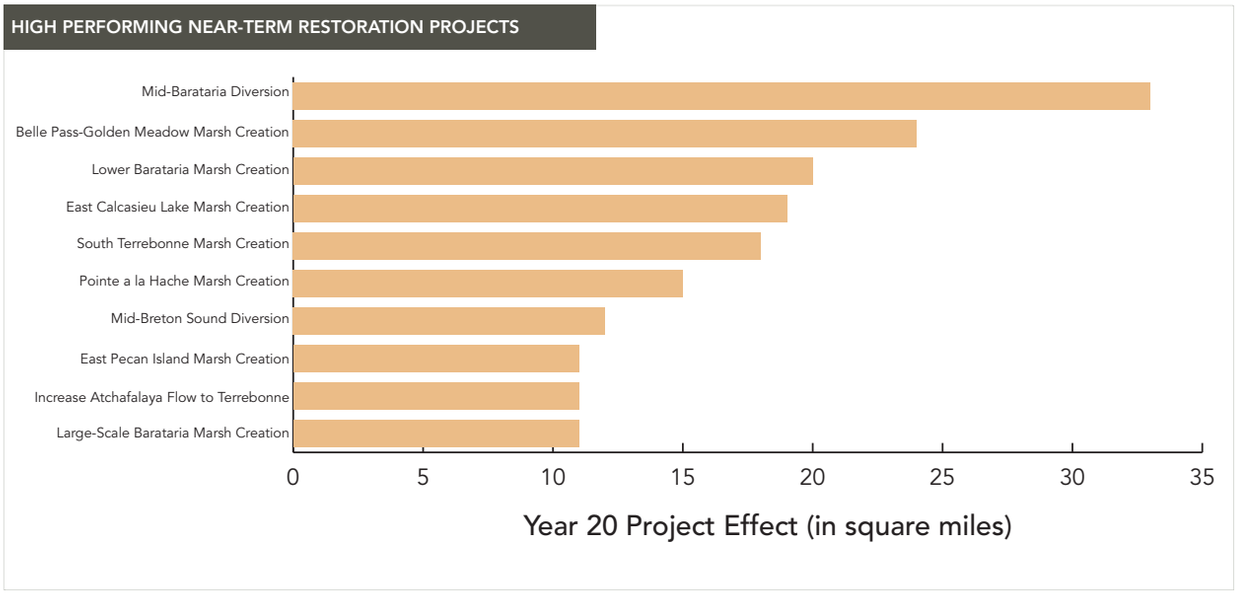
It is expected that the restoration projects in the 2017 Coastal Master Plan will maintain or create approximately 800 square miles of land by year 50, as shown on Figure 4.3. In some areas, such as the Upper Pontchartrain and Upper Barataria regions, we expect land areas to be largely maintained with implementation of the 2017 Coastal Master Plan, while in other areas, such as the Bird's Foot Delta, we anticipate land areas to greatly diminish.

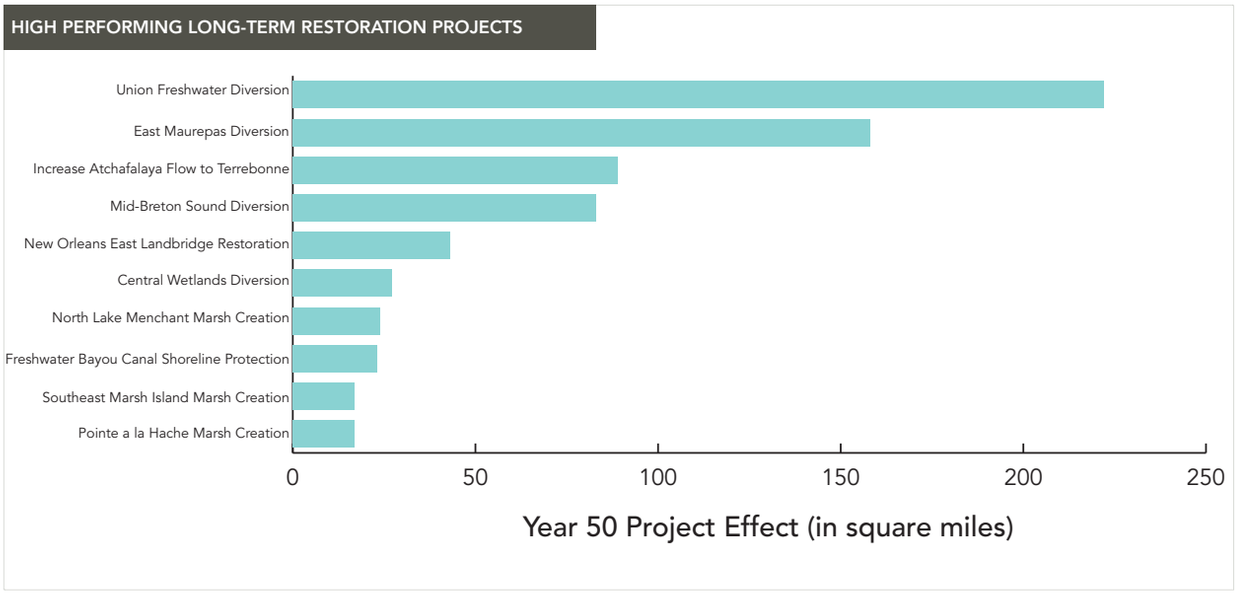


▲ FIGURES 4.3

By the end of 50 years, restoration projects in the 2017 Coastal Master Plan have the potential to maintain or create approximately 800 square miles of land under the Medium Environmental Scenario as compared to Future Without Action. The land building benefits provided by many of the restoration projects will continue beyond 50 years. These long-term benefits will support the key issues affecting people in and around Louisiana's coast.

The restoration projects that performed best in terms of their ability to build and/or maintain land in the near term or the long term are identified on Figures 4.4 and 4.5. Marsh creation and sediment diversion projects are shown to be the highest performing projects in both the near and long term.



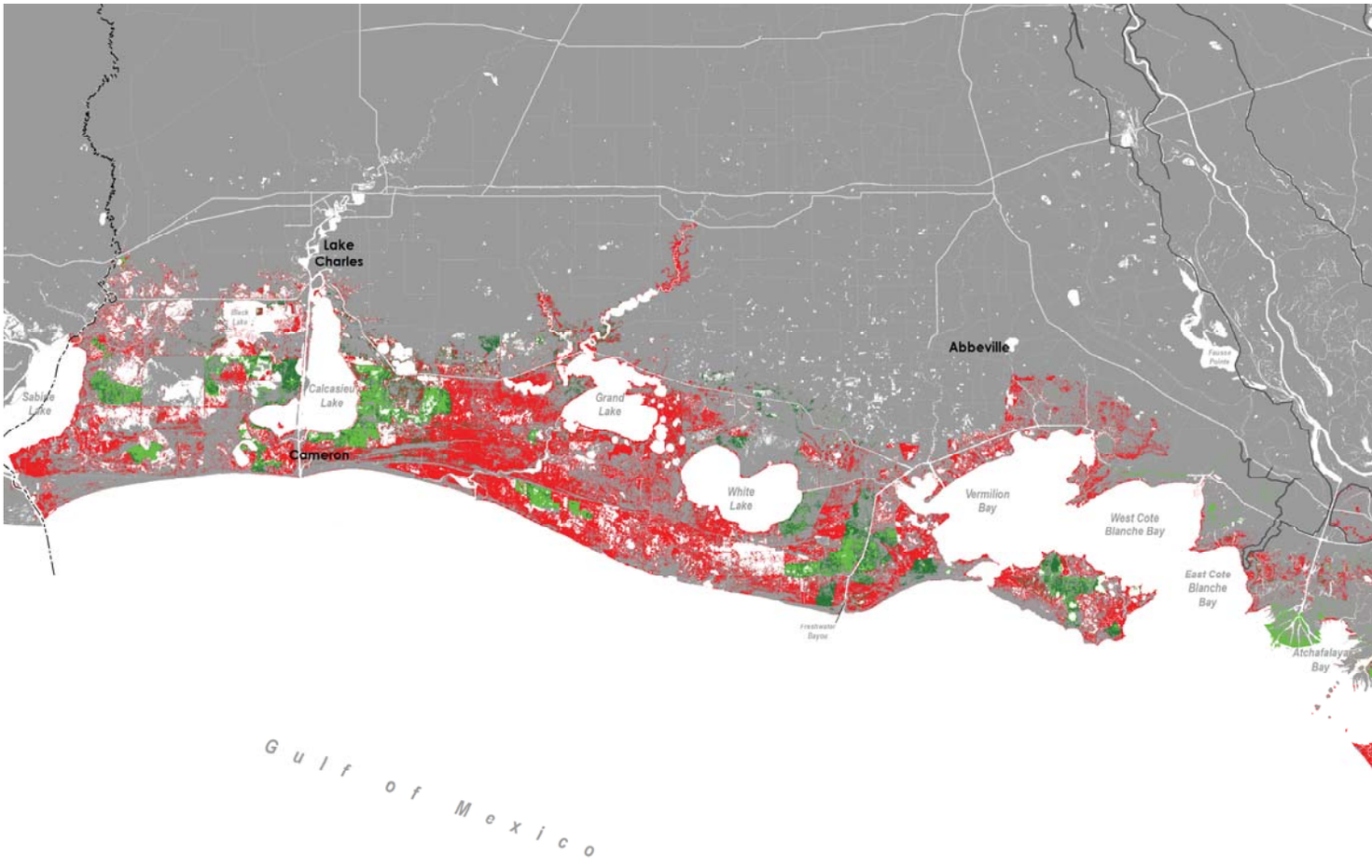


▲ FIGURES 4.4 & 4.5

The 2017 Coastal Master Plan includes key, high-performing restoration projects that build and/or maintain land both in the near and long term. These projects are shown here with land area benefited in years 20 and 50.

COAST WIDE LAND BENEFITS

THE MASTER PLAN RESULTS IN LAND GAINED AND MAINTAINED

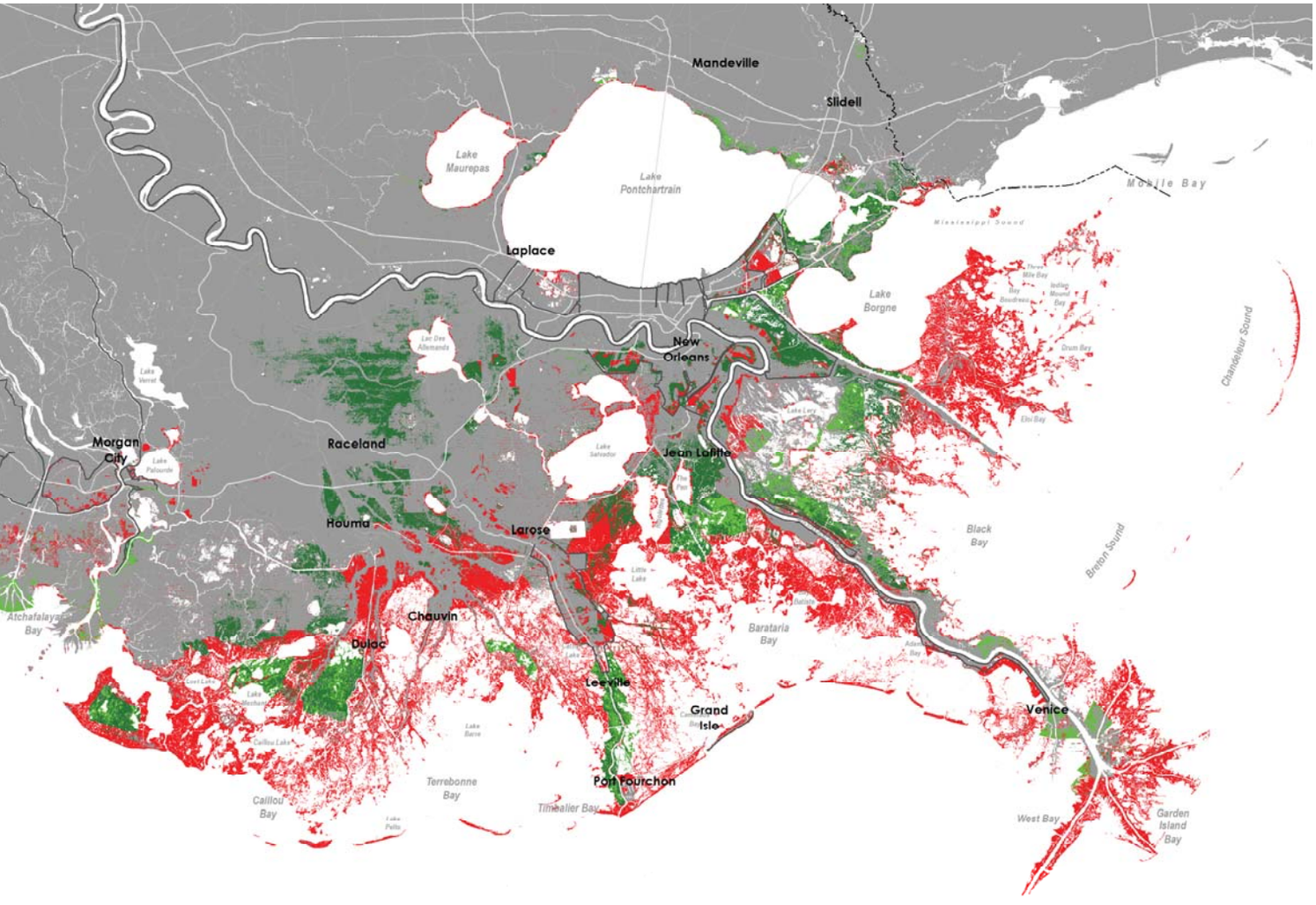


LAND CHANGE

- Land Lost
- Land Gained
- Land Maintained

▲ FIGURE 4.6

Predicted land gained and maintained along the Louisiana coast under the Medium Environmental Scenario over the next 50 years as an outcome of implementing 2017 Coastal Master Plan projects. Red indicates areas predicted to be lost, light green indicates areas where land would be created, and dark green indicates areas where existing land that would otherwise be lost will instead be maintained.

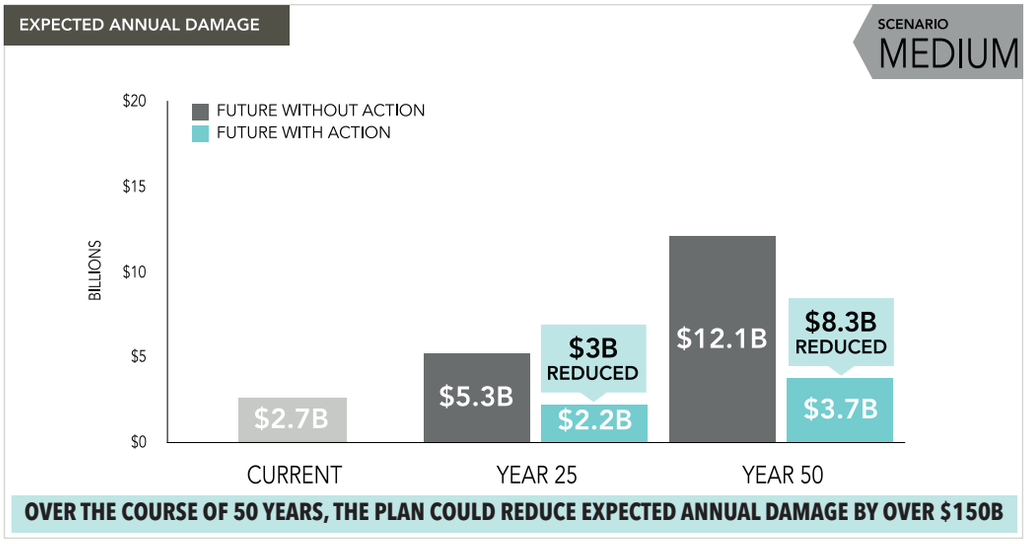


BY THE END OF 50 YEARS, PROJECTS IN THE 2017 COASTAL MASTER PLAN HAVE THE POTENTIAL TO CREATE OR MAINTAIN APPROXIMATELY 800 SQUARE MILES OF LAND UNDER THE MEDIUM ENVIRONMENTAL SCENARIO.

FLOOD RISK REDUCTION BENEFITS

THE MASTER PLAN REDUCES EXPECTED ANNUAL DAMAGE ACROSS THE COAST

Louisiana's coastal communities are no strangers to storm surge flooding. We cannot eliminate the impacts of these storms, but we can take steps to significantly reduce their impacts. If we do nothing more than we have done to date, we could experience annual economic damage from coast wide flooding ranging from $5.3 billion at year 25 to $12 billion at year 50, as shown on Figure 4.7. In contrast, if we take steps to restore and protect our coast, we could prevent $3 billion at year 25 and $8.3 billion at year 50 in direct asset damage to individuals, communities, and industry with implementation of the 2017 Coastal Master Plan. Over the course of 50 years, the plan could reduce expected annual damage by more than a total of $150 billion. These estimates do not account for responding to natural disasters and recovery costs, which during the 2005 hurricane season alone cost more than $250 billion.

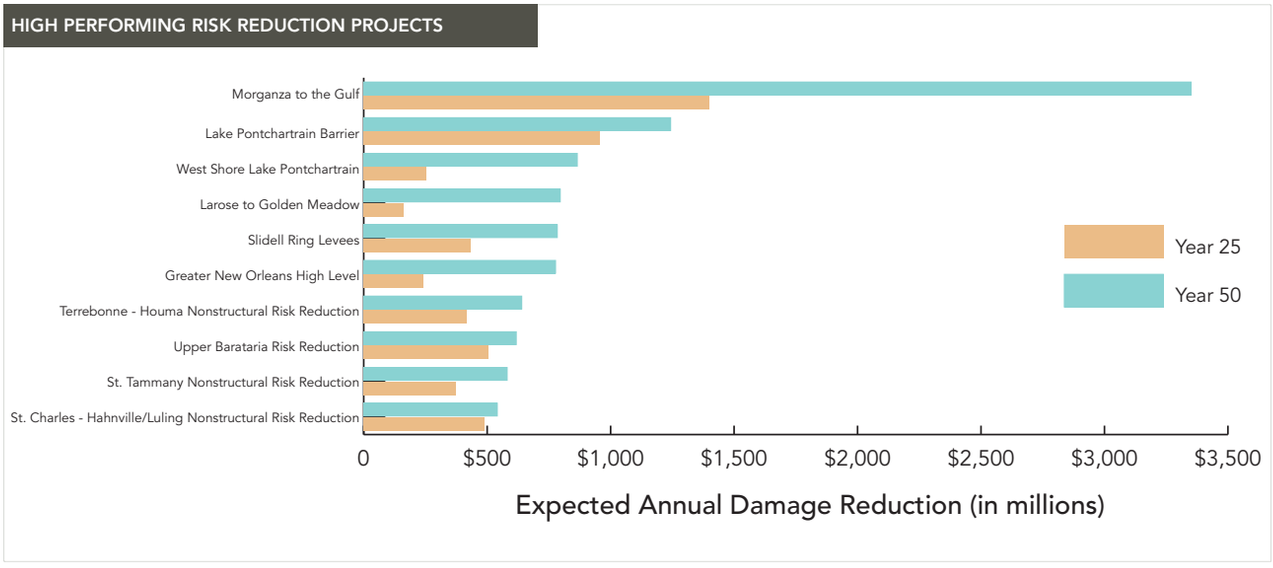


▲ FIGURE 4.7

Projects in the 2017 Coastal Master Plan would reduce expected annual damage from flooding throughout Louisiana's coast. For example, at year 50, the plan could reduce expected annual damage by up to $8.3 billion annually under the Medium Environmental Scenario as compared to Future Without Action. Over the course of 50 years, the plan could reduce expected annual damage by more than a total of $150 billion under the Medium Environmental Scenario. Expected annual damage, expressed in dollars, represents the average direct economic damage projected to result from a storm surge flooding event in any given year, taking into account both the expected damage and the overall chance of a storm occurring.

The 2017 Coastal Master Plan includes projects that will effectively reduce flood damage coast wide by varying levels. Communities along the rim of Lake Pontchartrain and Lake Borgne, especially Slidell, Lacombe, Mandeville, Madisonville, and Ruddock, and communities associated with the Upper Barataria Basin, especially Des Allemands, Kraemer, and Chackbay, will benefit from implementation of structural risk reduction projects. Coastal communities and areas outside of the major levee systems, such as Lafitte, Lower Terrebonne, the west bank of Plaquemines and St. Bernard parishes, the Chenier Plain, Cameron, Pecan Island, Hackberry, Sulphur, and Lake Charles, will benefit from implementation of nonstructural risk reduction measures. Additionally, the 2017 Coastal Master Plan identifies many locations where structural and nonstructural projects will be implemented in concert to provide risk reduction.

The risk reduction projects that performed best in terms of their ability to reduce storm surge based flood risk in the near term or the long term are identified on Figure 4.8. Both structural and nonstructural projects are included in this list of the highest performing projects.

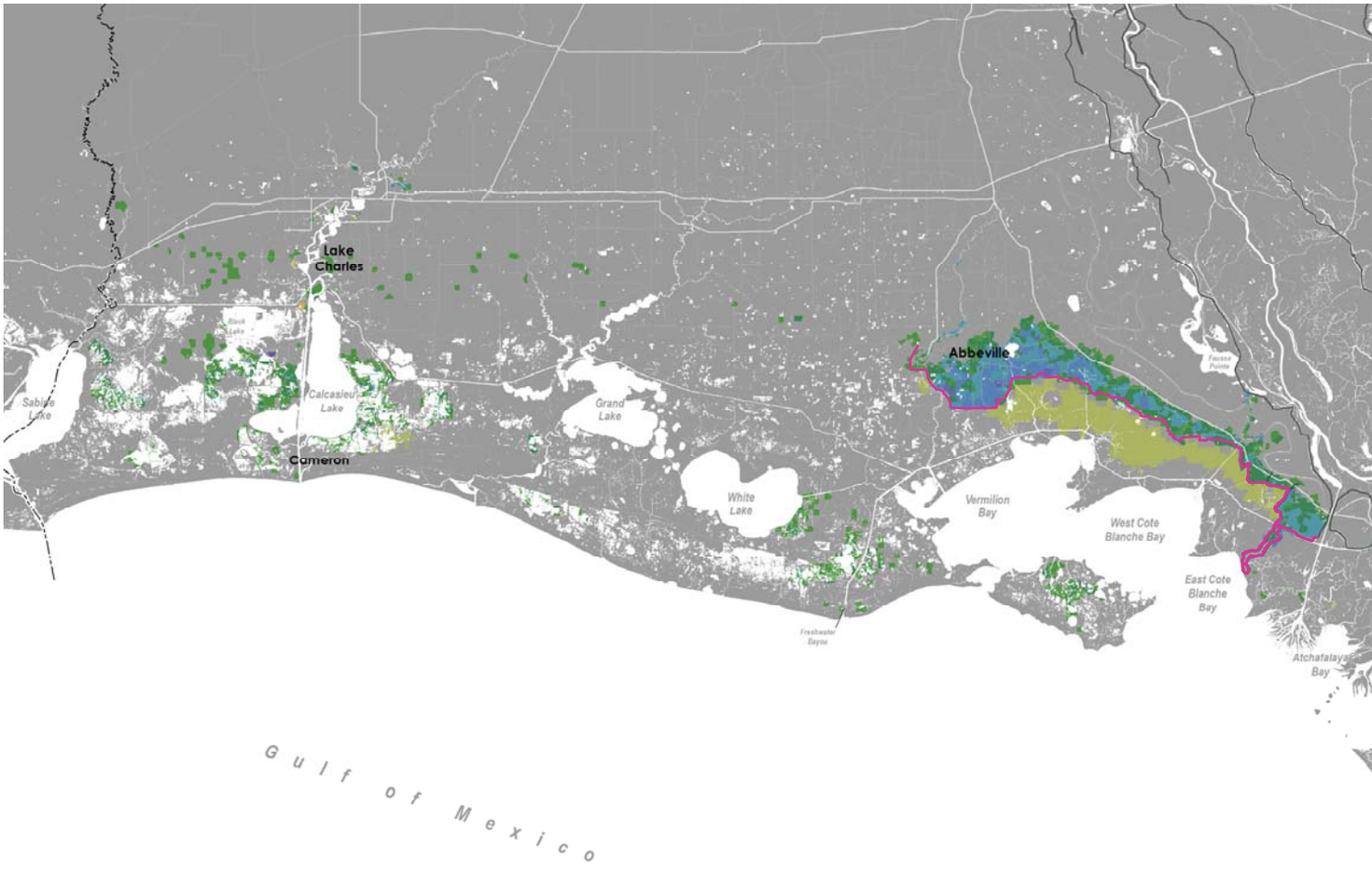


▲ FIGURE 4.8

The 2017 Coastal Master Plan includes key, high-performing risk reduction projects that reduce damage both in the near and long term. These projects are shown here with predicted expected annual damage reduced at year 25 and year 50.

COAST WIDE RISK REDUCTION

THE MASTER PLAN REDUCES FLOOD DEPTHS

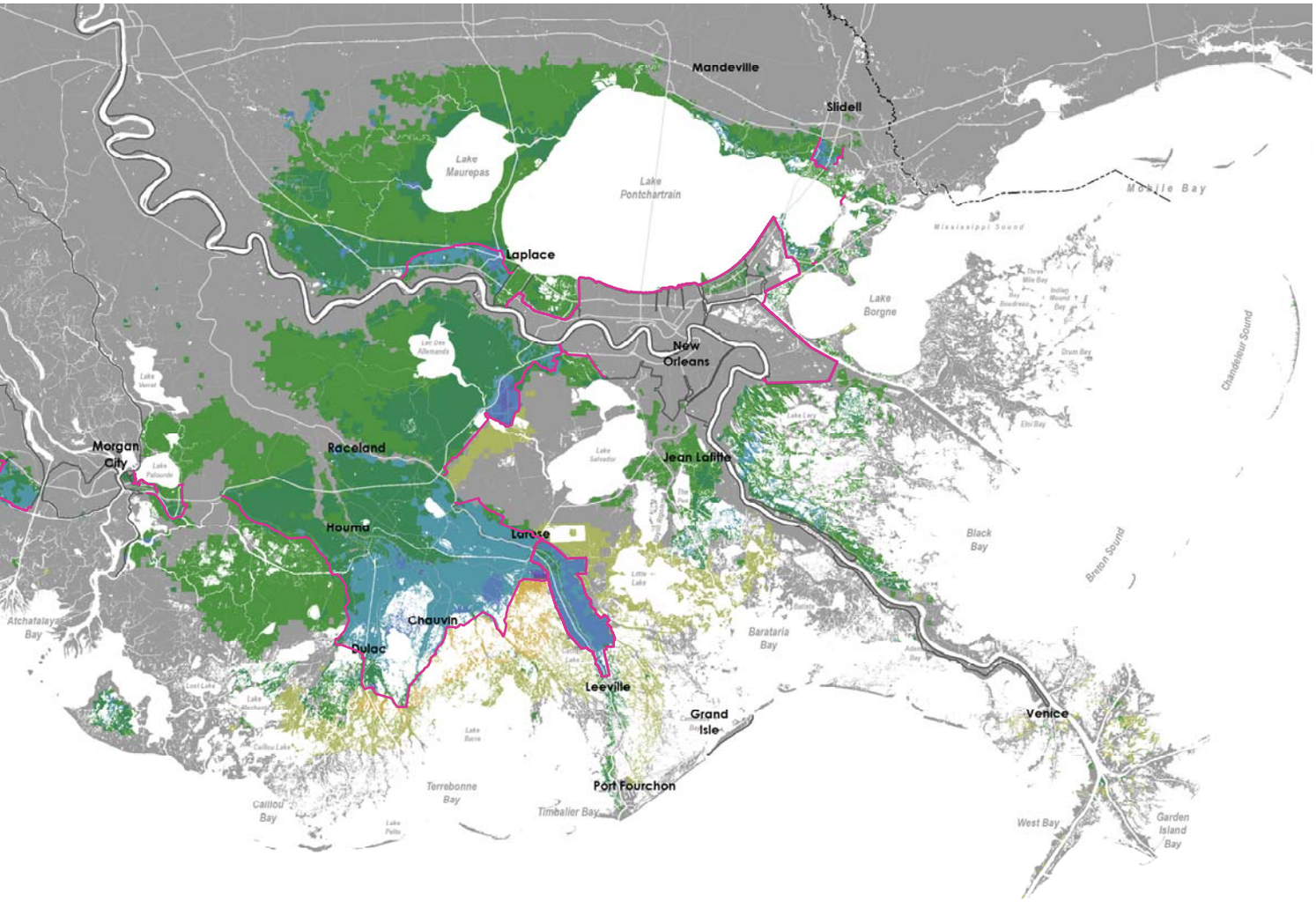


FLOOD DEPTHS

<-9 ft	-6 to -3 ft	1 to 3 ft
-9 to -6 ft	-3 to -1 ft	> 3 ft

▲ FIGURE 4.9

Outcomes of master plan projects on flood depths at year 50 by comparing the master plan's projects to a future where we take no further action on improving our flood defenses. For instance, flood depths could be reduced by 5 feet in Houma, and as much as 5 to 10 feet in areas like Laplace, Des Allemands, Larose, Golden Meadow, and along the Hwy 90 corridor from Delcambre to Franklin.



MASTER PLAN PROJECTS COULD REDUCE FLOOD DEPTHS BY UP TO 10 FEET IN SOME COMMUNITIES.

WHAT THE PLAN DELIVERS

- The plan dedicates nearly $18 billion to marsh creation using dredged material, $5 billion to sediment diversions, and more than $2 billion to other types of restoration projects – providing land building benefits of more than 800 square miles, compared to the Future Without Action.
- The plan dedicates $19 billion for structural risk reduction and $6 billion for nonstructural risk reduction; these projects will save more than $8.3 billion in annual economic damage by year 50 as compared to Future Without Action and are expected to pay for themselves three times over the course of implementing the plan.
- The Flood Risk and Resilience Program focuses on proactive investments to make our communities more resilient. It provides for floodproofing of more than 1,400 structures, elevation of more than 22,500 structures, and acquisition of approximately 2,400 structures in areas that are most at risk.
- We know our risk will increase into the future, but through the combination of structural and nonstructural risk reduction projects, we estimate that we can reduce the expected annual damage we would face from storm surge by more than 75% for the Houma, Slidell, Franklin and Charenton, Edgard, Kenner and Metairie, lower St. Mary, and Prairieville and Sorrento regions, and by more than 90% for the Garyville, Ama, Laplace and Reserve, Algiers, Hahnville and Luling, Montz, Donaldsonville, Convent, Vacherie, Larose and Golden Meadow, Morgan City, Abbeville and Delcambre, and Iberia regions.
- The ecosystem benefits provided by the plan will support commercial and recreational fisheries and wildlife coast wide, along with other ecosystem outcomes that benefit our communities.
- The plan improves coast wide habitat for wild crawfish, largemouth bass, alligator, and mottled duck, as compared to Future Without Action conditions.
- The plan results in increased suitable habitat coast wide for species like adult bay anchovy and spotted seatrout, small juvenile white and brown shrimp, oyster, and green-winged teal as compared to initial conditions but reduced suitable habitat as compared to Future Without Action conditions at year 50.
- The plan results in similar coast wide suitable habitat for blue crabs, juvenile gulf menhaden, and gadwall at year 50 when compared to current or Future Without Action conditions.
- The plan provides a blueprint for action that is consistent with and supportive of other efforts like the Mabus Report, the Gulf Coast Ecosystem Restoration Task Force's Regional Ecosystem Restoration Strategy, the Revived Economies of the Gulf Coast States (RESTORE) Act multi-year implementation plan, the Natural Resource Damage Assessment Programmatic Damage Assessment and Restoration Plan, and the mission of the National Fish and Wildlife Foundation. Additionally, the plan positions Louisiana for continued state and federal investment.
- The plan provides tremendous economic development opportunities for Louisiana and its citizens. Our investment in coastal research has spurred the growth of related fields. For example, learning to live with water is central to our wetland restoration and flood risk reduction strategies. The state's interest in this subject has created a welcoming business climate for water managers who help communities reduce flooding and promote effective water management strategies.

BENEFITS AS MEASURED BY METRICS

Support for Traditional Fishing Communities. Master plan benefits for communities in Upper Barataria, Lower Barataria, and Lower Terrebonne include a reduction in expected annual damage and an improvement in habitat suitability for the fisheries resources used by each community.

Support for Oil and Gas Activities and Communities. The master plan benefits all oil and gas communities. Expected annual damage will be reduced and more land is sustained than if we do nothing more than we have done to date.

Support for Agricultural Communities. Master plan benefits for the Upper Barataria, Lower Terrebonne, and Mermentau Lakes agricultural communities include a reduction in expected annual damage, and a reduction in flooding that will help maintain appropriate salinities in agricultural areas.

Use of Natural Processes. The benefits of master plan projects that promote the use of natural processes are more significant than the impacts of those that might impede natural processes.

Flood Protection of Historic Properties. The master plan reduces flooding by 33% for properties registered with the National Register of Historic Places that are subject to flooding from a 50-year storm event.

Flood Protection of Strategic Assets. The master plan reduces flooding by 26% for strategic assets that are subject to flooding from a 50-year storm event.

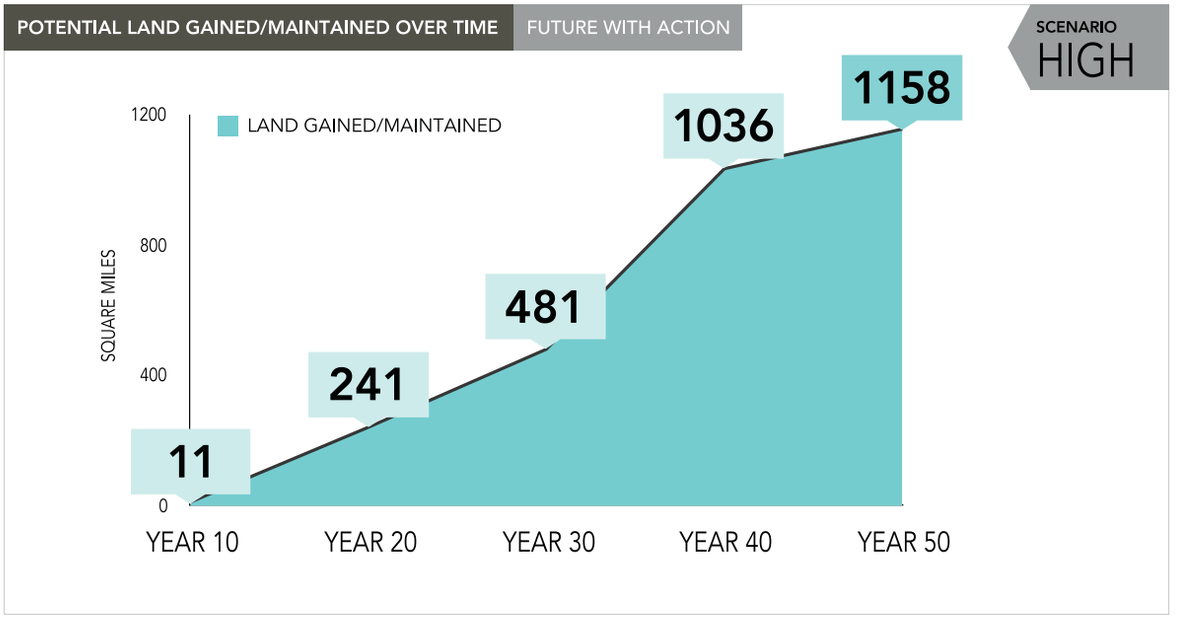
Social Vulnerability. The master plan does not disproportionately affect communities identified as vulnerable, whether that vulnerability is based on income levels; where people live (rural or urban); whether residents are very young, elderly, or non-English speaking; or whether people depend on a single natural resource for employment or sustenance.

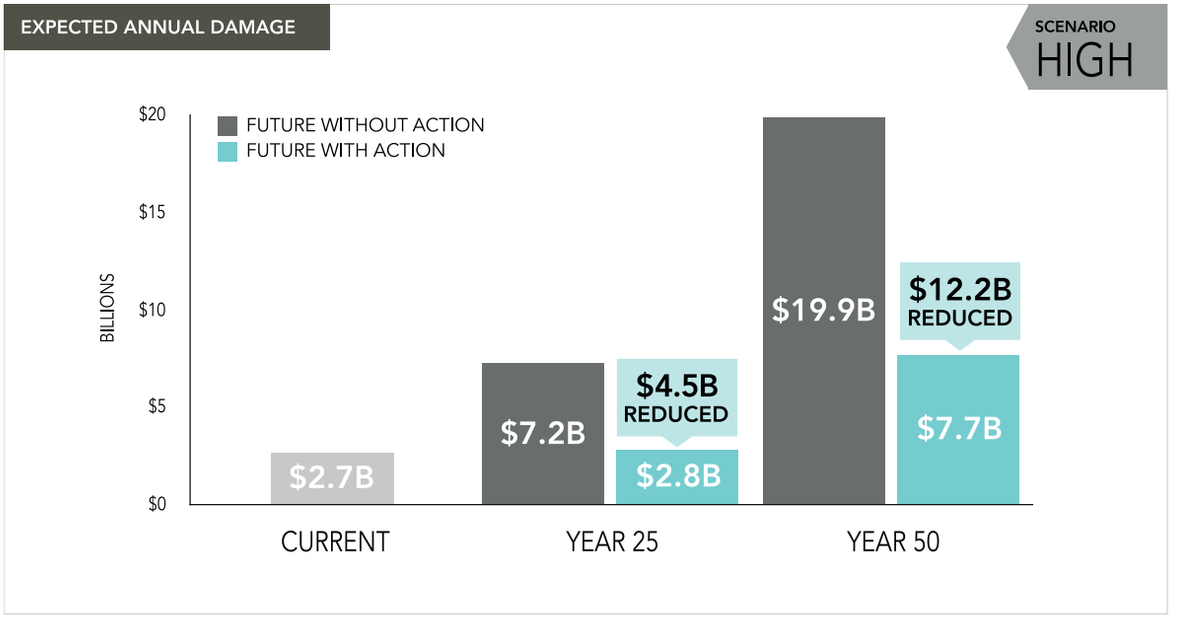
Photos courtesy of Louisiana Sea Grant

HIGH SCENARIO BENEFITS

MASTER PLAN OUTCOMES ON POTENTIAL CONDITIONS OF LAND LOSS AND FLOOD RISK UNDER THE HIGH ENVIRONMENTAL SCENARIO

As described in Chapter 3, CPRA included three environmental scenarios in its evaluation of the predicted future landscape and the effects of master plan projects. If the predicted future landscape is similar to the High Environmental Scenario, master plan projects will provide benefits as shown on Figures 4.10 – 4.13.

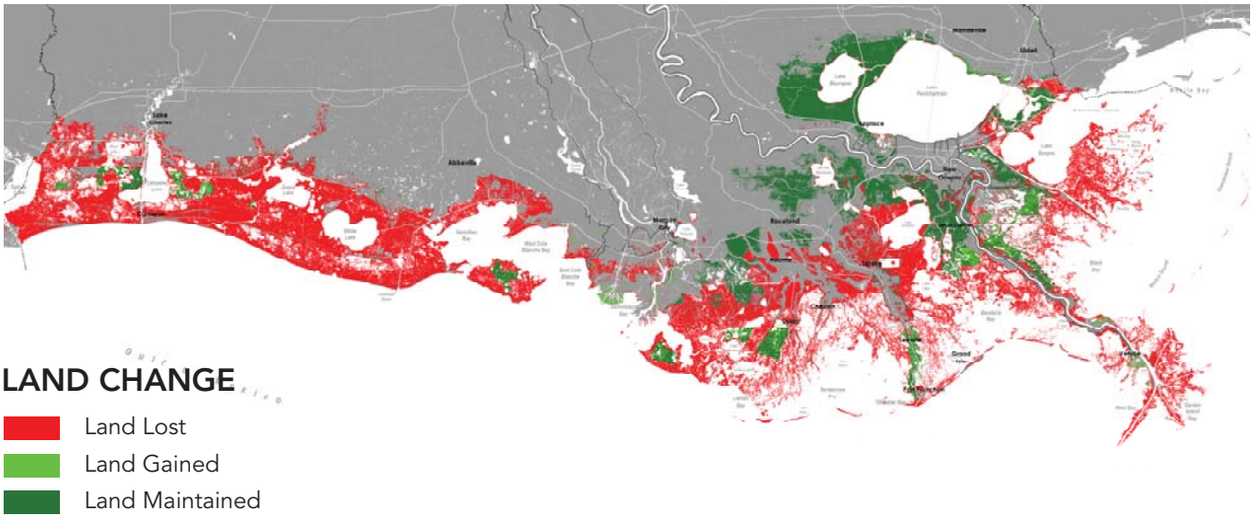




▲ FIGURES 4.10 & 4.11

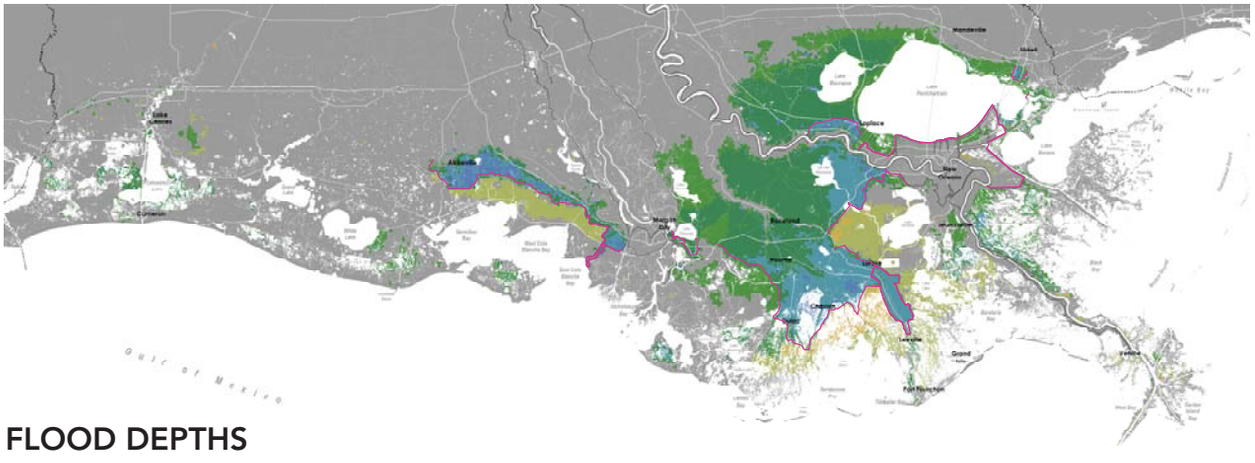
By the end of 50 years, restoration projects have the potential to conserve or create more than 1,100 square miles under the High Environmental Scenario as compared to Future Without Action, and risk reduction projects in the 2017 Coastal Master Plan have the potential to reduce expected annual damage by more than $12.2 billion at year 50 under the High Environmental Scenario as compared to Future Without Action.

LAND GAINED AND MAINTAINED UNDER THE HIGH ENVIRONMENTAL SCENARIO



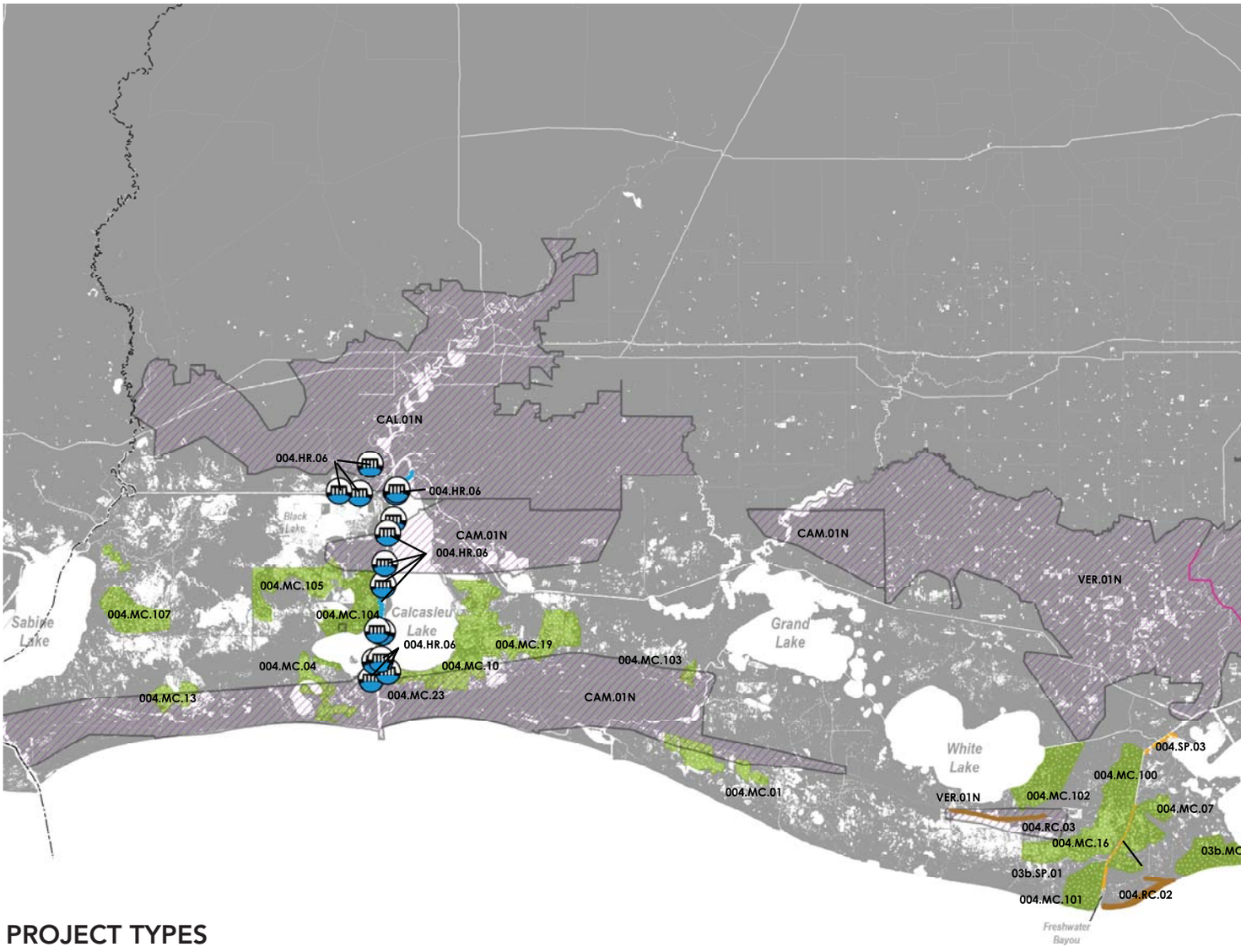
▲ FIGURE 4.12
Predicted land gained and maintained along the Louisiana coast over the next 50 years under the High Environmental Scenario. Red indicates areas predicted to be lost, light green indicates areas where land would be created, and dark green indicates areas where existing land that would otherwise be lost will instead be maintained.

FLOOD DEPTH REDUCTION UNDER THE HIGH ENVIRONMENTAL SCENARIO



▲ FIGURE 4.13
Outcomes of master plan projects on flood depths at year 50 under the High Environmental Scenario by comparing the master plan's projects to a future where we take no further action on improving our flood defenses.

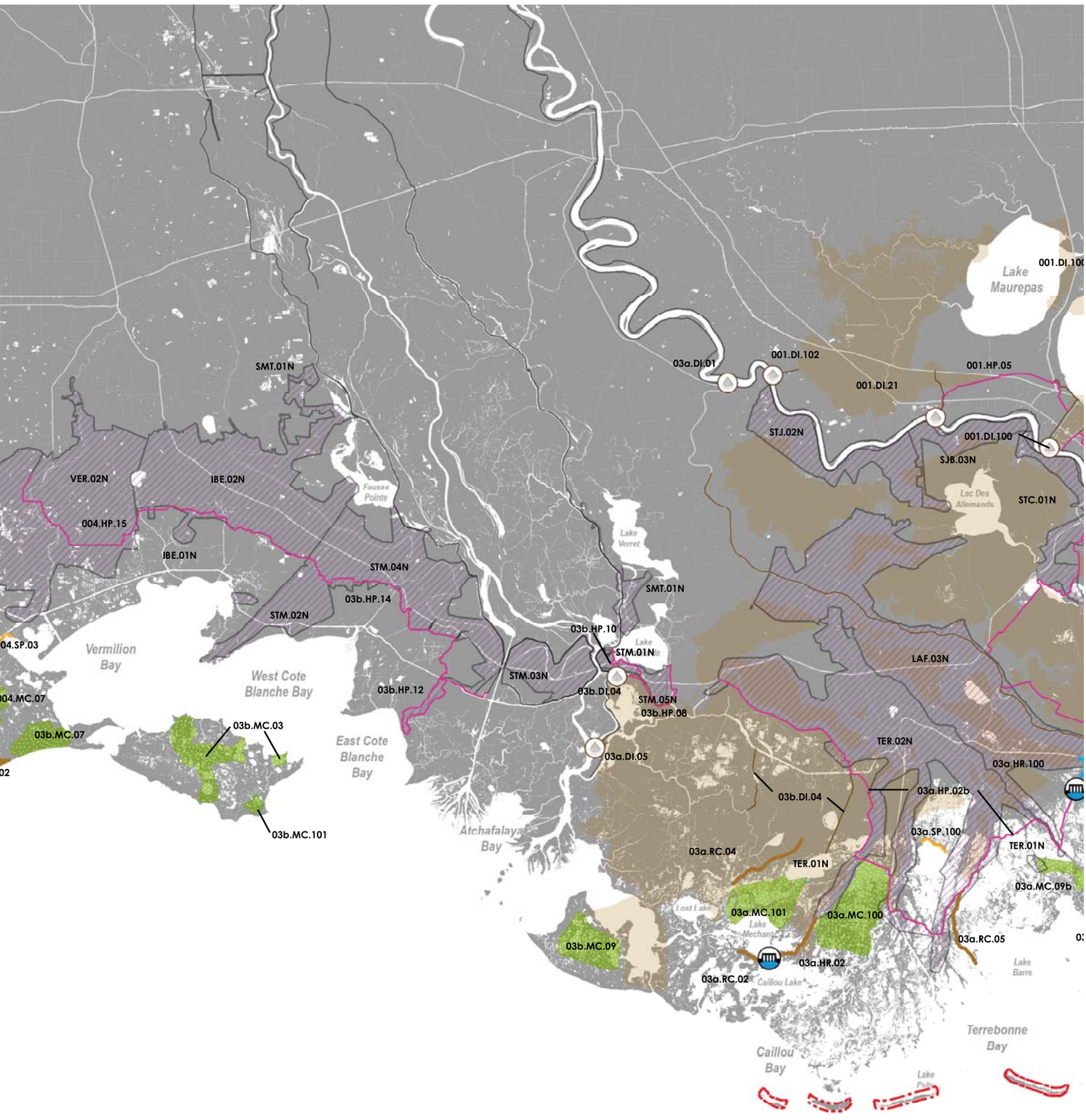
SOUTHWEST COAST PROJECTS



PROJECT TYPES

PROJECTS SELECTED FOR INCLUSION

The maps on the following pages depict the projects selected for inclusion for the 2017 Coastal Master Plan. The maps are accompanied by tables, which provide information on project details such as project descriptions, costs, and implementation periods. Further information on all projects considered can be found in Appendix A, *Project Definition*.



▲ FIGURE 4.14

2017 Coastal Master Plan projects to be implemented in the Southwest Coast region: 26 restoration projects, 5 structural risk reduction projects, and 12 nonstructural risk reduction projects.

Southwest Coast Projects

Project Type	Project No.	Project Description	Implementation Period	Project Costs
Hydrologic Restoration	004.HR.06	Calcasieu Ship Channel Salinity Control Measures: Construction of sill and wall structures in West Pass, East Pass, Lake Wall, Long Point Lake, Nine Mile Cut, Dugas Cut 1, Dugas Cut 2, Texaco Cut, Turner's Bay, Salt Ditch, Drainage Canal, and Choupique Bayou to prevent saltwater from moving into Calcasieu Ship Channel.	Years 1-10	$262,300,000
Marsh Creation	03b.MC.07	East Rainey Marsh Creation: Creation of approximately 8,200 acres of marsh in the eastern portion of Rainey Marsh to create new wetland habitat and restore degraded marsh.	Years 1-10	$102,000,000
	004.MC.100	Freshwater Bayou North Marsh Creation: Creation of approximately 4,800 acres of marsh in Vermilion Parish west of Freshwater Bayou to create new wetland habitat and restore degraded marsh.	Years 1-10	$201,700,000
	004.MC.101	Freshwater Bayou South Marsh Creation: Creation of approximately 5,800 acres of marsh in Vermilion Parish west of Freshwater Bayou to create new wetland habitat and restore degraded marsh.	Years 1-10	$78,600,000
Sediment Diversion	03a.DI.05	Atchafalaya River Diversion: Sediment diversion off the Atchafalaya River to benefit the Penchant Basin and southwest Terrebonne marshes with 30,000 cfs capacity (modeled at 26% of the Atchafalaya River flow upstream of the confluence with Bayou Shaffer).	Years 1-10	$282,900,000
	03b.DI.04	Increase Atchafalaya Flow to Terrebonne: Dredging of the Gulf Intracoastal Waterway (GIWW) and construction of a bypass structure at the Bayou Boeuf Lock from the Atchafalaya River to Terrebonne marshes with 20,000 cubic cfs capacity.	Years 1-10	$397,900,000
Shoreline Protection	03b.SP.01	Freshwater Bayou Shoreline Protection (Belle Isle Canal to Lock): Shoreline protection through rock breakwaters designed to an elevation of 3.5 feet NAVD88 along approximately 36,000 feet of the east bank of Freshwater Bayou Canal from Belle Isle Canal to Freshwater Bayou Lock to preserve shoreline integrity and reduce wetland degradation from wave erosion.	Years 1-10	$71,800,000
	004.SP.03	Freshwater Bayou Canal Shoreline Protection: Shoreline protection through rock breakwaters designed to an elevation of 3.5 feet NAVD88 along approximately 7,500 feet of the south bank of Freshwater Bayou Canal at Little Vermilion Bay to preserve shoreline integrity and reduce wetland degradation from wave erosion.	Years 1-10	$14,900,000
Nonstructural Risk Reduction	CAM.01N	Cameron Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$127,000,000
	IBE.01N	Iberia - Lower Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$1,000,000
	IBE.02N	Iberia - Atchafalaya Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$289,400,000

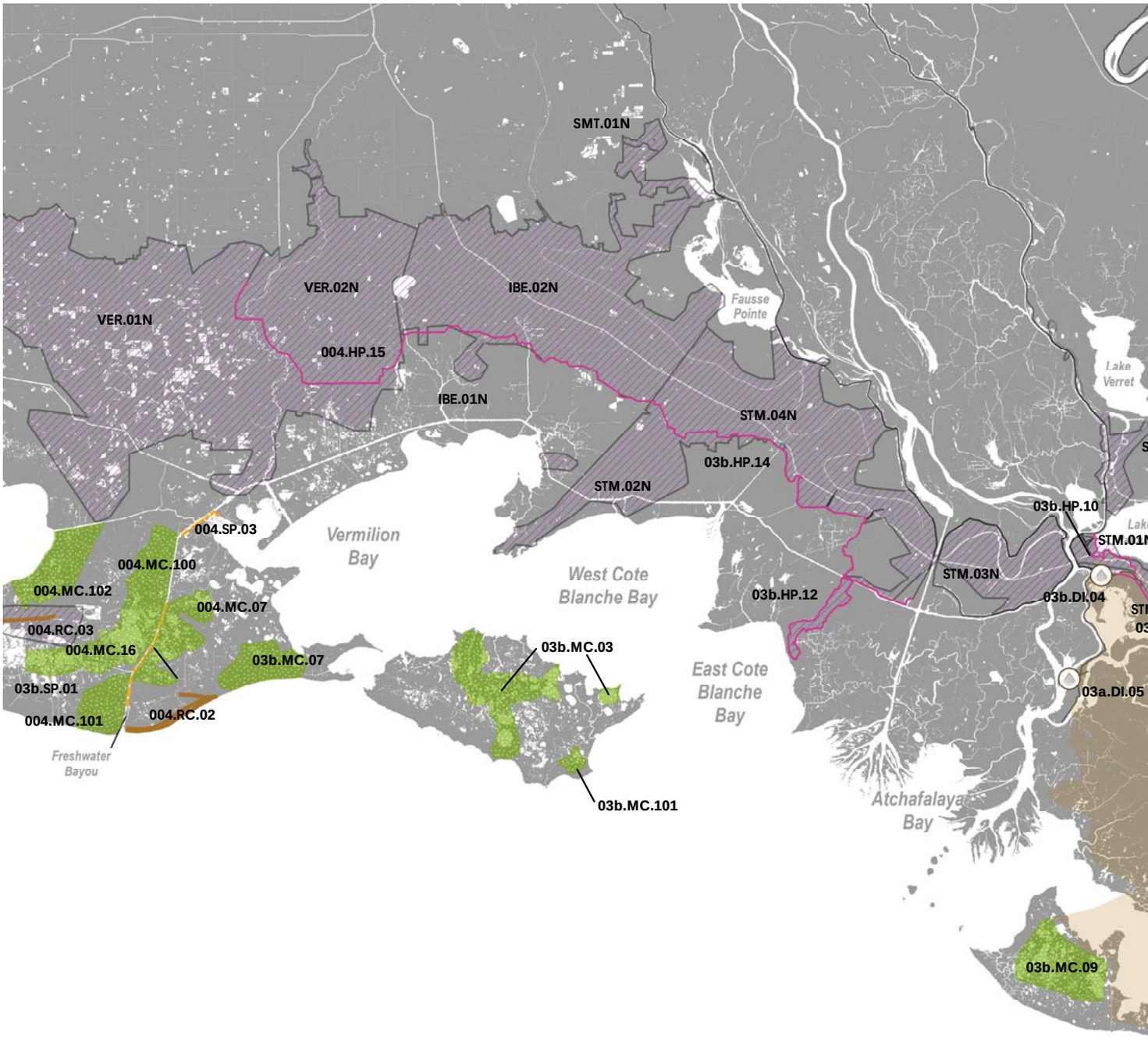
Project Type	Project No.	Project Description	Implementation Period	Project Costs
Nonstructural Risk Reduction (continued)	SMT.01N	St. Martin Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$13,200,000
	STM.04N	St. Mary - Franklin/Charenton Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$80,400,000
	STM.05N	St. Mary - Lower Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$7,200,000
	VER.01N	Vermilion Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$109,900,000
	VER.02N	Vermilion - Abbeville/Delcambre Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$190,600,000
Structural Protection	03b.HP.08	Amelia Levee Improvements: Construction of a levee to an elevation of 18 feet NAVD88 along the GIWW between Lake Palourde and the Bayou Boeuf Lock near Amelia. Project features approximately 46,400 feet of earthen levee, approximately 13,400 feet of T-wall, (4) 40-foot roller gates, (1) 250-foot barge gate, (1) 110-foot barge gate, and a 5,000 cfs pump station.	Years 1-30	$1,051,700,000
	03b.HP.14	Iberia/St Mary Upland Levee: Construction of a levee to an elevation between 15.5 to 20 feet NAVD88 in Iberia and St. Mary Parishes between the Delcambre Canal and the Charenton Canal. Project features approximately 158,300 feet of earthen levee, approximately 15,100 feet of T-wall, (3) 110-foot barge gates, (5) 30-foot barge gates, (8) 24-foot sluice gates, (11) 16-foot sluice gates, (11) 8-foot sluice gates, (2) 40-foot swing gates, (2) 40-foot roller gates, and (7) pump stations with a total capacity of 16,320 cfs.	Years 1-30	$1,482,100,000
Marsh Creation	03b.MC.03	Marsh Island Marsh Creation: Creation of approximately 11,500 acres of marsh on Marsh Island to create new wetland habitat and restore degraded marsh.	Years 11-30	$448,400,000
	03b.MC.101	Southeast Marsh Island Marsh Creation: Creation of approximately 1,100 acres of marsh on the eastern tip of Marsh Island to create new wetland habitat and restore degraded marsh.	Years 11-30	$32,300,000
	004.MC.01	South Grand Chenier Marsh Creation: Creation of approximately 6,700 acres of marsh south of Highway LA 82 near Grand Chenier to create new wetland habitat and restore degraded marsh.	Years 11-30	$326,800,000
	004.MC.04	Mud Lake Marsh Creation: Creation of approximately 5,100 acres of marsh at Mud Lake south of West Cove, Calcasieu Lake to create new wetland habitat and restore degraded marsh.	Years 11-30	$181,300,000

Southwest Coast Projects – continued

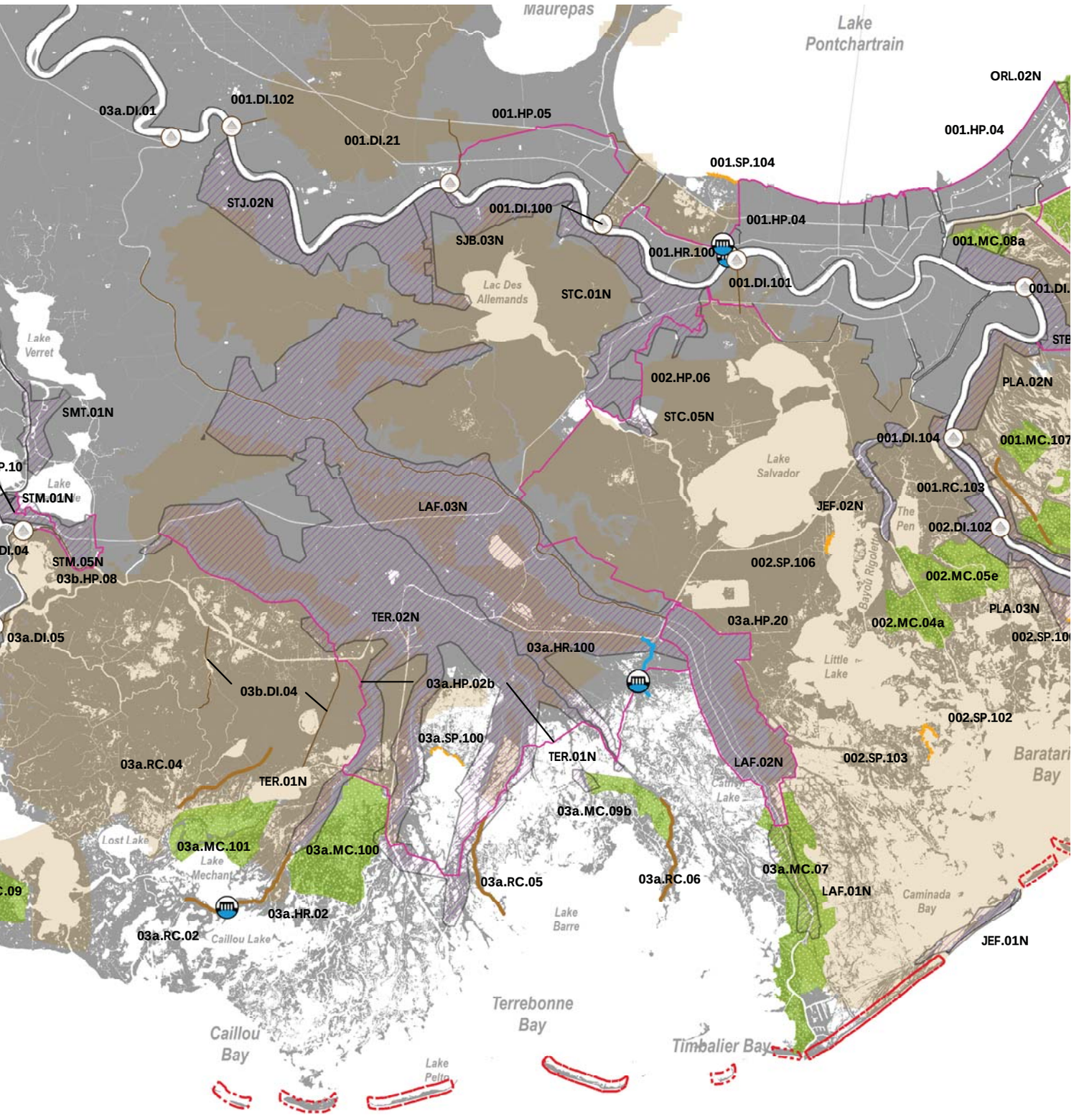
Project Type	Project No.	Project Description	Implementation Period	Project Costs
Marsh Creation (continued)	004.MC.07	West Rainey Marsh Creation: Creation of approximately 7,600 acres of marsh at Rainey Marsh near the southeast bank of the Freshwater Bayou Canal to create new wetland habitat and restore degraded marsh.	Years 11-30	$237,600,000
	004.MC.10	Southeast Calcasieu Lake Marsh Creation: Creation of approximately 7,700 acres of marsh southeast of Calcasieu Lake to create new wetland habitat and restore degraded marsh.	Years 11-30	$331,600,000
	004.MC.13	Cameron Meadows Marsh Creation: Creation of approximately 3,600 acres of marsh at Cameron Meadows north of Johnsons Bayou to create new wetland habitat and restore degraded marsh.	Years 11-30	$107,700,000
	004.MC.16	East Pecan Island Marsh Creation: Creation of approximately 10,100 acres of marsh between Pecan Island and the west bank of the Freshwater Bayou Canal to create new wetland habitat and restore degraded marsh.	Years 11-30	$435,500,000
	004.MC.23	Calcasieu Ship Channel Marsh Creation: Creation of approximately 2,500 acres of marsh south of Calcasieu Lake near Cameron to create new wetland habitat and restore degraded marsh.	Years 11-30	$108,300,000
	004.MC.102	White Lake Marsh Creation: Creation of approximately 10,100 acres of marsh in Vermilion Parish east of White Lake to create new wetland habitat and restore degraded marsh.	Years 11-30	$376,200,000
	004.MC.107	West Sabine Refuge Marsh Creation: Creation of approximately 6,100 acres of marsh east of Sabine Lake to create new wetland habitat and restore degraded marsh.	Years 11-30	$365,300,000
Nonstructural Risk Reduction	CAL.01N	Calcasieu Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 31-50	$125,100,000
	STM.01N	St. Mary - Morgan City Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 31-50	$4,200,000
	STM.02N	St. Mary - Glencoe Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 31-50	$15,800,000
	STM.03N	St. Mary - Patterson Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 31-50	$3,000,000
Structural Protection	03b.HP.10	Morgan City Back Levee: Construction of a levee to an elevation between 10 and 12 feet NAVD88 to protect the northern side of Morgan City. Project features approximately 30,600 feet of earthen levee, approximately 4,600 feet of T-wall, (1) 40-foot swing gate, (1) 30-foot barge gate, and (1) pump station with a total capacity of 1,604 cfs.	Years 31-50	$140,500,000

Project Type	Project No.	Project Description	Implementation Period	Project Costs
Structural Protection (continued)	03b.HP.12	Franklin and Vicinity: Improvements of existing levees to an elevation between 12.5 and 18 feet NAVD88 from the Wax Lake Outlet to the Charenton Canal as well as the Bayou Sale polder. Project features approximately 204,600 feet of earthen levee, approximately 8,700 feet of T-wall, (1) 40-foot sluice gate, (1) 16-foot sluice gate, and (1) 40-foot roller gate.	Years 31-50	$380,600,000
	004.HP.15	Abbeville and Vicinity: Construction of a levee to an elevation of 23.5 feet NAVD88 in the area south of Delcambre, Erath, and Abbeville roughly following Highway 330. Project features approximately 102,700 feet of earthen levee, approximately 2,800 feet of T-wall, (2) 56-foot sector gates, (3) 30-foot stop logs, (1) 20-foot stop log, and (1) 20-foot sluice gate.	Years 31-50	$755,300,000
Marsh Creation	03b.MC.09	Point Au Fer Island Marsh Creation: Creation of approximately 13,400 acres of marsh on Point Au Fer Island to create new wetland habitat and restore degraded marsh.	Years 31-50	$661,800,000
	004.MC.19	East Calcasieu Lake Marsh Creation: Creation of approximately 17,700 acres of marsh in the eastern Cameron-Creole watershed to create new wetland habitat and restore degraded marsh.	Years 31-50	$992,200,000
	004.MC.103	Little Chenier Marsh Creation: Creation of approximately 1,000 acres of marsh in Cameron Parish south of Grand Lake to create new wetland habitat and restore degraded marsh.	Years 31-50	$56,300,000
	004.MC.104	Calcasieu Lake West Bank Marsh Creation: Creation of approximately 8,100 acres of marsh in Cameron Parish west of Calcasieu Lake to create new wetland habitat and restore degraded marsh.	Years 31-50	$258,100,000
	004.MC.105	West Brown Lake Marsh Creation (PT-10 and PT-11): Creation of approximately 8,900 acres of marsh in Cameron Parish south of Black Lake to create new wetland habitat and restore degraded marsh.	Years 31-50	$541,700,000
	004.MC.107	West Sabine Refuge Marsh Creation: Creation of approximately 2,900 acres of marsh east of Sabine Lake to create new wetland habitat and restore degraded marsh.	Years 31-50	$215,000,000
Ridge Restoration	004.RC.02	Cheniere au Tigre Ridge Restoration: Restoration of approximately 77,800 feet of Bill and Cheniere au Tigre Ridges to an elevation of 5 feet NAVD88 to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation for approximately 130 acres.	Years 31-50	$8,500,000
	004.RC.03	Pecan Island Ridge Restoration: Restoration of approximately 43,800 feet of Pecan Island Ridge to an elevation of 5 feet NAVD88 to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation for approximately 80 acres.	Years 31-50	$6,800,000

CENTRAL COAST PROJECTS



PROJECT TYPES



▲ FIGURE 4.15

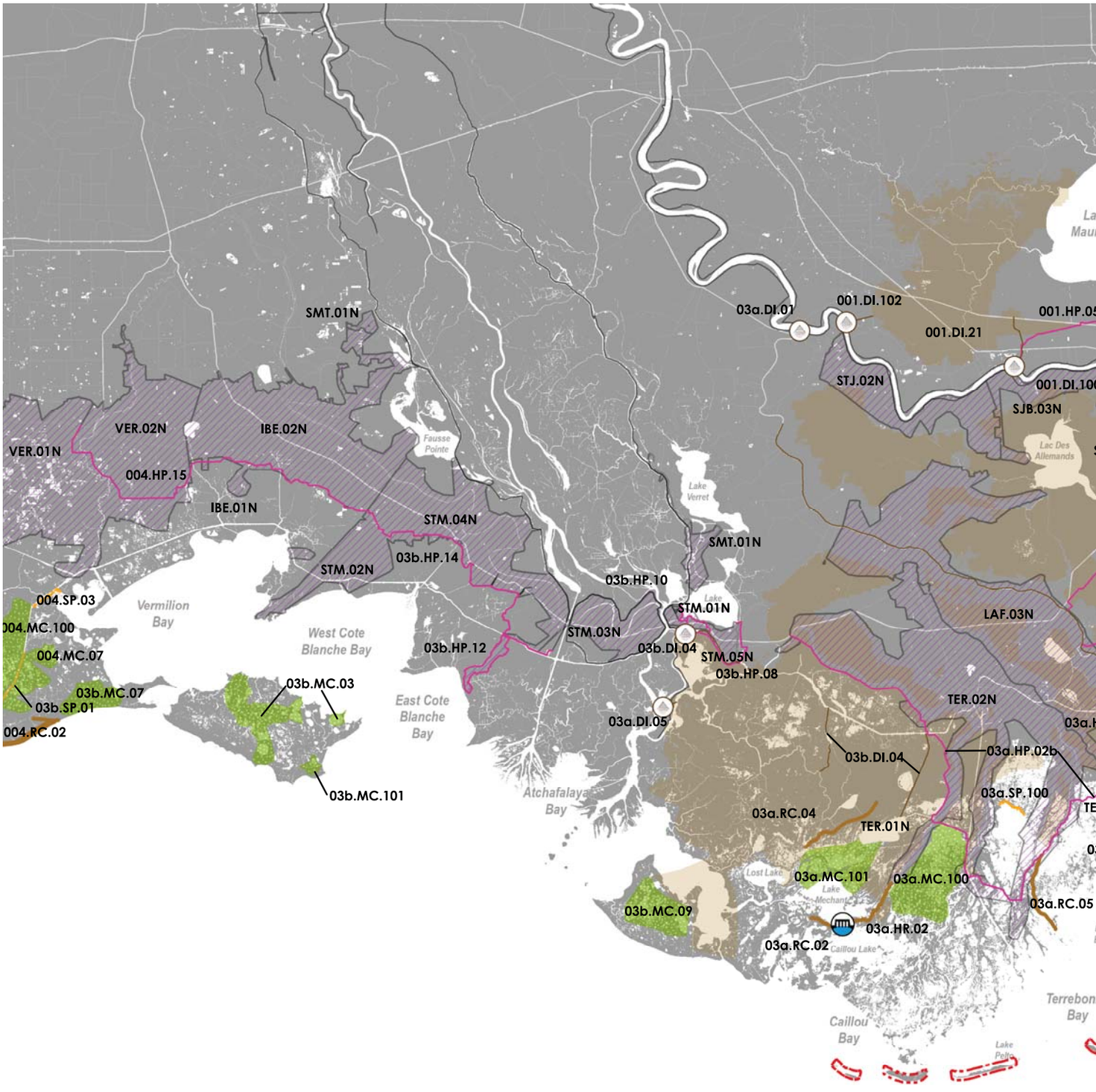
2017 Coastal Master Plan projects to be implemented in the Central Coast region: 12 restoration projects, 1 structural risk reduction projects, and 2 nonstructural risk reduction projects.

Central Coast Projects

Project Type	Project No.	Project Description	Implementation Period	Project Costs
Hydrologic Restoration	03a.HR.02	Central Terrebonne Hydrologic Restoration: Construction of a rock plug in Grand Pass with a 150-foot by 15-foot navigable section to prevent saltwater intrusion from Caillou Lake into Lake Mechant.	Years 1-10	$19,000,000
Ridge Restoration	03a.RC.04	Mauvais Bois Ridge Restoration: Restoration of approximately 43,400 feet of historic ridge to an elevation of 5 feet NAVD88 at Mauvais Bois to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation for approximately 90 acres.	Years 1-10	$9,900,000
	03a.RC.06	Bayou Pointe au Chene Ridge Restoration: Restoration of approximately 43,600 feet of historic ridge to an elevation of 5 feet NAVD88 to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation for approximately 90 acres along the southern portions of Bayou Pointe au Chien.	Years 1-10	$10,600,000
Sediment Diversion	03a.DI.01	Bayou Lafourche Diversion: Diversion of the Mississippi River into Bayou Lafourche to increase freshwater flow down Bayou Lafourche with 1,000 cfs capacity (modeled with continuous operation at 1,000 cfs, independent of Mississippi River flow).	Years 1-10	$196,100,000
Nonstructural Risk Reduction	TER.01N	Terrebonne - Lower Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$87,700,000
	TER.02N	Terrebonne - Houma Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$1,264,000,000
Structural Protection	03a.HP.02b	Morganza to the Gulf: Construction of a levee to an elevation between 15 and 26.5 feet NAVD88 around Houma and Terrebonne Ridge communities from Larose to Humphreys Canal. Project features 471,500 feet of earthen levee, 39,600 feet of T-wall, (22) 6-foot sluice gates, (1) 30-foot stop log, (2) 20-foot stop logs, (13) 56-foot sector gates, (1) 250-foot sector gate, (1) 175-foot sector gate, (1) 125-foot sector gate, (1) 110-foot sector gate, (1) 30-foot sector gate, (1) 110-foot lock gate, (1) 30-foot roller gate, (4) 40-foot roller gates, (1) 56-foot barge gate, (1) 30-foot barge gate, and (4) pump stations.	Years 1-30	$8,281,900,000
Hydrologic Restoration	03a.HR.100	Grand Bayou Hydrologic Restoration: Dredging of Margaret's Bayou and Grand Bayou in conjunction with the construction of a fixed crest structure at Grand Bayou and the installation of (5) 48-inch flap-gated culverts on the western bank of Grand Bayou.	Years 11-30	$8,700,000
Marsh Creation	03a.MC.07	Belle Pass-Golden Meadow Marsh Creation: Creation of approximately 24,800 acres of marsh from Belle Pass to Golden Meadow to create new wetland habitat and restore degraded marsh.	Years 11-30	$1,859,600,000
	03a.MC.09b	North Terrebonne Bay Marsh Creation - Component B: Creation of approximately 4,700 acres of marsh south of Montegut between Bayou St. Jean Charles and Bayou Pointe au Chien to create new wetland habitat and restore degraded marsh.	Years 11-30	$304,000,000
	03a.MC.100	South Terrebonne Marsh Creation: Creation of approximately 25,200 acres of marsh south of Dulac between Bayou du Large and Houma Navigation Canal to create new wetland habitat and restore degraded marsh.	Years 11-30	$1,672,200,000

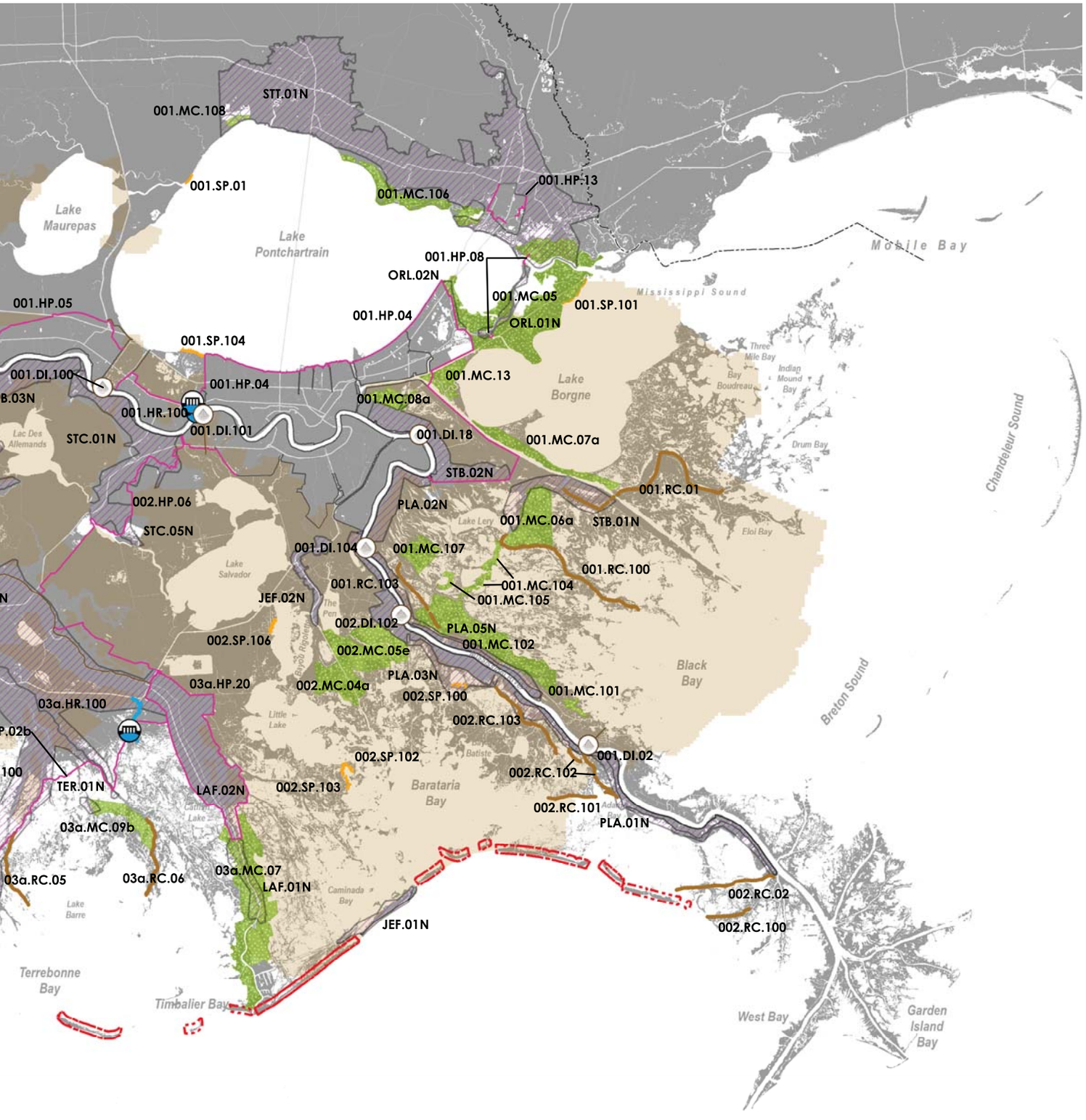
Project Type	Project No.	Project Description	Implementation Period	Project Costs
Marsh Creation (continued)	03a.MC.101	North Lake Mechant Marsh Creation: Creation of approximately 13,300 acres of marsh between Lake de Cade and Lake Mechant to create new wetland habitat and restore degraded marsh.	Years 11-30	$1,059,700,000
Ridge Restoration	03a.RC.02	Bayou DuLarge Ridge Restoration: Restoration of approximately 53,200 feet of historic ridge to an elevation of 5 feet NAVD88 to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation for approximately 100 acres along Bayou DuLarge.	Years 11-30	$9,600,000
	03a.RC.05	Bayou Terrebonne Ridge Restoration: Restoration of approximately 40,700 feet of historic ridge to an elevation of 5 feet NAVD88 to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation for approximately 80 acres along the southern portions of Bayou Terrebonne.	Years 11-30	$8,800,000
Shoreline Protection	03a.SP.100	North Lake Boudreaux Shoreline Protection: Shoreline protection through rock breakwaters designed to an elevation of 3.5 feet NAVD88 along approximately 15,400 feet of the northern shore of Lake Boudreaux east of Hog Point to preserve shoreline integrity and reduce wetland degradation from wave erosion.	Years 11-30	$29,300,000

SOUTHEAST COAST PROJECTS



PROJECT TYPES

Structural Protection | Nonstructural Protection | Ridge Restoration | Shoreline Protection | Barrier Island Restoration | Marsh Creation | Sediment Diversion | Hydrologic Restoration



▲ FIGURE 4.16

2017 Coastal Master Plan projects to be implemented in the Southeast Coast region: 38 restoration projects, 6 structural risk reduction projects, and 18 nonstructural risk reduction projects.

Southeast Coast Projects

Project Type	Project No.	Project Description	Implementation Period	Project Costs
Hydrologic Restoration	001.HR.100	LaBranche Hydrologic Restoration: Construction of a 750 cfs hybrid pump-siphon structure, intake structure, and an approximately 1 mile long conveyance system to LaBranche wetlands via the Mississippi River to restore the historically fresh to intermediate marshes. Features also include a conveyance channel roadway and railroad crossings.	Years 1-10	$80,900,000
Marsh Creation	001.MC.05	New Orleans East Landbridge Restoration: Creation of approximately 11,700 acres of marsh in New Orleans East Landbridge to create new wetland habitat and restore degraded marsh.	Years 1-10	$421,200,000
	001.MC.13	Golden Triangle Marsh Creation: Creation of approximately 4,200 acres of marsh in Golden Triangle Marsh between the Mississippi River-Gulf Outlet (MRGO) and GIWW to create new wetland habitat and restore degraded marsh.	Years 1-10	$272,800,000
	001.MC.108	Guste Island Marsh Creation: Creation of approximately 700 acres of marsh in St. Tammany Parish along the northwest Lake Pontchartrain shoreline to create new wetland habitat and restore degraded marsh.	Years 1-10	$64,300,000
Ridge Restoration	001.RC.100	Bayou Terre aux Boeufs Ridge Restoration: Restoration of approximately 91,200 feet of historic ridge to an elevation of 5 feet NAVD88 to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation to approximately 180 acres along Bayou Terre aux Boeufs.	Years 1-10	$15,200,000
	001.RC.103	Carlisle Ridge Restoration: Restoration of approximately 38,200 feet of historic ridge to an elevation of 5 feet NAVD88 to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation to approximately 80 acres near Carlisle.	Years 1-10	$9,300,000
	002.RC.101	Adams Bay Ridge Restoration: Restoration of approximately 31,600 feet of historic ridge to an elevation of 5 feet NAVD88 to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation to approximately 60 acres along Adams Bay.	Years 1-10	$7,200,000
	002.RC.102	Bayou Eau Noire Ridge Restoration: Restoration of approximately 34,800 feet of historic ridge to an elevation of 5 feet NAVD88 to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation to approximately 70 acres along Bayou Eau Noire.	Years 1-10	$9,800,000
	002.RC.103	Grand Bayou Ridge Restoration: Restoration of approximately 48,100 feet of historic ridge to an elevation of 5 feet NAVD88 to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation to approximately 90 acres along Grand Bayou.	Years 1-10	$10,300,000
Sediment Diversion	001.DI.02	Lower Breton Diversion: Sediment diversion of 50,000 cfs into Lower Breton Sound to build and maintain land (modeled at 50,000 cfs for river flows at 1,000,000 cfs; variable flows above 200,000 cfs calculated using a linear function up to 1,000,000 cfs; and open with variable flow rate [larger than 50,000 cfs, estimated using linear extrapolation] for river flow above 1,000,000 cfs. No operation below 200,000 cfs.	Years 1-10	$383,200,000
	001.DI.18	Central Wetlands Diversion: Diversion into Central Wetlands near Violet to provide sediment for emergent marsh creation and freshwater to sustain existing wetlands, 5,000 cfs capacity (modeled at a constant flow of 5,000 cfs, independent of the Mississippi River flow).	Years 1-10	$231,000,000
	001.DI.21	East Maurepas Diversion: Diversion into East Maurepas near Angelina to provide sediment for emergent marsh creation and freshwater to sustain existing wetlands, 2,000 cfs capacity (modeled at a constant flow of 2,000 cfs, independent of the Mississippi River flow).	Years 1-10	$184,900,000

Project Type	Project No.	Project Description	Implementation Period	Project Costs
Sediment Diversion (continued)	001.DI.100	Manchac Landbridge Diversion: A structure in the existing western spillway guide levee to divert 2,000 cfs thereby increasing freshwater exchange with adjacent wetlands.	Years 1-10	$148,200,000
	001.DI.102	Union Freshwater Diversion: Diversion into West Maurepas swamp near Burnside to provide sediment for emergent marsh creation and freshwater and fine sediment to sustain existing wetlands, 25,000 cfs capacity (modeled at 25,000 cfs when Mississippi River flow equals 400,000 cfs; closed when river flow is below 200,000 cfs or above 600,000 cfs; a variable flow rate calculated using a linear function from 0 to 25,000 cfs for river flow between 200,000 cfs and 400,000 cfs and held constant at 25,000 cfs for river flow between 400,000 cfs and 600,000 cfs).	Years 1-10	$876,700,000
	001.DI.104	Mid-Breton Sound Diversion: Sediment diversion into Mid-Breton Sound in the vicinity of White's Ditch to build and maintain land, 35,000 cfs (modeled at 35,000 cfs when the Mississippi River flow equals 1,000,000 cfs; flow rate calculated using a linear function for river flow from 200,000 cfs to 1,000,000 cfs; flows variable above 1,000,000 cfs; 5,000 cfs minimum flow maintained when Mississippi River flow is below 200,000 cfs).	Years 1-10	$479,100,000
	002.DI.102	Mid-Barataria Diversion: Sediment diversion into Mid-Barataria near Myrtle Grove to build and maintain land, 75,000 cfs (modeled at 5,000 cfs for Mississippi River flows below 200,000 cfs; variable flows to capacity between 200,000 and 1,250,000 cfs calculated using a linear function; diverts exactly 75,000 cfs when flows are at 1,250,000 cfs).	Years 1-10	$998,800,000
Shoreline Protection	001.SP.01	Manchac Landbridge Shoreline Protection: Shoreline protection through rock breakwaters designed to an elevation of 3.5 feet NAVD88 along approximately 5,500 feet of the west side of Lake Pontchartrain north of Pass Manchac near Stinking Bayou to preserve shoreline integrity and reduce wetland degradation from wave erosion.	Years 1-10	$11,600,000
	001.SP.101	Unknown Pass to Rigolets Shoreline Protection: Shoreline protection through rock breakwaters designed to an elevation of 3.5 feet NAVD88 along approximately 2,000 feet of the east side of the New Orleans Landbridge from Unknown Pass to the Rigolets to preserve shoreline integrity and reduce wetland degradation from wave erosion.	Years 1-10	$5,200,000
	001.SP.104	LaBranche Wetlands Shoreline Protection: Shoreline protection through rock breakwaters designed to an elevation of 3.5 feet NAVD88 along approximately 11,100 feet of the southern shore of Lake Pontchartrain near the LaBranche wetlands to preserve shoreline integrity and reduce wetland degradation from wave erosion.	Years 1-10	$23,100,000
	002.SP.100	Lake Hermitage Shoreline Protection: Shoreline protection through rock breakwaters designed to an elevation of 3.5 feet NAVD88 along approximately 6,500 feet around the southern shore of Lake Hermitage to preserve shoreline integrity and reduce wetland degradation from wave erosion.	Years 1-10	$14,500,000
	002.SP.102	East Snail Bay Shoreline Protection: Shoreline protection through rock breakwaters designed to an elevation of 3.5 feet NAVD88 along approximately 7,300 feet of the northeastern shore of Snail Bay south of Little Lake to preserve shoreline integrity and reduce wetland degradation from wave erosion.	Years 1-10	$15,400,000
	002.SP.106	Bayou Perot Shoreline Protection: Shoreline protection through rock breakwaters designed to an elevation of 3.5 feet NAVD88 along approximately 5,900 feet of the western shore of Bayou Perot to preserve shoreline integrity and reduce wetland degradation from wave erosion.	Years 1-10	$13,400,000

Southeast Coast Projects – continued

Project Type	Project No.	Project Description	Implementation Period	Project Costs
Nonstructural Risk Reduction	JEF.01N	Jefferson - Grand Isle Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$98,200,000
	JEF.02N	Jefferson - Lafitte/Barataria Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$200,800,000
	LAF.01N	Lafourche - Lower Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$2,500,000
	LAF.02N	Lafourche - Larose/Golden Meadow Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$32,600,000
	LAF.03N	Lafourche - Raceland Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$363,500,000
	ORL.01N	Orleans - Rigolets Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$18,000,000
	ORL.02N	Orleans - Lake Catherine Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$135,600,000
	PLA.01N	Plaquemines - West Bank Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$264,700,000
	PLA.02N	Plaquemines - Braithwaite Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$56,400,000
	PLA.03N	Plaquemines - Grand Bayou Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$3,000,000

Project Type	Project No.	Project Description	Implementation Period	Project Costs
Nonstructural Risk Reduction (continued)	PLA.05N	Plaquemines - Phoenix/Pointe A La Hache Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$38,300,000
	STB.01N	St. Bernard - Yscloskey/Delacroix Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$70,400,000
	STB.02N	St. Bernard Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$2,400,000
	STC.05N	St. Charles - Salvador Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$3,000,000
	SJB.03N	St. John the Baptist - Edgard Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$7,800,000
	STT.01N	St. Tammany Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 1-30	$1,611,300,000
Structural Protection	001.HP.05	West Shore Lake Pontchartrain: Construction of a levee to an elevation between 16 and 19 feet NAVD88 in the LaPlace area. Project features approximately 91,000 feet of earthen levee, approximately 5,000 feet of T-wall, (1) 18-foot sluice gate, (1) 25-foot sluice gate, (2) 25-foot swing gates, (1) 150-foot roller gate, and (4) pump stations with a total capacity of 2,150 cfs.	Years 1-30	$730,400,000
	001.HP.08	Lake Pontchartrain Barrier: Construction of closure gates and weirs to an elevation of 2 feet NAVD88 across the passes at Chef Menteur and The Rigolets for storm surge risk reduction within the Lake Pontchartrain Basin. Project features approximately 5,200 feet of earthen levee, 630 feet of combi-wall constructed to 2 feet, a 150-foot closure gate at each pass for navigation, and multiple vertical lift gates to maintain tidal exchange through the passes.	Years 1-30	$2,409,600,000
	001.HP.13	Slidell Ring Levees: Construction of a levee to an elevation of 16 feet NAVD88 for storm surge risk reduction around Slidell. Project features approximately 31,000 feet of earthen levee and 14,500 feet of T-wall.	Years 1-30	$181,300,000

Southeast Coast Projects – continued

Project Type	Project No.	Project Description	Implementation Period	Project Costs
Structural Protection (continued)	002.HP.06	Upper Barataria Risk Reduction: Construction of a levee to an elevation between 12.5 and 15 feet NAVD88 along Highway 90 between the West Bank and Larose. Project includes 204,300 feet of earthen levee, 8,200 feet of T-wall, (4) 10-foot sluice gates, (1) 250-foot barge gate, (2) 40-foot swing gates, and (8) pump stations with a total capacity of 6,837 cfs.	Years 1-30	$940,900,000
	03a.HP.20	Larose to Golden Meadow: Improvements to the existing Larose to Golden Meadow levee system, including raising to an elevation between 12 and 21 feet NAVD88. Project features approximately 249,900 feet of earthen levee and approximately 6,700 feet of T-wall.	Years 1-30	$355,500,000
Marsh Creation	001.MC.05	New Orleans East Landbridge Restoration: Creation of approximately 21,400 acres of marsh in New Orleans East Landbridge to create new wetland habitat and restore degraded marsh.	Years 11-30	$1,033,900,000
	001.MC.06a	Breton Marsh Creation - Component A: Creation of approximately 11,800 acres of marsh in the Breton Marsh east of Delacroix Island to create new wetland habitat and restore degraded marsh.	Years 11-30	$922,500,000
	001.MC.07a	Lake Borgne Marsh Creation - Component A: Creation of approximately 6,100 acres of marsh along the south shoreline of Lake Borgne near Proctors Point to create new wetland habitat and restore degraded marsh.	Years 11-30	$261,100,000
	001.MC.08a	Central Wetlands Marsh Creation - Component A: Creation of approximately 3,000 acres of marsh in Central Wetlands near Bayou Bienvenue to create new wetland habitat and restore degraded marsh.	Years 11-30	$129,900,000
	001.MC.102	Pointe a la Hache Marsh Creation: Creation of approximately 14,100 acres of marsh on the eastbank of Plaquemines Parish near Pointe a la Hache to create new wetland habitat and restore degraded marsh.	Years 11-30	$595,700,000
	001.MC.104	East Bank Land Bridge Marsh Creation: Creation of approximately 2,300 acres of marsh in Plaquemines Parish between Grand Lake and Lake Lery to create new wetland habitat and restore degraded marsh.	Years 11-30	$149,800,000
	001.MC.105	Spanish Lake Marsh Creation: Creation of approximately 800 acres of marsh in Plaquemines Parish along the eastern shore of Spanish Lake to create new wetland habitat and restore degraded marsh.	Years 11-30	$58,200,000
	001.MC.106	St. Tammany Marsh Creation: Creation of approximately 5,900 acres of marsh in St. Tammany Parish along the northern shore of Lake Pontchartrain to create new wetland habitat and restore degraded marsh.	Years 11-30	$194,900,000
	001.MC.107	Tiger Ridge/Maple Knoll Marsh Creation: Creation of approximately 4,500 acres of marsh in Plaquemines Parish near Tiger Ridge to create new wetland habitat and restore degraded marsh.	Years 11-30	$200,100,000
	002.MC.05e	Large-Scale Barataria Marsh Creation - Component E: Creation of approximately 12,400 acres of marsh in the Barataria Basin south of the Pen to the Barataria Landbridge to create new wetland habitat and restore degraded marsh.	Years 11-30	$679,500,000
Ridge Restoration	001.RC.01	Bayou LaLoutre Ridge Restoration: Restoration of approximately 108,900 feet of historic ridge to an elevation of 5 feet NAVD88 to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation to approximately 210 acres along Bayou LaLoutre.	Years 11-30	$20,200,000

Project Type	Project No.	Project Description	Implementation Period	Project Costs
Ridge Restoration (continued)	002.RC.02	Spanish Pass Ridge Restoration: Restoration of approximately 46,300 feet of historic ridge to an elevation of 5 feet NAVD88 to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation to approximately 30 acres west of Venice along the banks of Spanish Pass.	Years 11-30	$11,600,000
	002.RC.100	Red Pass Ridge Restoration: Restoration of approximately 23,000 feet of historic ridge southwest of Venice to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation to approximately 50 acres along the banks of Red Pass.	Years 11-30	$3,500,000
Sediment Diversion	001.DI.101	Ama Diversion: Sediment diversion into Upper Barataria near Ama to provide sediment for emergent marsh creation and freshwater to sustain existing wetlands, 50,000 cfs capacity (modeled at 50,0000 cfs when the Mississippi River flow equals 1,000,000 cfs; open with a variable flow rate calculated using a linear function from 0 to 50,000 cfs for river flow between 200,000 cfs and 1,000,000 cfs, diverts exactly 50,000 cfs when the Mississippi River flow is 1,000,000 cfs; and open with a variable flow rate (larger than 50,000 cfs, estimated using linear extrapolation) for river flow above 1,000,000 cfs. No operation below 200,000 cfs.	Years 11-30	$882,400,000
Shoreline Protection	002.SP.103	West Snail Bay Shoreline Protection: Shoreline protection through rock breakwaters designed to an elevation of 3.5 feet NAVD88 along approximately 16,600 feet of the western shoreline of Snail Bay south of Little Lake to preserve shoreline integrity and reduce wetland degradation from wave erosion.	Years 11-30	$30,000,000
Nonstructural Risk Reduction	STC.01N	St. Charles - Hahnville/Luling Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 31-50	$829,500,000
	STJ.02N	St. James - Vacherie Nonstructural Risk Reduction: Project includes floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.	Years 31-50	$3,900,000
Structural Protection	001.HP.04	Greater New Orleans High Level: Improvements of existing Hurricane and Storm Damage Risk Reduction System (HSDRRS) levees surrounding the East Bank of Greater New Orleans to elevations between 19 and 35 feet NAVD88. Project features approximately 202,000 feet of earthen levee and approximately 242,100 feet of T-wall.	Years 31-50	$2,222,700,000
Marsh Creation	001.MC.101	Uhlan Bay Marsh Creation: Creation of approximately 800 acres of marsh on the east bank of Plaquemines Parish around Uhlan Bay to create new wetland habitat and restore degraded marsh.	Years 31-50	$30,500,000
	001.MC.102	Pointe a la Hache Marsh Creation: Creation of approximately 5,900 acres of marsh on the east bank of Plaquemines Parish near Pointe a la Hache to create new wetland habitat and restore degraded marsh.	Years 31-50	$382,000,000
	002.MC.04a	Lower Barataria Marsh Creation - Component A: Creation of approximately 7,900 acres of marsh in Jefferson Parish on the east shore of Little Lake and Turtle Bay to create new wetland habitat and restore degraded marsh.	Years 31-50	$759,700,000

Chapter 5
IMPLEMENTATION STRATEGY

- FUNDING & IMPLEMENTATION
- PHASING IN PROJECTS
- SEDIMENT DIVERSIONS
- FLOOD RISK & RESILIENCE
- 2017 NONSTRUCTURAL PROJECTS
- STRUCTURAL RISK REDUCTION
- POLICY TOOLS

Photo courtesy of Monsour's Photography

FUNDING & IMPLEMENTATION

NEAR-TERM FUNDING SOURCES SUPPORT THE 2017 COASTAL MASTER PLAN

CPRA's *Integrated Ecosystem Restoration & Hurricane Protection in Coastal Louisiana: Fiscal Year Annual Plan* identifies available funding for a 3-year period and the programs and projects that funding will support.

The annual plan provides details on CPRA expenditures and revenues for the next 3 years and is used to track the progress of CPRA projects in different phases of implementation. The majority of resources available in the coming fiscal year are focused on engineering and design and construction of coastal projects. The implementation plan and funding projections presented in the annual plan represent a snapshot in time based on available funding sources. The state actively explores new sources of funding to ensure that the coastal program maintains its current momentum. Included in the annual plan are funds to construct some of the largest barrier island and marsh creation projects in the history of our program, and funds that will advance sediment diversion projects, which are critical to the long-term outcomes of coastal Louisiana.

Louisiana anticipates using funding associated with Deepwater Horizon Oil Spill settlement funds, which includes funds under the RESTORE Act; the Gulf of Mexico Energy and Security Act (GOMESA); the Coastal Protection and Restoration (CPR) Trust Fund; the CWPPRA; the Water Resource Development Act (WRDA)/Energy & Water Appropriation Act; State Capital Outlay funds; disaster-based funding; and grants to support implementation of the 2017 Coastal Master Plan.

> THE ANNUAL PLAN PROVIDES AN UPDATE ON RECENT PROGRESS AND PROJECTED REVENUES AND EXPENDITURES.

CONSENT DECREE FOR DEEPWATER HORIZON OIL SPILL SETTLEMENT FUNDS

On April 4, 2016, the United States District Court for the Eastern District of Louisiana entered a Consent Decree resolving civil claims against BP by the United States and the five Gulf states arising from the 2010 Deepwater Horizon Oil Spill disaster. The global settlement is worth more than $20 billion and will be paid out over a 15 year period beginning in 2017 and ending in 2031, with interest and additional payments paid no later than 2032. Louisiana is anticipated to receive a minimum of $6.8 billion for claims related to natural resource damages under the Oil Pollution Act, Clean Water Act civil penalties, and the state's various economic claims.

The Consent Decree also contained an agreement to allocate $8.1 billion in natural resource damages, including a minimum of $5 billion specifically for Louisiana, among five different restoration goals and 13 different restoration categories designed to meet those goals. This amount includes the $1 billion BP previously committed to pay for early restoration projects.

Under the Consent Decree, BP must pay the following:

- Up to $8.8 billion for natural resource damages, which includes $1 billion in early restoration projects;
- $5.5 billion (plus interest) for Clean Water Act civil penalties (subject to the RESTORE Act); and
- $600 million for other claims.

Additionally, BP has entered into a separate agreement to pay $4.9 billion to the five Gulf states, and up to a total of $1 billion to several hundred local governmental bodies to settle claims for economic damage suffered as a result of the spill.

A breakdown of the Louisiana share of these funds is as follows:

- A minimum of $5 billion for natural resource damages, which includes $368 million previously allocated for early restoration projects;
- A minimum of approximately $787 million for Clean Water Act civil penalties (subject to the RESTORE Act); and
- $1 billion for state economic damages.

Combined Settlements. This settlement, combined with prior Deepwater Horizon Oil Spill-related settlements and recoveries, totals approximately $8.7 billion over 15 years for Louisiana coastal restoration and economic damage. Entry of the Consent Decree and completion of the Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement, which governs the use of the NRDA settlement funds has allowed the state to move forward with identifying and implementing critical restoration projects.

OTHER SIGNIFICANT FUNDING SOURCES

The RESTORE Act was signed into law on July 6, 2012 and creates a Gulf Coast Ecosystem Restoration Council (RESTORE Council), consisting of the governors of the five Gulf Coast states and the secretaries of six federal agencies. The Council's Gulf Coast Restoration Trust Fund (RESTORE Trust Fund) will receive 80% of the Deepwater Horizon Oil Spill Clean Water Act civil penalties for purposes of restoring the long-term health of the natural ecosystems and economy of the Gulf Coast region. These funds will be received over the 15 year period ending April 4, 2031.

PUBLIC ENGAGEMENT AND RESTORATION PLANNING

In anticipation of receiving Deepwater Horizon Oil Spill dollars, CPRA began public discussions related to comprehensive oil spill restoration planning in 2013. Planning efforts and discussions continue to be refined as additional information becomes available. Even though each source of oil spill funding is subject to various criteria and public approval processes, CPRA considers oil spill funding sources holistically in an effort to maximize the use of these dollars.

Louisiana's share of the RESTORE Trust Fund is as follows:

- Direct Component – approximately $260.4 million
- Spill Impact Component – approximately $551.5 million
- Centers of Excellence Funding Component – approximately $26.6 million

In order to expend Direct Component or Spill Impact Component funds, CPRA is required to draft a plan describing how it will use those funds. The state's initial RESTORE Plan, which described how the state would spend the Direct Component funds it had available at that time, was approved by the CPRA Board for submission to the U.S. Department of Treasury (Treasury) on July 15, 2015. On September 21, 2015, the Treasury formally notified Louisiana that it was the first state to have a plan accepted by the Treasury for expenditure of Direct Component funds. This initial RESTORE Plan was limited to the funds that were currently available in the RESTORE Trust Fund to CPRA at that time. Under this Plan, the state committed to funding two projects and two programs for a total of approximately $39.4 million:

- Houma Navigation Canal Lock Complex project ($16 million)
- Calcasieu Ship Channel Salinity Control Measures project ($16 million)
- Adaptive Management Program ($2.4 million)
- Parish Matching Program ($3.9 million)

Entry of the April 4, 2016 Consent Decree triggered the effective date for the RESTORE Council's Spill Impact allocation formula, which distributes 34.59% of the total Spill Impact Component funds, or approximately $551.5 million over a 15 year period, to CPRA. CPRA also has five projects totaling $38.3 million that have been selected for funding under the Council-Selected Restoration Component as part of the Council's Initial Funded Priorities List (FPL) approved December 15, 2015. Planning activities for the following projects and programs will be funded under the Initial FPL:

- River Reintroduction into Maurepas Swamp project ($14.2 million)
- Golden Triangle Marsh Creation project ($4.3 million)
- Biloxi Marsh Living Shoreline project ($3.2 million)
- West Grand Terre Beach Nourishment project ($7.3 million)
- Lowermost Mississippi River Management Program ($9.3 million)

CPRA will submit additional projects for funding once the RESTORE Council opens subsequent solicitations for project proposals under the Council-Selected Restoration Component.

GOMESA established a program in 2006 to create a dedicated funding stream for coastal restoration and risk reduction activities for the four Gulf States that permit outer continental shelf (OCS) exploration. Beginning in 2017, these states will receive 37.5% of all qualified OCS revenues. Louisiana will receive a 38.77% share of the allotted amount, which is the largest allotted portion among the states.

GOMESA funds may be used toward five purposes:

1. Projects and activities for coastal restoration, risk reduction, or conservation
2. Mitigation of damage to fish, wildlife, or natural resources
3. Implementation of a federally-approved marine, coastal or comprehensive conservation management plan
4. Mitigation of the impact of OCS activities by funding onshore infrastructure projects
5. Planning assistance and administrative costs of compliance, not to exceed 3%

Louisiana's CPR Trust Fund is largely supported by mineral revenues and severance taxes on oil and gas production on state lands. The CPR Trust Fund provides funding for the coastal program's ongoing operating expenses and for continued efforts in coastal restoration and risk reduction.

CWPPRA was originally authorized as part of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 and has since been reauthorized three times through 2019. CWPPRA funds are used for planning and implementing projects that create, protect, restore, and enhance wetlands in coastal Louisiana. The current net Louisiana wetland area that CWPPRA has protected, created, or restored is 96,806 acres. More than 355,647 additional acres have also been enhanced. As of October 2016, the program has authorized 210 projects with 108 currently constructed. Another 23 projects are currently under construction, 23 are in the engineering and design phase, and 57 have been deauthorized or transferred to other programs. CWPPRA projects are operated, maintained, and managed for a 20-year project lifespan.

CWPPRA currently receives a 12.95% share of Boater Safety Trust Fund revenues, so the total amount of funds can change on an annual basis depending on circumstances related to the state of the economy and consumer spending. Louisiana is expected to receive between $75 and $80 million per year of the federal share, which is matched by a 15% state cost share through the end of the program's current authorization. Because of the importance of the program, CPRA is working to ensure re-authorization.

Title VII of the 2007 WRDA/Energy and Water Appropriation Act authorizes USACE to address the problem of coastal land loss in the Louisiana Coastal Area and to take measures to restore coastal ecosystems and reestablish flood and storm surge risk reduction for the local population. Funding for WRDA projects through the Energy and Water Appropriation Act largely depends on projects being approved by USACE's Chief Engineer, on the availability of federal funds, and on political support. CPRA is following the development of USACE draft implementation plans for consistency with the 2017 Coastal Master Plan and to determine where there may be overlap or potential funding opportunities for nonstructural projects in areas where USACE authorizes mitigation measures and appropriates funds for those measures.

Capital Outlay budget generated by the Louisiana Office of the Governor grants cash and non-cash lines of credit for state and non-state projects. CPRA anticipates receiving $10 million per year over the next 3 years in Capital Outlay funding to supplement implementation of 12 projects.

Future disaster-based funding will be applied toward projects like nonstructural mitigation that remediate damage from the precipitating event. CPRA will coordinate closely with other state agencies to direct applicable future disaster funds toward implementation of nonstructural projects identified in the 2017 Coastal Master Plan.

Grants from businesses, industry, large corporations, and national philanthropic organizations are also a potential future funding source for projects.

PHASING IN PROJECTS

PREPARATIONS FOR THE FIRST IMPLEMENTATION PERIOD

As discussed in Appendix A, *Project Definition* projects with dedicated engineering and design funds, but not dedicated construction funds, are still analyzed within the master plan framework even when in stages of preliminary design. Once projects receive construction funds from one of the aforementioned sources and have the necessary stakeholder partnerships in place, they are considered by the master plan to be part of the Future Without Action condition and are moved from a project planning phase within the master plan, to the project construction phase within the Annual Plan.

A wide distribution of project types are slated for implementation in the first 10 years of the master plan. Hydrologic restoration, marsh creation, sediment diversions, ridge restoration, and shoreline protection are located from the Sabine River to the Pearl River across the coast. Louisiana is actively engaged in planning, engineering, and design phases for sediment diversion projects for the first implementation period, such as the Mid-Barataria, Mid-Breton, Increase Atchafalaya, and Maurepas diversions. Other restoration projects started as part of the 2012 plan, such as the Golden Triangle Marsh Creation, recently received RESTORE Act grants for engineering and design phases, while the Bayou Terrebonne Ridge and Marsh, the Spanish Pass Ridge, and Lake Borgne Marsh Creation projects have been submitted to be developed as part of the NRDA restoration plan associated with the Deepwater Horizon Oil Spill.

Rendering courtesy of LSU Coastal Sustainability Studio

Mid-Barataria Sediment Diversion rendering showing how the diversion could build land over time.

SEDIMENT DIVERSIONS

AN IN-DEPTH LOOK AT HOW DIVERSION PROJECTS ARE IMPLEMENTED

For decades, sediment diversion projects have been a staple of every coastal plan that has been published. The question is rarely whether we should build them, but how and where to build them, how to pay for them, and how to operate them once built. That all has changed over the past 5 years since the 2012 Coastal Master Plan made it clear that sediment diversions must be part of our overall restoration strategy, and since the recent Deepwater Horizon Oil Spill settlement has made funding more certain.

CPRA and USACE have worked together since the 2012 Coastal Master Plan on the Mississippi River Hydrodynamic and Delta Management Study (MRHDMS) to develop cutting edge technical models to better understand and predict the effects of using river resources for large-scale restoration projects, such as Mississippi River sediment diversions on the river as well as adjacent basins. These models have led to improvements in our understanding of river and estuarine dynamics and to the development of river and basin wide models to support project implementation in Barataria and Breton Basins.

The 2012 Coastal Master Plan called for eight sediment diversions along the Mississippi River. Over the past several years, CPRA has conducted in-depth analyses on the Lower Breton (50,000 cfs), Lower Barataria (50,000 cfs), Mid-Breton (35,000 cfs), and Mid-Barataria (50,000 cfs) diversion projects in order to determine which projects should be prioritized for engineering and design and construction. Each project was modeled to predict project effects on variables, such as land building, salinity, sediment transport, nutrients, and water levels. As part of this analysis, the state also considered innovative marsh creation projects that could be implemented in conjunction with sediment diversion projects in order to enhance sediment capture and build more land.

This modeling effort helped inform CPRA's decision in fall 2015 to recommend that the Mid-Breton and Mid-Barataria diversions move forward to preliminary engineering and design. Over the next several years, CPRA will work to optimize operations, formulate the final project design, and apply for appropriate construction permits in order to construct these foundational projects for the coastal master plan. At the same time, planning efforts will continue to evaluate additional diversions.

Concurrent with these efforts, through a collaboration of various public, private, and academic institutions, including representatives from CPRA, the "Changing Course" competition was launched in September 2013. The primary goal of the competition was to develop innovative and exploratory ideas focused on maximizing restoration of a functioning deltaic system (land building and natural habitats) in areas adjacent to the Mississippi River below New Orleans while continuing to meet the needs of navigation, flood risk reduction, coastal industries, and communities.

A major aspect of the competition was how best to maximize use of the Mississippi River's water and sediment in the long-term. After an extensive application and interview process, three teams were selected to develop and propose project designs: Baird & Associates, Moffatt and Nichol, and Studio Misi-Ziibi. Their design proposals consistently included the following themes:

- Reconnecting the Mississippi River to its coastal plain to help restore southeast Louisiana's first line of defense against powerful storms and rising sea levels.
- Planning for a sustainable delta, including a gradual shift in population to create more protected and resilient communities.
- Protecting and maximizing the region's port and maritime activities, including moving the navigation channel further north within the system.
- Increasing future economic opportunities in a smaller delta through expanding shipping capacity, coastal restoration infrastructure, outdoor recreation, and tourism, and commercial fishing.

Efforts like this are critical in developing the next generation of innovative projects that will help us face the threats of sea level rise and subsidence. More information on Changing Course can be found at **http://changingcourse.us/**

While CPRA focuses on implementing the Mid-Barataria and Mid-Breton sediment diversion projects, CPRA and its partners, including USACE and The Water Institute of the Gulf, will continue to maintain and develop the suite of river models to further investigate and inform decisions for beneficial future river management. We aim to improve upon landscape analysis in relation to storm surge impacts, enhance capabilities to measure subsidence, and further evaluate the use of channel maintenance dredging. This analysis will also include an in-depth look at which elements from the Changing Course competition could be incorporated into lower Mississippi River management. The predictive modeling tools will also be used to continuously evaluate suites of projects, including additional diversions, dedicated dredging, and navigation projects. We will use all available tools to identify areas in the greatest need to river sediment and water. The planning process will consider the need for these projects under variable relative sea level rise and Mississippi River water and sediment discharge.

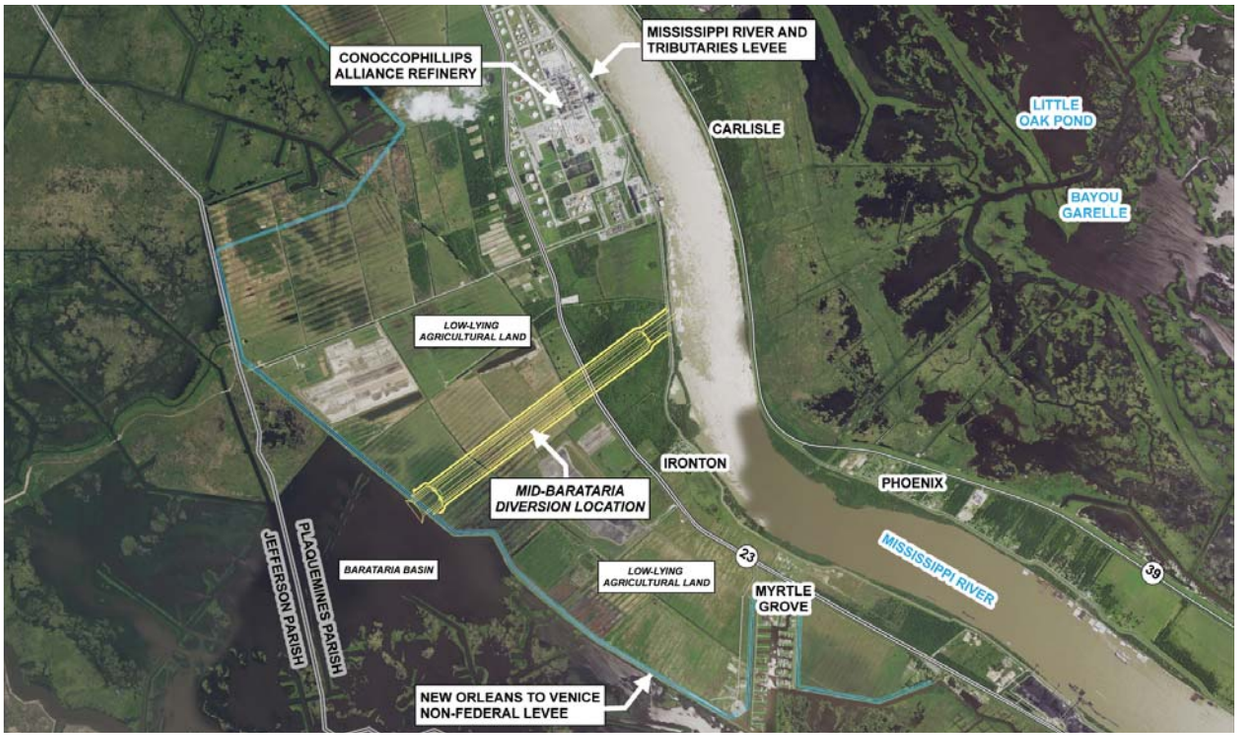


Illustration courtesy of CPRA.

Mid-Barataria Project illustration

FLOOD RISK & RESILIENCE

AN IN-DEPTH LOOK AT FLOOD RISK AND RESILIENCE PROGRAM IMPLEMENTATION

CPRA's Flood Risk and Resilience Program focuses on implementing nonstructural projects, increasing flood risk awareness, and supporting state-level policies that promote wise development and greater resilience across the Louisiana coast. Building upon past efforts, CPRA has expanded and refined the nonstructural projects, programmatic details, and policy recommendations first introduced in the 2012 Coastal Master Plan. As part of the 2017 Coastal Master Plan, the Flood Risk and Resilience Program creates a comprehensive strategy to identify and prioritize nonstructural projects and provides a robust program framework to implement recommended projects. Key advances include:

Updated modeling and analysis for nonstructural project implementation. An increased focus on effective implementation has led to more refined nonstructural project areas. Advances in the simulation of storm surge based flooding have enabled the identification of the most-at-risk communities both today and over the next 50 years. Lastly, newer datasets about the building stock and assets at risk, as well as added population growth scenarios, have improved the assessment of potential future economic damages and aided in the evaluation of nonstructural projects.

More robust program framework. The Flood Risk and Resilience Program's framework, developed in coordination with key stakeholder groups and partners, has been improved to promote a more coordinated coast wide approach to project implementation. Key elements of this framework include: the methodology for analyzing and prioritizing nonstructural projects; nonstructural application process for parishes; program policies and procedures; project specific policies and procedures; and identification of potential funding sources for nonstructural projects.

Expanded resilience-focused collaborations. To better develop and implement the Flood Risk and Resilience Program, various groups have been assembled to promote interagency and cross-sector dialogue. These groups include the Flood Risk and Resilience Subcommittee of the CPRA Board, TAC, Flood Risk and Resilience Stakeholder Group, and Floodplain Managers Group.

More in-depth policy recommendations. CPRA has enhanced its policy recommendations to better promote the programmatic measures needed to reduce flood risk and enhance community resilience. Key policy recommendations pertain to: planning (including comprehensive, multi-jurisdictional, land use, and recovery plans); hazard mitigation planning; regulatory tools (including local ordinances, the National Flood Insurance Program, and Coastal Zone Management Program); infrastructure and building standards; and capital improvement plans and incentives. These recommendations aim to augment project implementation, and to promote flood risk reduction measures in local and state planning efforts. They also take into consideration recent federal guidance promoting increased flood risk management standards. The holistic approach summarizes current state and parish activities, notes areas for improvement, and focuses specific recommendations for other state agencies, parish governments, local academics, and NGOs.

CPRA's Flood Risk and Resilience Program builds upon the great progress carried out by other state agencies and local parishes across coastal Louisiana over the last decade. The devastation of Hurricanes Katrina and Rita in 2005 led to the nation's largest home elevation program. Subsequent hurricanes have created the impetus to implement many types of flood risk reduction projects and to develop local community plans. Several state agencies have been working to increase community resilience, including OCD-DRU, GOHSEP, and DOTD. CPRA recognizes these agencies' tremendous efforts to help coastal Louisiana communities rebuild from storms more safely and to promote smarter future development. As the Flood Risk and Resilience Program is implemented, CPRA is proactively partnering with other agencies to incorporate lessons learned, share data, leverage institutional expertise, and develop closer interagency coordination and collaboration.

2017 NONSTRUCTURAL RISK REDUCTION PROJECT RECOMMENDATIONS

Nonstructural mitigation measures may include non-residential structure floodproofing, residential structure elevation, or residential structure acquisition. In total, 32 project areas were recommended for nonstructural mitigation in the 2017 Coastal Master Plan. The 2017 nonstructural risk reduction projects include a total of 26,569 structures recommended for mitigation at a cost of $6.06 billion. This totals 1,412 floodproofings, 22,716 elevations, and 2,416 voluntary acquisitions.

Below is a summary of how the 32 nonstructural projects vary in size and scope:

- Cost: $1 million to $1.6 billion
- Total structures recommended for mitigation: 2 to 6,265 structures
- Non-residential floodproofings recommended: 0 to 375 structures
- Residential elevations recommended: 0 to 5,307 structures
- Residential voluntary acquisitions recommended: 0 to 889 structures
- Repetitive loss/severe repetitive loss properties included: 0 to 6,265 structures

Selected in conjunction with structural risk reduction projects, nonstructural risk reduction projects were recommended primarily based on their ability to reduce expected annual damage and to provide benefits to areas with high vulnerability to future flood depths. However, 10 nonstructural risk reduction projects were also identified as prerequisites to proposed structural risk reduction projects that resulted in increased flood depths outside the levee system.

In coordination with recent federal resilience policy recommendations, the 2017 nonstructural risk reduction project recommendations employ the state's best available climate science and include mitigation standards that are not tied to a static FEMA Base Flood Elevation (BFE). Projects slated for the initial implementation period (years 1 to 30) are designed to reduce economic damage due to 100-year flood depths occurring 10 years into the future, while projects selected in the last implementation period (years 31 to 50) are designed to reduce economic damage due to flood depths occurring 25 years into the future. These recommendations are intended to provide planning level estimates rather than a list of specific structures to be mitigated, which will be determined by the parish.

OVERVIEW OF THE PROGRAM AND PARISH APPLICATION PROCESS

The Flood Risk and Resilience Program is an important component of CPRA's objective to reduce storm surge based flood risk across coastal Louisiana. It aims to reduce coastal flood risk through the development and implementation of nonstructural risk reduction projects and related polices over the next 50 years.

The program sets forth the process and requirements for parishes to implement the nonstructural mitigation measures recommended in the 2017 Coastal Master Plan. Development of the program was influenced by extensive outreach efforts that focused on integration of federal and state agency best practices, while recognizing the local context of coastal communities and the robust knowledge of parishes who have implemented mitigation measures to support effective, locally appropriate solutions.

An in-depth assessment of future flood risk and vulnerability paired with consideration of existing and recommended structural protection projects allows the program to focus on the set of projects that most effectively reduced future flood risk and to direct resources to areas of highest need. The Flood Risk and Resilience Program is designed to fill existing gaps, offer greater flexibility to parish grant administrators, streamline programmatic requirements, encourage wider participation from vulnerable communities, and focus on areas of

critical need and greatest storm surge flood risk. The program is also designed to adaptively respond to local needs by enabling parishes to further develop and refine nonstructural projects. All nonstructural risk reduction projects are considered voluntary in nature. Local parishes can prioritize the order in which specific structures will be mitigated based on local needs and goals. See Appendix E, *Flood Risk and Resilience Program Framework*, to read more about CPRA's nonstructural project development and an overview of the application process. For more details on the application process, see Attachment E4, *Parish Applicant's Handbook*.

POLICY RECOMMENDATIONS

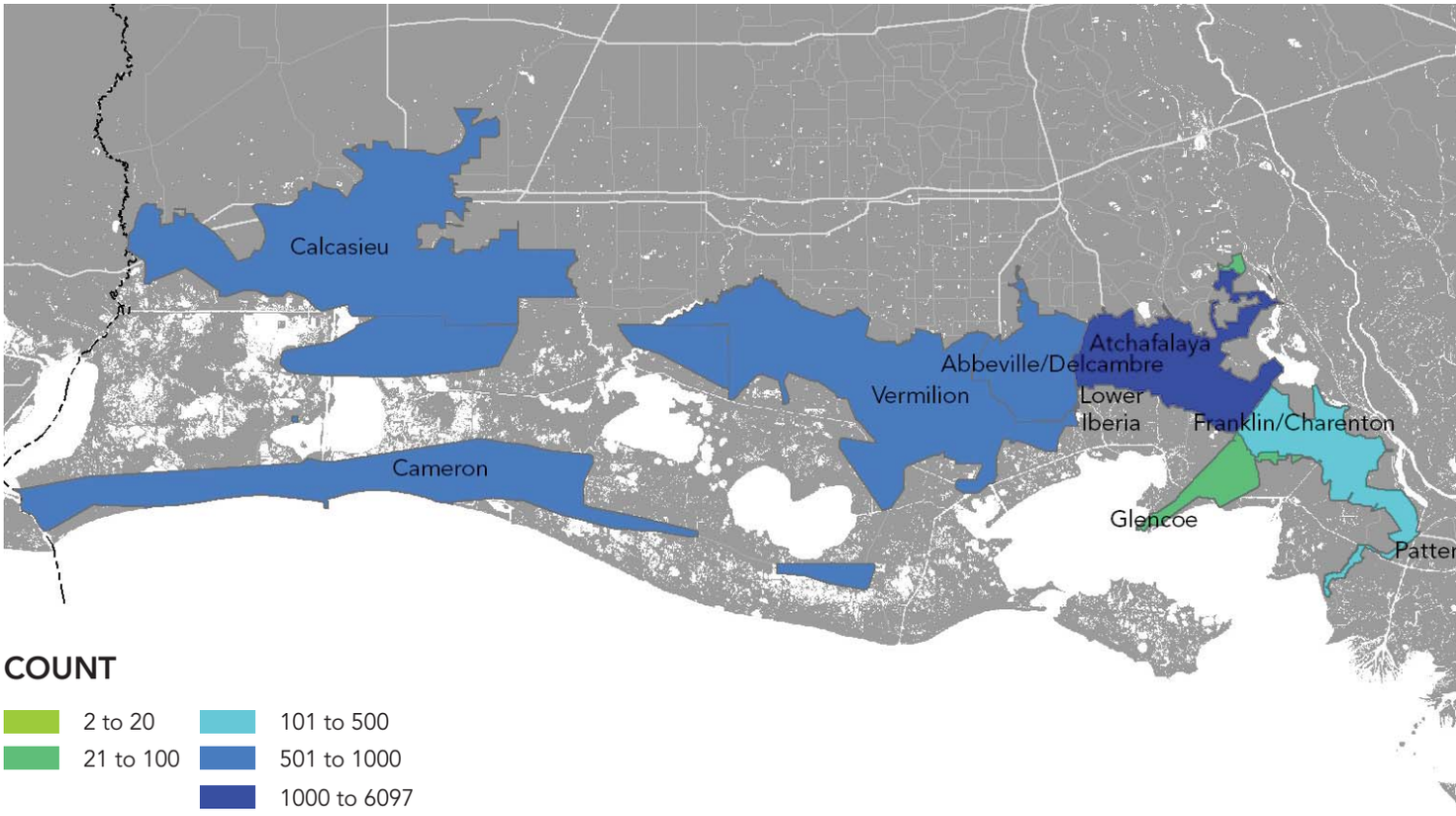
While a major component of the Flood Risk and Resilience Program is to determine effective nonstructural projects and to support project implementation, focusing on the mitigation of structures alone is not sufficient to meet the challenges of increasing flood risk and coastal climate adaptation. There are a wide range of policies and programmatic measures that can be undertaken to reduce flood risk to individuals and communities. These policy recommendations aim to further the progress made (by GOHSEP, OCD, DOTD, and coastal parishes), and to support and enhance these entities' ongoing resiliency efforts. Programmatic measures, such as land use planning, hazard mitigation planning, flood ordinances, and building codes can reduce risk to future community development and, therefore, are integral elements of achieving risk reduction goals across coastal Louisiana. Attachment E1, *Policy Recommendations*, describes key policy recommendations that can advance communities' collective ability to reduce flood risk through methods beyond the mitigation of individual structures.

FLOOD RISK OUTREACH AND EDUCATION

Outreach and education are critical programmatic elements of a holistic flood risk reduction strategy. CPRA has worked to increase its outreach and promote flood risk education in several ways, including updating our Master Plan Data Viewer and providing a nonstructural risk reduction funding guide. The Viewer encourages flood risk awareness and promotes access to resources that can help communities reduce their flood risk. CPRA also published a resource titled *Pocket Guide to Funding Resources: Reducing Coastal Flood Risk for Homeowners + Renters + Business Owner.* This document aims to provide coastal residents with more information about current mitigation grant programs and connect interested individuals with resources to reduce their flood risk.

2017 NONSTRUCTURAL PROJECTS

TOTAL COUNT OF STRUCTURES RECOMMENDED BY NONSTRUCTURAL PROJECT AREA IN THE 2017 COASTAL MASTER PLAN

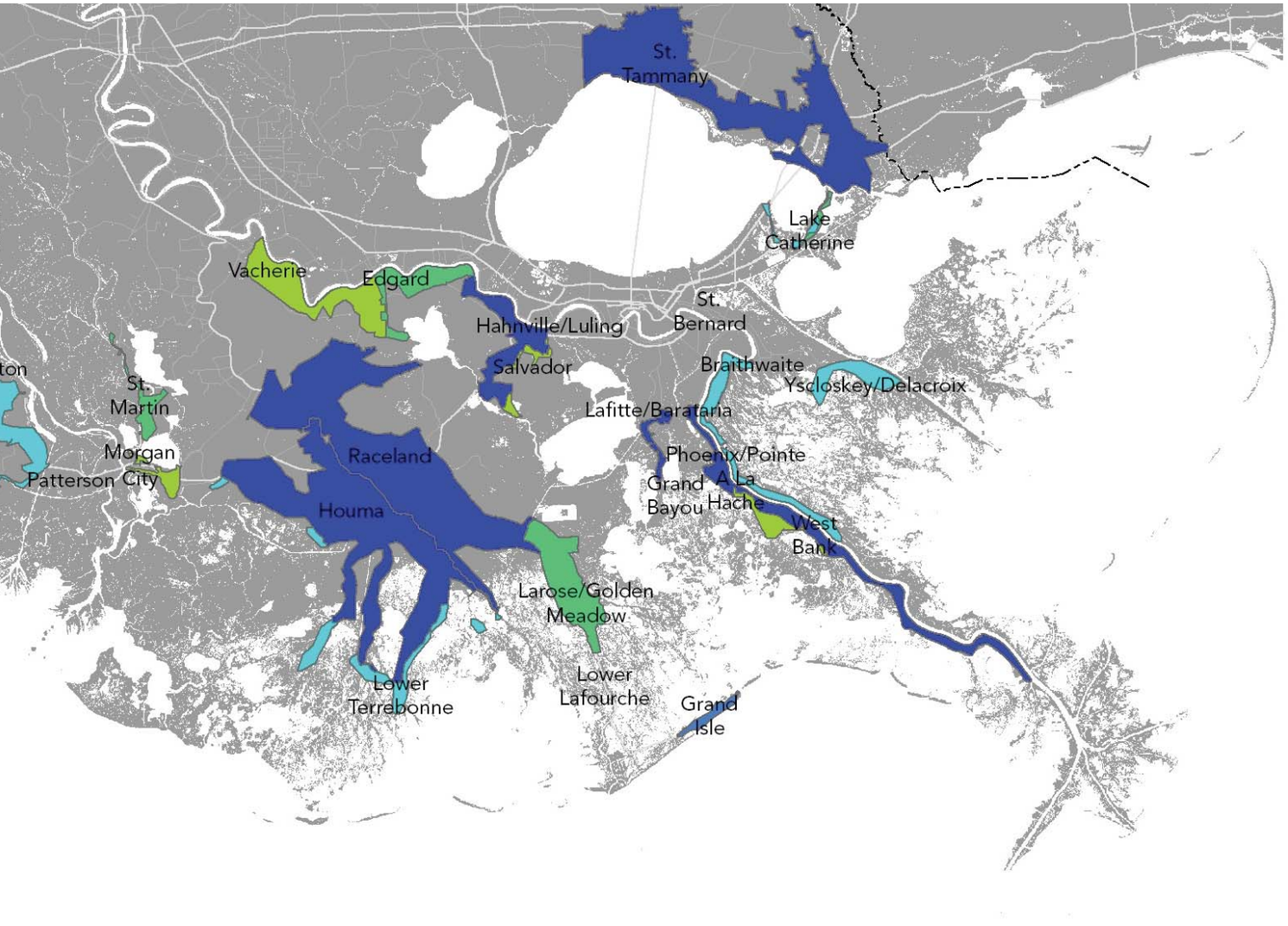


COUNT

- 2 to 20
- 21 to 100
- 101 to 500
- 501 to 1000
- 1000 to 6097

Photo courtesy of Louisiana Sea Grant

The 2017 Coastal Master Plan includes a range of nonstructural risk reduction projects that, when combined with structural risk reduction projects, effectively reduce expected annual damage due to storm surge flood risk.



▲ **FIGURE 5.1**
Nonstructural mitigation projects include non-residential floodproofing where 100-year flood depths are 0 to 3 feet, residential elevation where 100-year flood depths are 3 to 14 feet, and residential voluntary acquisition where 100-year flood depths are greater than 14 feet.

OVERALL, 32 NONSTRUCTURAL PROJECTS ARE SELECTED FOR THE MASTER PLAN WITH RECOMMENDATIONS FOR OVER 26,000 STRUCTURES TO BE MITIGATED AT A COST OF $6 BILLION.

RELATED INITIATIVES

In addition to the Flood Risk and Resilience Program, CPRA coordinates with other state and federal initiatives to leverage resources and promote consistency across state agencies and federal programs.

National Disaster Resilience Competition. In 2014, HUD, in conjunction with the Rockefeller Foundation, launched the NDRC to allocate $1 billion in CDBG funds. The competition challenged applicants to brainstorm effective and innovative resilience-building strategies in disaster affected areas. OCD-DRU worked with CPRA and local parishes to submit a proposal for the competition, and the state was awarded $92.6 million at its conclusion. These funds will support two programs, the LA SAFE Fund and the Community Resettlement of Isle de Jean Charles. CPRA's future flood risk and economic damage data and datasets outlining areas that may experience minimal future flood risk were instrumental in developing the state's application and resilience-building strategies.

LA SAFE. The LA SAFE Framework complements the master plan and promotes the advancement of community planning and risk reduction goals across the coast. LA SAFE notes that, "while the Coastal Master Plan focuses on techniques to reverse negative environmental trends while remaining mindful of the cultural and social uniqueness of our communities and our way of life, LA SAFE takes a people-driven approach to maintain that unique way of life while remaining mindful of the future risk projections at the state's disposal." LA SAFE's policy framework takes "a three pronged approach to the future of our coastal parishes," with a development strategy that will: "depart from our most vulnerable geographies, fortify economic assets and maintain a community development footprint to service those assets, and finally, maximize underdeveloped areas – in which minimal risk is projected – as a catalyst for thoughtful, high-quality community development in our high-ground territories." As OCD-DRU's LA SAFE and CPRA's Flood Risk and Resilience Program continue to advance, the two entities will coordinate and collaborate across both initiatives to maintain a consistent approach to resilience planning and nonstructural risk reduction project implementation across coastal Louisiana.

In early 2017, OCD-DRU will launch a planning process to commence LA SAFE Fund activities. This process will pilot in six initial parishes – Jefferson, Lafourche, Plaquemines, St. John the Baptist, St. Tammany and Terrebonne. The goal of this initial planning effort is to work directly with communities to develop a resilience strategy mitigating current and future environmental, social, and economic risks and vulnerabilities. Once the six parish strategies are completed, OCD-DRU, along with its partners, will work to implement the programs, projects, and policies proposed within.

Southwest Coastal Louisiana Feasibility Study. The Southwest Coastal Louisiana Feasibility Study recommends nonstructural hurricane and storm surge damage risk reduction measures and ecosystem restoration projects in Calcasieu, Cameron, and Vermilion parishes in southwest Louisiana. CPRA and USACE have worked together to develop the project, and the National Economic Development (NED) Plan supports master plan recommendations requiring the inclusion of climate change and sea level rise in the evaluation of potential nonstructural risk reduction measures.

Recommended nonstructural risk reduction measures are 100% voluntary, and 3,961 residential and non-residential structures meet the initial eligibility criteria. The project cost for initial implementation is $906 million, and the expected annual benefits for addressing all structures within the 25-year floodplain are approximately $204 million. Recommendations for this study are an essential part of an overall strategy to reduce risks associated with hurricanes and storm surge damage to the communities in southwest Louisiana. The nonstructural risk reduction projects recommended in the 2017 Coastal Master Plan are consistent with the areas and measures that were explored in the NED plan, and CPRA supports the ongoing work of this study to further reduce risk in these communities.

STRUCTURAL RISK REDUCTION

AN IN-DEPTH LOOK AT HOW STRUCTURAL RISK REDUCTION PROJECTS ARE IMPLEMENTED

Photo courtesy of CPRA

Morganza to the Gulf Floodgate

CPRA is moving forward with planning, engineering and design and construction of multiple risk reduction efforts throughout coastal Louisiana. In some cases, like Morganza to the Gulf, the state has contributed funding and works with the local levee district to implement project features. In other cases, CPRA has funded additional planning level efforts to advance risk reduction efforts around Lake Pontchartrain, Southcentral Louisiana, and in the Upper Barataria region.

Morganza to the Gulf Hurricane and Storm Damage Risk Reduction System. Since 2004 when "Morganza to the Gulf" was authorized, USACE, the State of Louisiana, and the Terrebonne Levee and Conservation District (TLCD) have partnered to develop and implement a hurricane protection system for Terrebonne and Lafourche parishes. The project was designed to provide hurricane and storm surge risk reduction benefits while ensuring there would be no drawbacks to navigational passage and tidal exchange. CPRA and TLCD have been handling construction aspects of the project. TLCD has self-imposed a sales tax bond to ensure project stages are completed.

2005 Hurricanes Katrina and Rita prompted updates to overall construction standards that aim to provide protection up to a 100-year level storm event. Changes to the original project design were included in USACE's Post Authorization Change Report, which incorporated new project costs and updated economic benefits. The overall project system is designed through 2085. The updated plan consists of approximately 98 miles of earthen levee (the eastern extent of the authorized levee alignment ties into Larose to Golden Meadow levee south of the GIWW), 22 floodgates on navigable waterways, 23 environmental water control structures, and a lock complex consisting of a lock in the Houma Navigation Canal measuring 110 feet wide by 800 feet long, an adjoining floodgate measuring 250 feet wide, and a dam closure.

Lake Pontchartrain Barrier. The 2012 Coastal Master Plan included consideration of a project to build a protective barrier across the mouth of Lake Pontchartrain. With increasing flood risk to the adjacent communities along Lake Pontchartrain due to storm surge, and with no tangible barrier currently erected to protect these communities, the continued analysis into this project's feasibility was approved to move forward. One of the missing components of the initial project design and analysis was the incorporation of data pertaining to potential impacts along the Mississippi coast. The initial project provided potential cost-effective risk reduction between $2.1 and $10.4 billion. Even with this potential positive impact on the Louisiana coast, a considerable investigation to

discover whether engineering and design would in fact return these benefits while safeguarding the State of Mississippi was imperative.

Through collaboration with USACE at the Mississippi Coastal Improvement Program, strategic assets for the State of Mississippi were incorporated into overall project modeling analysis, along with land features and existing protection structures. A number of storms of varying intensities were optimized specifically for this project to mimic the effects of a 100-year level storm event. Extensive modeling analysis has confirmed the storm surge and damage reduction benefits of the project.

Southcentral Coastal Hurricane Protection Study. The proposed implementation of a 100-year level hurricane risk reduction system for the southcentral portion of coastal Louisiana has now progressed to a feasibility stage. New storm surge and wave modeling data has been generated since the 2012 Coastal Master Plan to help determine the 100-year storm surge level, the level of risk reduction needed, and which existing levees provide sufficient risk reduction. Primarily focused on St. Mary and Iberia parishes, significant progress has been made to develop future expected costs associated with the risk reduction system, in addition to assuring that any proposed construction alleviates any potential impacts to coastal wetlands. With a more accurate prediction of expected construction costs now available, the next phases of project planning and development can proceed.

Although local planning efforts were incorporated into this study, a more formal public participation process will be conducted to ensure that project preferences meet the interests of the affected communities. Additionally, CPRA's Real Estate and Land Rights Division will work with St. Mary and Iberia parishes to determine actual property acquisition costs, which will provide further clarity on the scope of the projects

Upper Barataria Risk Reduction. Stormwater runoff from St. James, St. Charles, St. John the Baptist, and portions of Lafourche parishes feeds into the wetland areas west of Highway 90 in the Upper Barataria Basin. During a major storm event, the combination of stormwater runoff and infiltrating storm surge can cause an increase in flood risk to the adjacent communities. For the 2012 Coastal Master Plan, a conceptual project was evaluated that would build a storm surge protection barrier along Highway 90 to reduce the affects from storm surge. More detailed evaluation of the combined effects of storm surge and rainfall was conducted following the 2012 plan to identify a preferred alignment and estimate project costs while ensuring that the project can proceed to construction.

PARISH SUPPORT FOR MORGANZA TO THE GULF HELPS DRIVE FUNDING AND IMPLEMENTATION

Local parishes have played a critical role in assisting the state with maintenance of levee increments and operation of flood gates for the Morganza to the Gulf Hurricane and Storm Damage Risk Reduction System. Parishes have also partnered with the state on construction costs toward the lifting of levee increments. Terrebonne Parish has passed two sales tax measures, a ¼ cent sales tax in 2001 and a ½ cent sales tax in 2012, all of which bonded out $50 and $100 million to assist in the planning, design, and construction of Morganza to the Gulf project increments. Such local funding efforts provided crucial funds for construction of the Bubba Dove Barge Floodgate in 2013, the Bayou Petite Caillou Floodgate, and other projects, which have now provided flood risk reduction to communities along the bayou and to the Houma Navigation Canal. With continued local support for Morganza to the Gulf and other hurricane risk reduction projects, coordinated efforts will ensure projects are consistently maintained while reducing flood risk to our communities.

POLICY TOOLS

FEDERAL AND STATE POLICIES SUPPORT SUCCESSFUL IMPLEMENTATION

FEDERAL POLICIES

Executive Order 13690. In response to recent devastating flood events and the ongoing challenges facing the National Flood Insurance Program, there has been an increased focus across the nation on lowering communities' future flood risk in order to lower future disaster recovery costs. In January 2015, President Obama issued Executive Order 13690, which proposed a new Federal Flood Risk Management Standard. The goal of the policy is to lessen the impacts of climate change and to increase the resilience of communities.

Federal agencies are afforded flexibility in determining how to implement the recommended standards, which include several methods for determining the floodplain:

- Utilizing data and methods informed by best available, actionable climate science that integrates current and future changes in flooding;
- Building 2 feet above the 100-year (1% annual chance) BFE for most standard projects and 3 feet above BFE for critical buildings, such as hospitals and evacuation centers; or
- Building to the 500-year (0.2% annual chance) flood elevation for critical infrastructure.

Additionally, the executive order directs federal agencies to use, where possible, natural systems, ecosystem processes, and nature-based approaches when developing design alternatives for consideration. This executive order applies to all federal agencies and associated grants and, therefore, CPRA is aligning state practices to be consistent with federal programs and standards.

CPRA recommends that local parish and municipal governments adopt higher freeboard requirements , such as the FEMA Flood Insurance Rate Map (FIRM) BFE +2 for standard projects and BFE +3 for critical infrastructure, or building to the 500-year flood elevation as recommended by federal policy. CPRA also encourages local elevation requirements to be based on the best available climate science, such as 100-year flood depths derived from the 2017 CLARA Model and associated elevation heights, as available through the Master Plan Data Viewer.

STATE POLICIES AND PROGRAMS

CPRA collaborates with a number of state agencies and other entities to ensure that information developed through the master plan is available to support planning efforts coast wide. The State Steering Committee provides an opportunity for representatives from state departments and agencies to receive regular updates from CPRA and share their input. By working together, CPRA and its partners ensure that information is shared and used to inform refinements to the master plan, projects, and programs led by CPRA.

Department of Transportation and Development. DOTD works to implement flood control projects and support programmatic measures that reduce the impact of flooding through the National Flood Insurance Program (NFIP). The Statewide Flood Control Program reduces flood risk to areas experiencing structural damage or agricultural losses through a range of projects, including channel enlargement, levees, pump stations, relocation of homes and businesses, retention ponds, and other measures. With an average $10 million in available funds, the program emphasizes a statewide approach where 55% of funds are allocated to rural areas and 45% to urban areas.

Additionally, DOTD acts as the State Coordinating Agency for the NFIP and Community Rating System (CRS) to promote implementation of and compliance with NFIP regulations to prevent the loss of life and property due to flooding. DOTD supports parish and municipal jurisdictions by performing field audits in the floodplains and educating officials and citizens to reduce risk, remain compliant and maintain availability of flood insurance, disaster assistance, SBA, VA, and FHA loans. Almost all federal dollars require NFIP compliance. DOTD also works to support local parishes and communities to go beyond minimum NFIP requirements by enrolling in the CRS program. Communities can build more safely and substantially reduce flood insurance premiums as they improve their

CRS score. DOTD supports these activities by providing education and state coordination with FEMA and local communities to adopt higher standards. DOTD has also been appointed as Louisiana's Cooperating Technical Partner to assist FEMA in the development of Louisiana's FIRMs, delivering high-quality risk data, increasing awareness of flood risk, and promoting community mitigation actions. Additionally, DOTD's Public Works and Water Resources Division supports other Water Resources Development Programs, such as the USACE Water Development Program, NRCS Watershed Development Program, Levee Districts of Louisiana Technical Assistance Program, and the Cooperative Program with USGS.

For more information on these DOTD programs, visit **http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Engineering/Public_Works/**

Department of Natural Resources/Consistency. DNR-OCM is responsible for the maintenance and protection of the state's coastal wetlands, and is charged with implementing the Louisiana Coastal Resources Program and the Coastal Zone Management Program in order to balance natural resource conservation and coastal development. As part of these management duties, DNR-OCM oversees the Coastal Use Permit (CUP) process and works to ensure that any new development avoids or minimizes impacts to wetlands. As compensatory wetland creation, enhancement, restoration, and risk reduction projects are at times necessary in the CUP process, these projects must also be consistent with the master plan.

Beneficial Use. Beneficially using dredged material to rebuild wetlands is a strategy whose widespread adoption is universally supported and long overdue. Since 2009, the state, through DNR-OCM, has required private applicants who dredge more than 25,000 cubic yards of sediment to place the dredged material in a coastal restoration project or pay a fee. However, the state's regulations do not apply to USACE. Because USACE maintains federal navigation channels, they dredge more sediment than any other entity in Louisiana, averaging about 80 million cubic yards per year. Some of the material is used beneficially, but much of it is disposed of in upland disposal sites or in the Gulf of Mexico. Additional funding in USACE's dredging budget or from external sources, such as the Federal Harbor Maintenance Trust Fund, could be used to supplement the USACE budget for this purpose. The state recommends that this and other options be fully explored. Bringing in sediment from outside the system and using renewable sediment sources are fundamental principles of the plan.

CPRA fully supports beneficial use of dredged material and has financed many beneficial use projects in the past, including projects utilizing sediment from the Calcasieu Ship Channel, the Mississippi River Navigation Channel, the Houma Navigation Canal, and the Atchafalaya River. As the state implements the large-scale marsh creation projects laid out in the master plan, it is imperative that we use the sediment from all applicable dredging activities.

State Hazard Mitigation Plan. GOHSEP produces the State Hazard Mitigation Plan (SHMP), which analyzes a range of climatological, geological, and human-influenced hazards, and assesses the relative risk they pose to parishes. CPRA offers support by sharing sea level rise, subsidence, and future flood risk information used to develop the master plan. For instance, in the most recent 2014 SHMP discussion of climate change and future coastal conditions, there is extensive information in the land loss profile about projections of future land loss and economic damage in various coastal Louisiana parishes due to global sea level rise and subsidence between 2014 and 2024.

Hypoxia Task Force. The Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, or "Hypoxia Task Force," was established in 1997 to understand the causes and effects of eutrophication in the Gulf of Mexico and to coordinate management activities throughout the Mississippi-Atchafalaya River Basin to reduce its impacts. These activities include improvements in management of both point sources and nonpoint sources of nutrient pollution to reduce inputs into the river system. Every 5 years, the Hypoxia Task Force updates its Gulf Hypoxia Action Plan to assess actions taken, discuss success stories, and prioritize future efforts.

A critical component to the state aligning to the goals of the Gulf Hypoxia Action Plan has been development of the 2014 Louisiana Nutrient Management Strategy. The implementation strategy focuses on six key areas: river diversions, nonpoint source pollution management, point source pollution management, incentives, leveraging opportunities, and new science-based technologies and applications.

The Louisiana Nutrient Management Strategy is being implemented by an interagency team with members from CPRA, DEQ, the Department of Agriculture and Forestry, and DNR. Also, with the development of the System-Wide Assessment and Monitoring Program, numerous additional water quality monitoring stations will be added throughout Barataria Basin and Breton Sound to improve our spatial and temporal understanding of water quality within our coastal waters. These additional monitoring sites will not only provide improved baseline water quality data but will also help inform master plan models and measure proposed changes to water quality in coastal Louisiana.

Photo courtesy of Lindsey Janies Photography

Chapter 6
LOOKING TO THE FUTURE

- ADAPTIVE MANAGEMENT
- INFORMATION ACCESS
- LEADING THE NATION
- CONTINUOUS EVOLUTION

Photo courtesy of CPRA

ADAPTIVE MANAGEMENT

CPRA'S ADAPTIVE MANAGEMENT PLAN CONTINUALLY IMPROVES DECISION MAKING BY REDUCING UNCERTAINTY OVER TIME

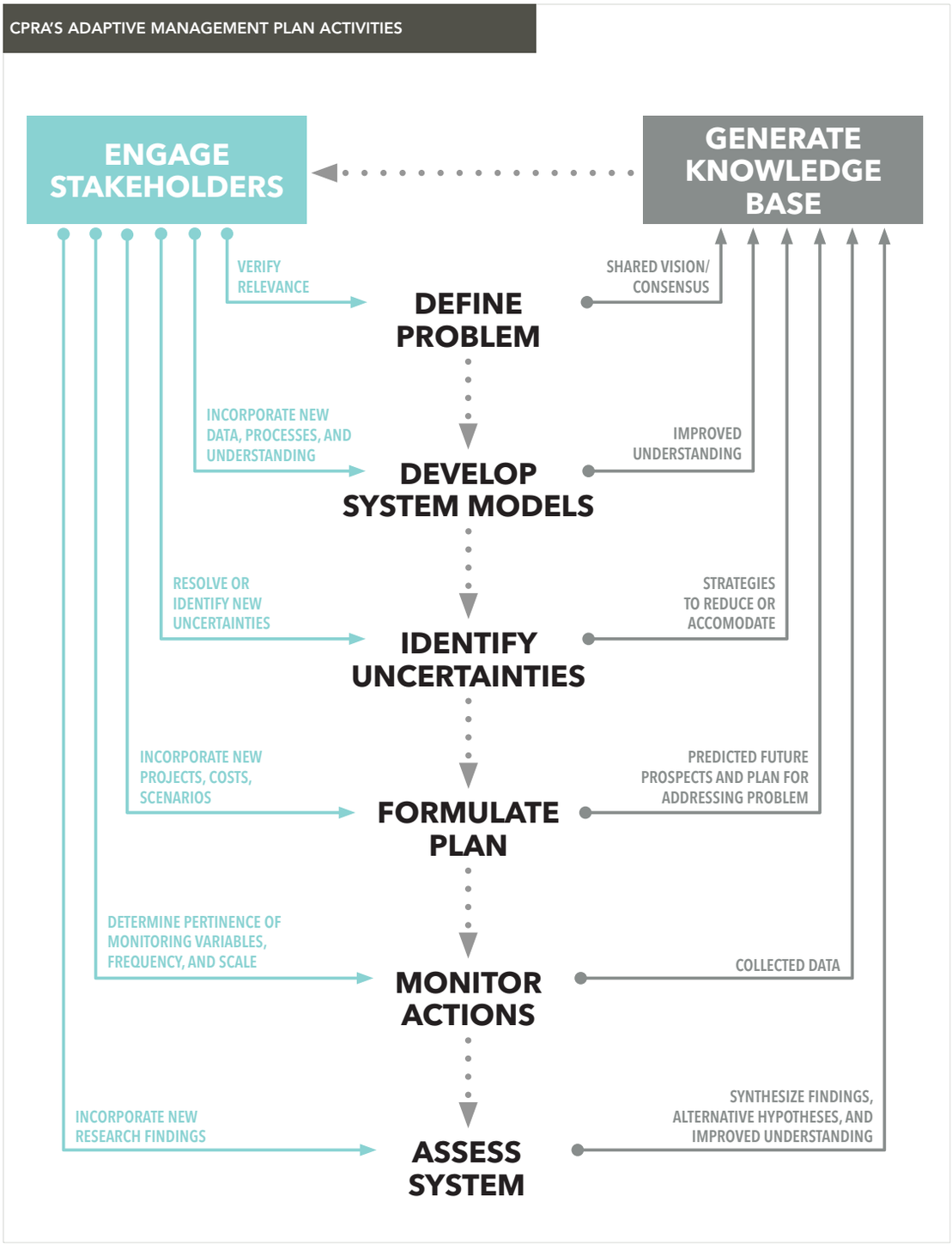
Future conditions of coastal Louisiana are highly uncertain due to the dynamics of riverine and marine processes, storm events, climate change, population growth, economic activity, and ongoing human reliance on the natural resources the coast provides. Managing such a complex system in which the natural and socio-economic systems are highly integrated is inherently difficult. In addition, coastal environments are uniquely challenged due to the interdependence and delicate balance of water, land, and economic systems and the future uncertainties associated with the magnitude and rate of climate change impacts. Adaptive management 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 pathways that allow for maximum flexibility of future decisions are two of the key concepts of adaptive management.

Another key concept of adaptive management is building institutional knowledge as we learn from our projects and as science evolves. It is one thing to build personal experience and knowledge at the individual level, but it is even more important to ensure that experience and knowledge does not leave the organization when people leave the organization. Adaptive management formalizes the lines of communication and institutionalizes the continual growth of knowledge as lessons are learned and as uncertainties are resolved.

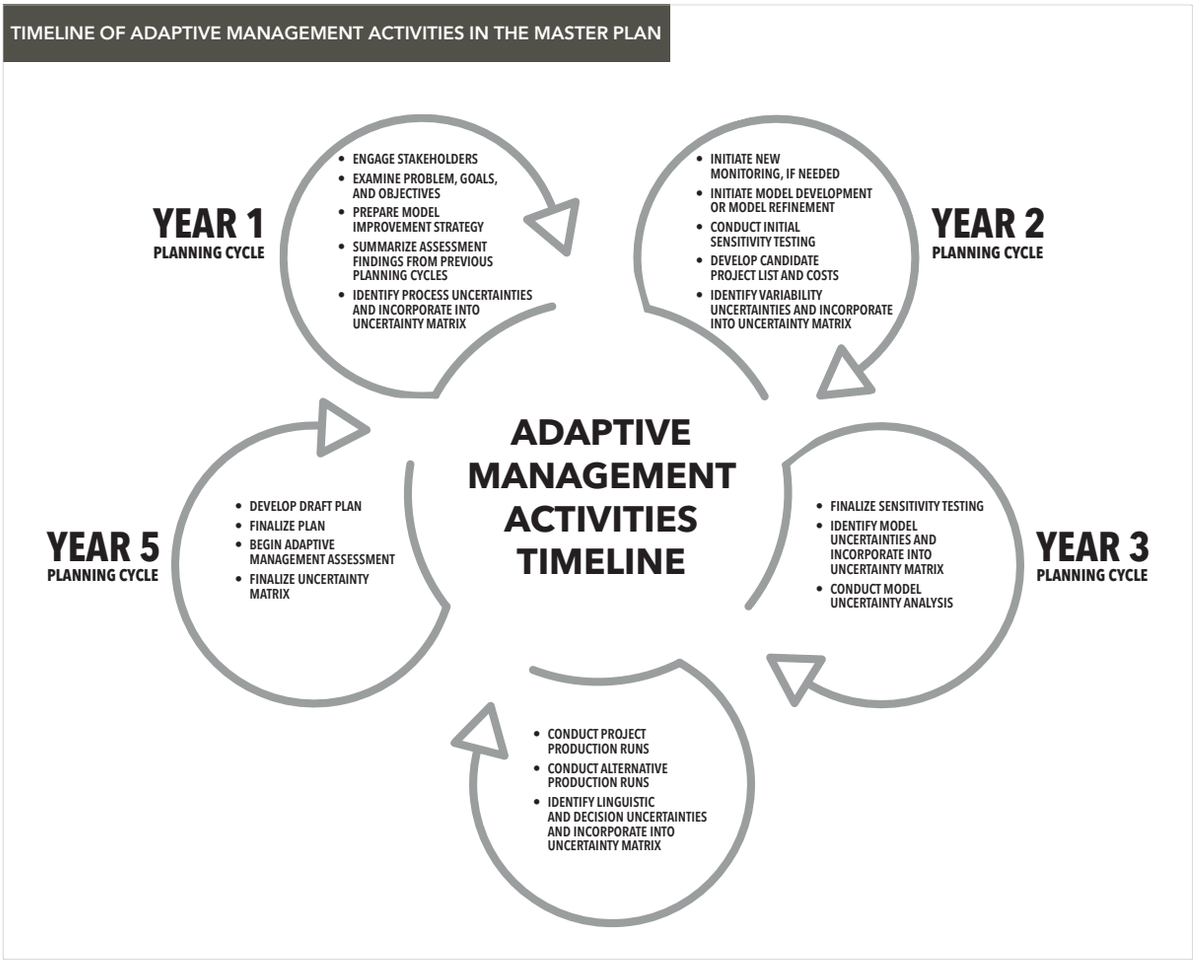
Adaptive management is a management tool to link learning with policy and implementation. Adaptive management reduces the uncertainty associated with a complex program through regular system monitoring and evaluation. A structured, iterative process is used to evaluate monitoring results at regular intervals and to adjust management actions based on what has been learned. In this way, adaptive management gathers information and uses it to gain new knowledge, reduce uncertainties, and improve future management decisions.

CPRA uses adaptive management in varying levels of project and program management – from the project level, to the larger hydrologic basin, to the overall master plan. CPRA incorporates all lessons learned every 5 years to establish an updated master plan. These 5-year updates are themselves adaptive management. The goal is to weave together an Adaptive Management Plan with an overarching framework that governs the master plan; all other CPRA planning efforts; and all other CPRA engineering, design, and operations activities. See Appendix F, *Adaptive Management*, to read more details.

As shown on Figure 6.1, CPRA is developing an Adaptive Management Plan that consists of seven activities at the program-scale: engaging stakeholders, defining the management problem, developing an existing understanding through system models, identifying uncertainties and alternate hypotheses based on experience, formulating a plan to allow continued action while learning, monitoring the effect of implementing new projects, and assessing and updating the system. These activities are incorporated into the 5-year master plan cycle, as shown on Figure 6.2.



▲ FIGURE 6.1
CPRA's Adaptive Management Plan consists of seven activities, from engaging stakeholders to assessing and updating the system. Throughout the master plan process, stakeholder engagement is integrally connected.



▲ FIGURE 6.2
The adaptive management plan includes a formal, structured approach that identifies pathways and mechanisms for integrating information into the 5-year master plan cycle.

ADAPTIVE MANAGEMENT AT THE PROJECT LEVEL

Adaptive management is employed at the project level to identify, develop, monitor, and evaluate projects on a repeated cycle. The master plan's goals and objectives drive the need for development of a project and determine the project's goals. If a project is actively managed, an Operational Strategy for the project will be designed and implemented. The Operations Management Team will monitor the project while the Adaptive Management Team will assess the monitoring adequacy and prepare an annual assessment of the project's performance. The two groups will continually provide feedback to one another on the project's status, and the Operations Management Team will periodically refine the operations plan based on input and feedback from the Adaptive Management Team. On a routine and recurring basis, the performance of actively managed projects will be reviewed. CPRA will solicit input from several key perspectives: an Advisory Panel consisting of landholders, stakeholders, and other groups; the Operations Management Team; the Adaptive Management Team; and the Science and Technical Subject Matter Experts. Input from these groups will be considered as routine updates

to the project's Operational Strategy. The CPRA Board and the Louisiana Legislature approve the revised project's Operational Strategy through the Annual Plan. Once approved, the updated project's Operational Strategy is launched and the project's adaptive management cycle starts anew. Operational changes and lessons learned from active projects will be incorporated into the next master plan's predictive models to reflect the latest science available, providing a link between project-level and program-level adaptive management. Figure 6.3 summarizes the adaptive management activities at the project level. If a project is still being designed when the next master plan is issued, then the project's design is used in the master plan process. If a project has already been constructed and operated when the next master plan is issued, then lessons learned from the project are incorporated into the Future Without Action Condition and into future project planning since the project and its effects are part of initial conditions by that time.

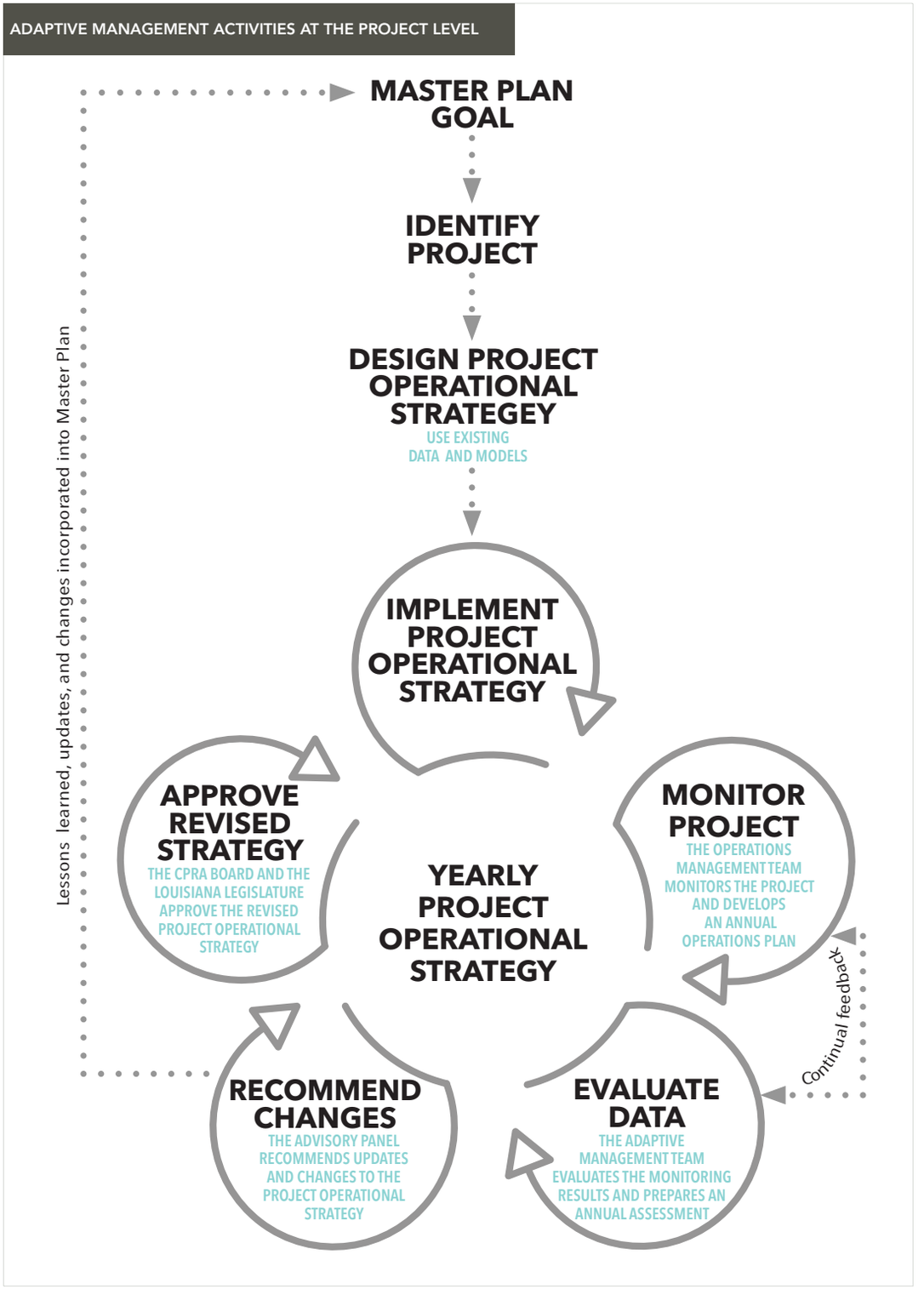
Adaptive management can be either active or passive. In the discussion above, adaptive management is considered active if there are ongoing operational requirements. Active projects are more controllable and can be adjusted easily after they have been established. The system can be used differently to obtain different outcomes. As a result, learning can be designed into the operational strategy of active projects to deliberately resolve uncertainties in an experimental manner.

SYSTEM-WIDE ASSESSMENT AND MONITORING PROGRAM (SWAMP)

In fall 2015, the State of Louisiana initiated SWAMP for the Barataria Basin. SWAMP provides an overarching monitoring and assessment program for Louisiana's coast that helps coastal management programs adapt to the changing landscape, prioritize ecosystem restoration programs, allocate project funding, and utilize the latest data-gathering technology. SWAMP also serves as the monitoring program for the master plan.

The key design of SWAMP is to support a comprehensive network of coastal data collection activities to ensure effective development, implementation, and adaptive management of the coastal protection and restoration program. SWAMP helps tie in all of the supporting monitoring programs, such as the CRMS, the Barrier Island Comprehensive Monitoring Program, and the Louisiana Sand and Sediment Resource Database, to improve project efficiency and remove duplicative efforts. SWAMP has helped to integrate above/below ground biomass to assist wetland monitoring, added chlorophyll and nutrient components to help evaluate inshore hypoxia in the Mississippi Delta, improved fisheries monitoring protocols, and allowed for improved bathymetry data to better understand the potential effects of sediment diversions and to help improve predictive ecosystem models.

Through SWAMP, monitoring is conducted throughout the program and project cycles to track performance and to advance scientific understanding so that policies can be adjusted as part of the learning process. SWAMP monitoring methods are adjusted as needed based on projects or studies. The reverse is also true – the master plan and projects are adjusted in planning, design, or operations based on the performance monitored by SWAMP.



▲ FIGURE 6.3

Adaptive management at the project level includes monitoring, evaluating, and revising the project on a yearly basis. Updates are communicated to the overall master plan to make the plan stronger and more effective.

Passive projects, on the other hand, are not actively operated, are less controllable and less adaptable to change. Passive projects may need to be adjusted or maintained for an extended period of time, and lessons learned as a result of monitoring may result in corrections to the project; however, there is no provision for active operations. Once project performance evaluations are conducted, managers will consider if the project or system should have been built differently, in a different place, or with different equipment or materials, and whether there are lessons learned that would benefit future projects of similar type. As a result, changes and learning happen over an extended period of time.

Lake Hermitage Marsh Creation. A Passive Project Example. An example of a passive project is the Lake Hermitage Marsh Creation within the Barataria Hydrologic Basin in Plaquemines Parish, Louisiana. The goal of this project is to restore brackish marsh habitat in Barataria Bay to compensate for damage caused by the Deepwater Horizon Oil Spill.

Once the project was researched and designed, construction began in March 2012. Sediment was hydraulically dredged from a borrow area in the Mississippi River and pumped via pipeline to create approximately 104 acres of brackish marsh. The area was then planted with native vegetation.

After the marsh and plants were established in October 2015, the project has since been monitored following a prescribed monitoring plan. The 5-year evaluation will take place in the fall of 2020. At this time, the evaluation will determine the overall success and stability of the project based on the size of the marsh (spatial extent), the elevation of the marsh, the plant survival rate, the amount of vegetation cover of plantings, and the presence of invasive species. The trends observed and lessons learned from this project (and from other similar marsh creation projects) will be used to plan the construction of other marsh creation projects and for projects within future master plans.

Davis Pond Freshwater Diversion: An Active Project Example. An example of an active project is the Davis Pond Freshwater Diversion structure located along the west bank of the Mississippi River in St. Charles Parish. Scientists learned that the Mississippi River levees, while providing necessary flood control, were also preventing freshwater from entering the Barataria Basin and thus contributing to wetland loss. USACE and the state (through the Water Resources Development Act) constructed the Davis Pond Freshwater Diversion structure in 2002 to provide a controlled flow of freshwater, sediments, and nutrients from the Mississippi River to the Barataria Basin. The goals of this project are to maintain favorable salinity conditions in the estuary, to foster emergent marsh vegetation growth, to reduce marsh loss, and to increase commercial and recreational fisheries and wildlife productivity.

The Davis Pond structure includes four iron-gated 14-foot by 14-foot box culverts built into the Mississippi River levee, an inflow channel to direct river water into the structure, and an outflow channel to divert freshwater to the Barataria Basin. The structure also includes 19 miles of guide levees, 1.8 miles of rock weir, a pumping station, and a settling basin. The total project area comprises 10,084 acres, including 9,300 acres of settling basin.

CPRA operates, monitors, and evaluates the Davis Pond Freshwater Diversion structure on a daily basis. CPRA uses the salinity readings from established monitoring stations in the Barataria Basin to adjust freshwater flow levels so that optimal salinity levels in the basin are maintained. CPRA monitors the basin's fish and wildlife populations as indicators of a healthy ecosystem and tracks marsh creation/loss with periodic aerial photography.

Photo courtesy of LSU Coastal Sustainability Studio.

Davis Pond Freshwater Diversion.

INFORMATION ACCESS

ADVANCES IN TECHNOLOGIES HELP CONNECT PEOPLE WITH INFORMATION

LOUISIANA SAND RESOURCES DATABASE

The Louisiana Sand Resources Database (LASARD) was implemented prior to the 2012 Coastal Master Plan. Since that time, data availability has expanded to best serve the interests of coastal project managers and coastal communities, and data inputs have been organized into a comprehensive database. These advances have also improved coordination between project partners.

LASARD is part of the Louisiana Sediment Management Plan (LASMP), which is the overarching framework finalized in 2013 to help guide sediment resource inventory and applicability toward master plan project implementation. LASMP manages coordinated efforts with such stakeholders as the Bureau of Ocean Energy Management, USACE, the Gulf of Mexico Alliance, CWPPRA, and associated state agencies to avoid duplication of functions, to share sediment resource data, and to ensure compliance with environmental concerns.

Surficial sediment distribution maps have been developed for offshore coastal Louisiana and the lower Mississippi River to help locate potential sand deposits and allow further investigation for borrow area development in the future. Through development of these maps, key sediment deposits can now be protected for future coastal restoration projects and utilized more effectively in coordination with supporting state and federal agencies.

In conjunction with LASMP, the Borrow Area Monitoring and Management (BAMM) program helps determine how best to manage sediment borrow areas for optimum usage while incurring the least environmental impact. The goals of BAMM are to develop general guidelines for developing criteria for location, delineation, and design of potential borrow areas in inland, riverine, and offshore environments for coastal restoration and risk reduction projects in Louisiana. Another useful aspect of the BAMM program is to investigate the restrictions and regulations governing sediment borrow area design to determine their justification and ensure that restorations costs are managed effectively and efficiently.

COASTAL INFORMATION MANAGEMENT SYSTEM

Prior to the 2017 Coastal Master Plan update, an online and public accessible, geographic information system (GIS)-enabled data portal, called the Strategic Online Natural Resources Information System, functioned as CPRA's data management system. However, because data management needs have increased due to expanding responsibilities and improvements in data gathering capabilities, CPRA needed to significantly improve its data management and delivery capabilities. In 2013, through a partnership with The Water Institute of the Gulf, a Data Management Plan was formulated to address CPRA's data concerns. CPRA partnered with the USGS Wetland and Aquatic Research Center to produce CIMS in an effort to redesign its data management and delivery capabilities. The new system is user friendly, improves agency transparency, and contains up-to-date information. CIMS provides users:

- Spatial, GIS-based access to CPRA's suite of projects, data, and information available through an interactive project map viewer.
- Tabular database access to various information, such as hydrographic and surface elevation data from coastal monitoring stations.
- Downloadable CPRA project reports library.

Access CIMS at **http://cims.coastal.la.gov/**

One of the most recent additions to CIMS has been the Master Plan Data Viewer. This interactive tool enables the user to view potential flood risk to their community, in addition to viewing how land loss affects coastal Louisiana under different master plan scenarios. There are also resources to view 2017 Coastal Master Plan projects, socio-economic data, and download documentation to assist homeowners with steps to reduce risk. The CIMS team continually updates the Viewer as new data and other information becomes available.

Access the Master Plan Data Viewer at **http://cims.coastal.louisiana.gov/masterplan/**

CIMS INTERACTIVE PROJECT MAP

▲ FIGURE 6.4

Through our improved ability to synthesize and compile project information, CPRA has developed an interactive project map that includes information about coastal projects that are either completed or funded. Users can click on an individual project to access information about its estimated cost and acres of land benefited, and funding sources. The interactive map tool provides transparency about project information and enables residents to track the status of projects near their communities. Access the CIMS Interactive Project Map at **http://cims.coastal.la.gov/MapHome.aspx**

LEADING THE NATION

LOUISIANA IS A LEADER IN WATER RESOURCES AND PLANNING

THE WATER CAMPUS

Through a partnership between the State of Louisiana, the City of Baton Rouge, and the Baton Rouge Area Foundation, the Water Campus is being built on 35 acres along the Mississippi River, adjacent to downtown Baton Rouge. In only a few years' time, the number of researchers and support staff employed at the facility will expand to more than 4,000 from public, private, non-profit, and academic sectors, including CPRA and many coastal researchers. More than 1.2 million square feet of laboratories, research facilities, and commercial space will enable them to carry out vital work – collaborating and developing innovative solutions for challenges that affect Louisiana's coastal communities and wetlands and then replicating successes to other coastal areas and communities across the world.

The initial phase of development includes the investment of $45 million for the construction of three facilities: the new office building for CPRA, a new headquarters for The Water Institute of the Gulf that is under construction, and the LSU Center for River Studies, which features one of the largest and most accurate physical river models in the world.

The Water Campus will be for more than science and engineering. Other types of firms are expected to occupy the space, taking advantage of its riverfront location along Nicholson Drive between downtown Baton Rouge and LSU and next to existing employment centers, alternative transportation, and an unburdened road network. In fact, the site was selected to further enrich Baton Rouge's cityscape by stimulating new growth downtown, which has already seen more than $2 billion in comeback investments.

Learn more about the Water Campus at **www.thewatercampus.org**

Water Campus rendering courtesy of Commercial Properties Realty Trust

CENTER FOR RIVER STUDIES

CPRA's new location at the Water Campus features the 45,000 square foot Center for River Studies that opened in December 2016. Developed through a collaborative partnership between CPRA and LSU, the Center for River Studies is an unprecedented effort to showcase Louisiana's working delta, the state's coastal program, and research dedicated to coastal restoration and river management. An exhibit hall features illustrations and interactive features to visualize and communicate the importance of the Mississippi River Delta, the impacts of Louisiana's coastal crisis, and the integrated restoration and risk reduction strategies being developed. The primary focus of the Center for River Studies is to operate one of the world's largest physical models of the Mississippi River, which simulates approximately 14,000 square miles of the lower Mississippi River from Donaldsonville to the mouth of the river and the Gulf of Mexico. Engineers, coastal scientists, and other researchers will be able to utilize this physical model to improve our understanding of how natural systems function and to generate information that will further help decision makers identify river and delta management strategies.

CENTER OF EXCELLENCE

Under the RESTORE Act, 80% of Deepwater Horizon Oil Spill civil penalties paid under the Federal Water Pollution Control Act after July 6, 2012 are directed to the Gulf Coast Restoration Trust Fund. The Trust Fund will dedicate 2.5% of those funds to the establishment of Centers of Excellence in each of the five Gulf states.

The Water Institute of the Gulf, in collaboration with academic partners from Louisiana, submitted a competitive proposal to CPRA and was selected as Louisiana's Center of Excellence, which is now a separate program within the Institute's existing organizational structure. The primary functions of the Institute are to systematically develop and implement the Center of Excellence program, administer a competitive grant program that rewards the best and most relevant research proposals, and provide the appropriate coordination and oversight to ensure success metrics are tracked and achieved.

Through the Center of Excellence, more than $10 million of research funds will be available over the next decade to support research focused on advancing implementation of the master plan, specifically through research projects that relate to coastal sustainability, ecosystem research, monitoring, and economic growth.

Learn more about the Center of Excellence at **www.la-coe.org**

Mississippi River Model rendering courtesy of Mougeot Architecture

COASTAL INNOVATIVE PARTNERSHIP PROGRAM

In 2013, CPRA launched a collaborative program administered by The Water Institute of the Gulf to provide an avenue for identification of coastal innovations. The Coastal Innovative Partnership Program (CIPP) solicits and evaluates innovative concepts, technologies, and techniques that are intended to support coastal master plan projects. CPRA looks for innovations that are shovel-ready and would improve existing project methods, technologies, or strategies and overall project performance. This program allows interested participants to submit proposals to be screened by an expert panel of engineers and scientists through a two-tiered application process. In total, 91 innovative concepts have been submitted through the CIPP program in its brief 3-year history, with eight proposals receiving full endorsement – for example, oyster reef building techniques, floating breakwaters, and vegetation shields to protect levees and embankments.

Learn more about CIPP at **http://thewaterinstitute.org/innovation**

COASTAL SCIENCE ASSISTANTSHIP PROGRAM

The Coastal Science Assistantship Program (CSAP) was originally formed in 2008 as an avenue to improve applied coastal ecosystem restoration research while also providing potential job applicants with relevant work experience. Administered for CPRA by Louisiana Sea Grant, CSAP annually awards up to four assistantships to support Master of Science students for up to 3 years whom are both enrolled full-time at Louisiana colleges/universities and involved in science or engineering research relevant to Louisiana coastal protection and restoration efforts. Some of the current priority research needs include project engineering and design, decision-support tools, predictive models, and uncertainties in future environmental conditions. Students must complete 240 hours of internship, provide a copy of their completed thesis, and deliver a presentation on their research findings to CPRA staff upon completion of their research. Since 2008 there have been 35 Louisiana Master of Science students supported and over 6,000 internship hours completed. In addition to financial assistance, students are also rewarded with valuable on-the-job training that will help contribute to their future professional success.

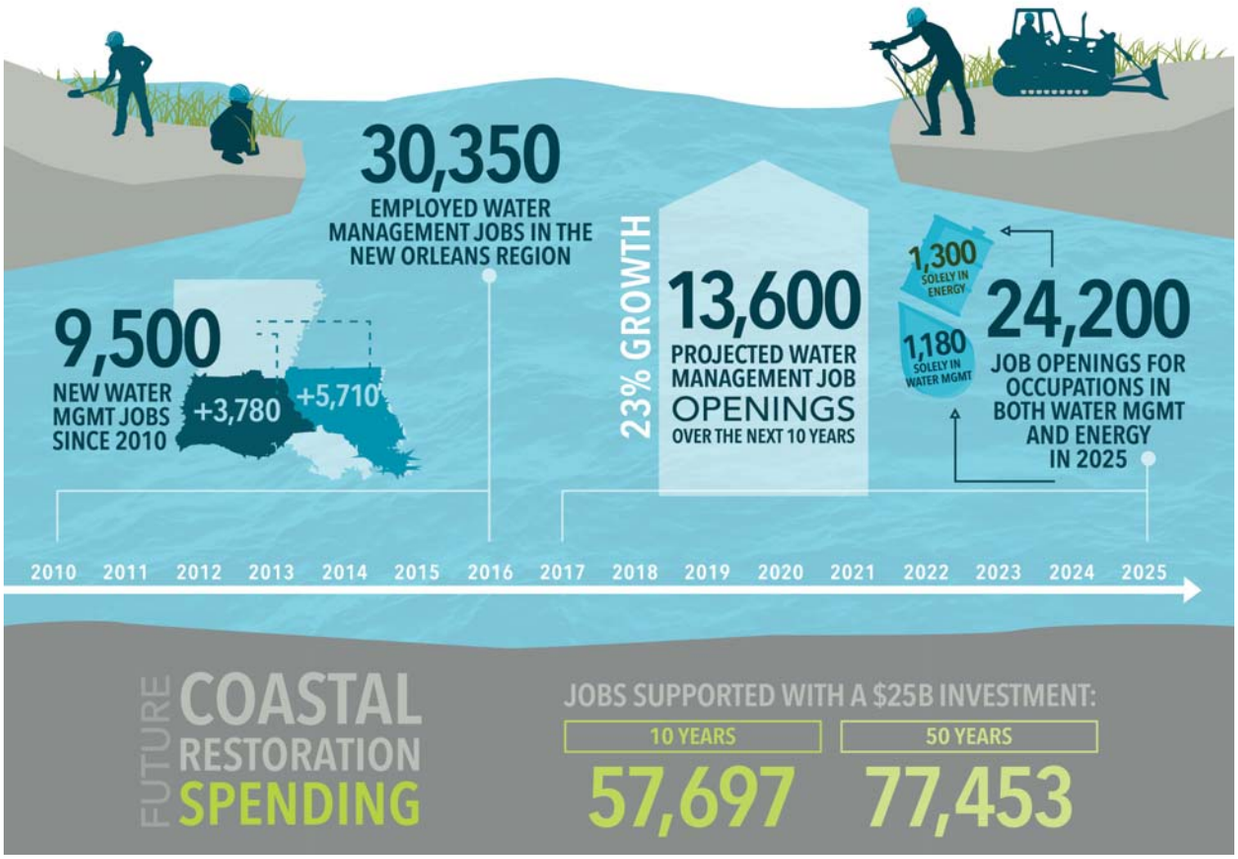
Learn more about CSAP at **http://www.laseagrant.org/research/student-research/csap/**

IN FEBRUARY 2016, A PUBLICATION FROM RESTORE THE MISSISSIPPI RIVER DELTA INDICATED THAT WATER MANAGEMENT NOW REPRESENTS THE LARGEST INDUSTRY DRIVER IN SOUTHEAST LOUISIANA AND IS ONLY SECOND TO THE OIL AND GAS INDUSTRY IN SOUTHWEST LOUISIANA. COMBINED, THESE TWO REGIONS REPRESENT 76% OF THE STATE'S ECONOMY IN SHEER NUMBER OF JOBS.

GENERATING A WORKFORCE

Louisiana's master plan not only impacts coastal protection and restoration activities but also benefits Louisiana's coastal workforce. A 2011 Louisiana Workforce Commission report on coastal restoration spending in Louisiana found that coastal restoration expenditures in 2010 directly created 4,880 jobs and an additional 4,020 indirect jobs. The study also examined both the direct and indirect economic benefits of coastal restoration spending against an annual future low spending estimate of $400 million and a high spending estimate of $750 million. Including indirect jobs, the future spending estimates reported a range of total employment impact from 5,510 to 10,320 jobs annually. The total economic output from this projected employment, including wages and value added, ranged from $700 million to $1.3 billion.

There are two main job sectors in Louisiana that will see an increase in available job opportunities in the near-future: water management and energy. Within the New Orleans region alone, an estimated 24,000 job opportunities will be created in these two job sectors by 2025. Water management alone is projected to see 13,632 job openings over the next 10 years ranging from civil engineers and operations managers to analysts and construction laborers. Additionally, out of those 24,000 job openings, nearly 6,600 will be middle-skill water management jobs. Middle skill jobs are those that generally require some education and training beyond high school but less than a bachelor's degree.[4] The 2015 Coastal Index published by the Data Center noted that within the New Orleans region, more than 14,000 water management jobs were gained from 2010 to 2014.



▲ FIGURE 6.5
As CPRA and other partners continue to increase coastal restoration and protection activities, the attributable economic benefits in jobs, spending, and value will continue to increase.[14,15,16]

CONTINUOUS EVOLUTION

THE ONGOING EVOLUTION OF THE MASTER PLAN PROCESS

The master plan is Louisiana's comprehensive framework for implementing large-scale restoration and risk reduction projects that provide benefits to the coast wide landscape. The plan focuses largely on key issues over which the State of Louisiana has authority and jurisdiction; however, we realize that bolder actions are needed to improve the sustainability and resilience of our coast. The 2017 Coastal Master Plan builds on what has come before and sets a path for the future. Through the collaborative partnerships and adaptive management processes described in this plan, we will continue to advance our understanding, tools, and strategies.

THE IMPORTANCE OF MANAGING THE MISSISSIPPI RIVER

We believe a healthy deltaic system supports all river uses and the river should be managed for ecosystem restoration, navigation, and flood risk reduction holistically. Also, we need a management plan that does not simply identify points of conflict as they arise, but anticipates them, and proactively seeks to implement mutually beneficial solutions. A holistic management plan for the Mississippi River that equally considers all river uses is only possible with the collaboration of all relevant stakeholder groups and local, state, and federal government agencies.

Restoration, navigation, and flood control along the Lower Mississippi are all concerned with the timing and amount of water and sediment delivered from upstream. In a watershed as vast as the Mississippi's, changes in relatively small areas can induce significant changes downstream. These changes can be man-made, such as dam construction on the Missouri River system, or natural, as climate variation can change the distribution and magnitude of precipitation across the sub-basins of the Mississippi watershed. Both will cause variability in the total amount of water and sediment delivered to the Lower Mississippi, as well as the timing and duration of flood events. The success of any type of project along the lower Mississippi River is directly tied to understanding the dynamics of the entire Mississippi River drainage basin.

The future without action conditions illustrated in this master plan present important questions about the future of some key activities on the coast. The long-term viability of the river as a navigation channel has been in active discussion and many are thinking about how the river can be used to meet multiple purposes. As described in Chapter 5, CPRA and various public, private, and academic institutions have interest in developing ways to maximize restoration of a functioning deltaic system (land building and natural habitats) in areas adjacent to the Mississippi River while continuing to meet the needs of navigation, flood risk reduction, and coastal industries and communities.

Our models, as well as advanced planning and engineering and design of sediment diversions, have taught us a lot about how we can operate sediment diversions in a way that they can build and sustain land without producing excessive flooding and optimize the delivery of sediment to the wetland basins. Some of this learning was incorporated into projects included in the master plan (e.g., incorporating a base flow into the operating regimes of the Mid-Barataria and Mid-Breton sediment diversions). Some of the larger diversion projects included in the 2012 plan needed additional analysis that could not be conducted in time for inclusion in the draft plan. As we design the Mid-Barataria and Mid-Breton diversions included in the master plan, we will learn more about how to effectively utilize river water and sediment to rejuvenate our estuarine basins and build and sustain land. What we learn will be considered in the 2022 Coastal Master Plan. CPRA remains committed to sediment diversions and to exploring how to maximize use of the riverine freshwater and sediment resources to produce a functioning deltaic system that also supports navigation and resilient coastal communities.

IDENTIFYING INNOVATIVE PROJECT CONCEPTS AND A BIGGER BOLDER EFFORT TO SAVE OUR COAST

The restoration and risk reduction projects evaluated for the master plan are either those that have been proposed through existing plans and programs such as CWPPRA or those that were submitted directly to CPRA as part of the 2017 Coastal Master Plan project development process. We realize that there are potentially other innovative project concepts that have not yet been considered and understand that identifying these concepts is an important next step in the process. To date, the way we think about projects and solutions has been contingent upon our understanding of past and present conditions. Each new study on global sea level rise projections seems to report a more dire future than the previous study. We acknowledge we need to adapt the ways we frame our thinking on projects and their attributes to address what are anticipated to be drastically changing future conditions. We will continue to identify innovative project concepts that have not yet been considered. In analyzing past trends of land loss, subsidence, and sea level rise and looking at future predictions, we must look at bigger and bolder projects to effect meaningful change on our coast. We must use all available tools to improve the sustainability of our coast while maximizing the use of our major river sediment resources.

PLANNING AHEAD FOR CHANGING RISK

CPRA's Flood Risk and Resilience Program developed a risk reduction strategy that coordinates state resources and prioritizes areas of high risk, while parishes will play a lead role in implementing projects and selecting specific structures to be mitigated. The program is intended to take advantage of nonstructural project funding outside federal grant programs in order to maximize flexibility and speed the implementation of shovel-ready projects that further comprehensive coastal risk reduction goals. The program considers future estimates of sea level rise and increases in flood depths in its design of nonstructural projects. Nonstructural projects recommended for the initial implementation period (years 1-30) are designed to mitigate the impacts of flood depths occurring 10 years into the future, while nonstructural projects selected in the last implementation period (years 31-50) are designed to mitigate the impacts of flood depths occurring 25 years into the future. Thus, nonstructural projects are designed to consider future flood depths and environmental conditions so that our communities are planning ahead and mitigating their homes to the highest standards.

In some cases, communities may want to consider retreating from flood prone areas and analysis from the master plan can greatly assist those communities in planning for near-term and long-term decisions on how best to adapt. Planning for, finding funding solutions, and execution of efforts like community scale relocation will require collaboration and close coordination between community members, state and local agencies, funding entities, and other stakeholders. It must be driven from the community-level up and be supported with data, financing, and management. CPRA is committed to working with communities, other state agencies and foundations to understand their needs and to identify appropriate adaptive solutions to meet those needs.

THE 2022 COASTAL MASTER PLAN

This document is the 5-year update of the Coastal Master Plan. It is a living document and we recognize that the science upon which it is based is continually evolving. Furthermore, the landscapes, populations, and industries whose futures we seek to preserve are also continually evolving. Our efforts do not end with approval of this document by the Louisiana Legislature. In fact, our efforts will continue in earnest – this is a plan of action. We work with urgency to implement master plan projects and programs, but we will continue to engage and listen to our communities so that their challenges and concerns are better understood and proposed solutions are developed to specifically address those concerns. It is how we ensure each master plan evolves to meet the changing needs of our coast.

ACKNOWLEDGEMENTS

We would like to offer our thanks to the participants of the 2017 Coastal Master Plan Framework Development Team; the Communities, Fisheries, Landowner, Energy and Industry, and Navigation Focus Groups; the Science and Engineering Board; the Predictive Models and Resiliency Technical Advisory Committees; and the Predictive Modeling Team who shared their expertise and perspectives on Louisiana's coastal protection and restoration issues.

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TABLES, FIGURES, & CITATIONS

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