Louisiana Coastal Protection and Restoration Authority Coastal Master Plan

The Louisiana 2012 Coastal Master Plan applies a variety of models to analyze the effects of restoration and structural and non-structural risk reduction projects on land building, flood risk, and coastal habitat. The information from the models is incorporated into a planning tool to evaluate the effects of various groups of projects on the coastal system. Through this science-based decision-making process, the 2012 Coastal Master Plan identified 109 restoration and protection projects and a coastwide non-structural risk reduction program as the best use of the estimated $50 billion to be invested over the next 50 years to reverse the loss of coastal land and support the resilience of the coastal system in Louisiana.

OVERVIEW

Lead developer(s): Louisiana Coastal Protection and Restoration Authority (CPRA).[1]

Year developed: 2012.[1]

Geographic area: Louisiana coastal areas (Fig. 1).[1]

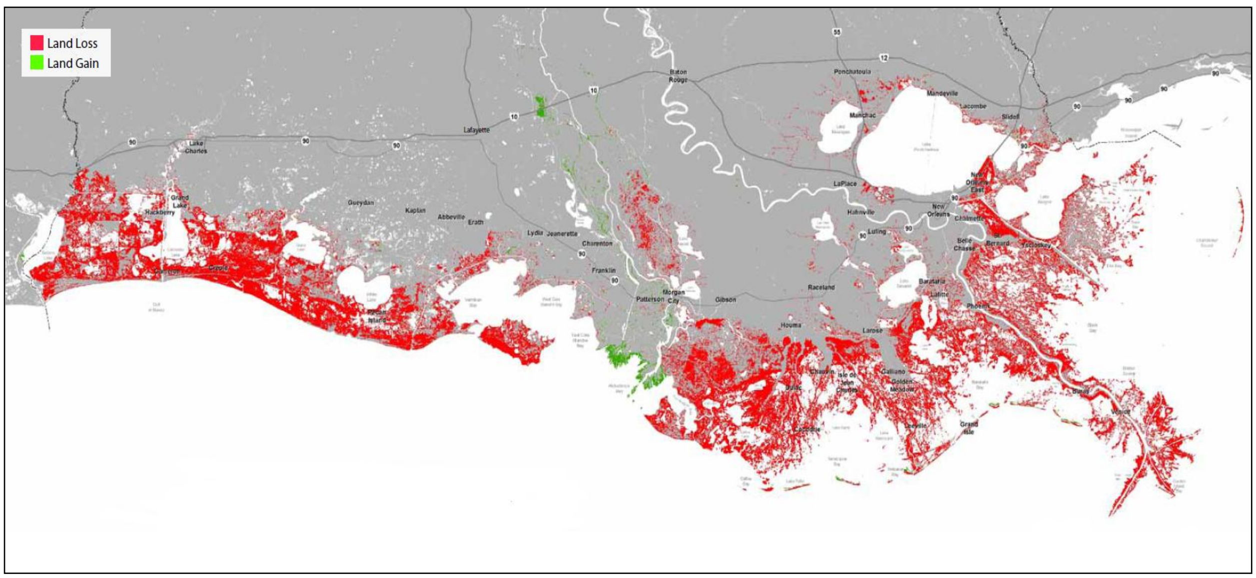

Figure 1. The Louisiana 2012 Coastal Master Plan identifies priorities along the Louisiana coastline, where an additional 1,750 square miles of land is predicted to be lost over the next 50 years if no action is taken (shaded above). Used with permission from Louisiana Coastal Protection and Restoration Authority.

Resource types: Wetlands.[1]

Restoration/conservation: Restoration (reestablishment) and protection.[1]

Stakeholders: The plan will benefit all Louisiana citizens and the national economy.

The plan was developed with the input of a Framework Development Team representing a wide-array of stakeholder interests. In addition, key user groups were heavily engaged through the Navigation Focus Group, Oil and Gas Focus Group, or Fisheries Focus Group.[2]

Current status: The 2012 Coastal Master Plan is currently being debated by the Louisiana Legislature, with action due prior to June 1, 2012. The Louisiana Legislature requires the master plan to be updated every 5 years. The state will be maintaining and improving the models used to develop the plan for future use. An Adaptive Management Framework is also being developed.[2]

PRIORITIZATION ANALYSIS

Determination of prioritization objectives: The Master Plan identified two primary objectives that coastal projects should address:[1]

- Flood risk reduction
- Land building

Landscape prioritization tool(s):

Before applying any landscape prioritization tools, CPRA began by assembling an initial list of over 1500 potential coastal projects that had yet to be funded for construction based on existing studies, reports, presentations, and plans. From this list, CPRA derived a smaller list of 397 candidate projects for detailed site-specific analysis by applying the following screening criteria:[1]

- No duplicate projects.
- All projects are generally at least 500 acres in size.
- All projects are described in enough detail to be evaluated by the model (below).

Of these 397 projects, 248 were restoration projects that were grouped into the following categories:[1]

- Bank stabilization
- Barrier island/headland restoration
- Hydrologic restoration
- Marsh creation
- Oyster barrier reef establishment
- Ridge creation
- Sediment diversion
- Channel realignment
- Shoreline protection

CPRA also identified 33 structural risk reduction projects that included:[1]

- Earthen levees
- Concrete walls
- Floodgates
- Pumps

Furthermore, CPRA identified 116 non-structural projects that could be implemented to reduce storm-related flood risk by modifying residential or commercial structures. These included:[1]

- Elevating residential structures
- Floodproofing structures
- Voluntary acquisition of structures where other measures were not feasible.

CPRA then ran a series of predictive models to assess how each project, if implemented, would affect the coastal system and the level of risk from flooding. These predictive models included the following:[1]

- Eco-hydrology model: Predicts how projects change water characteristics in estuaries such as water levels, salinity patterns, sediment delivery, and water quality.
- Wetland morphology model: Predicts how projects change total wetland area by accounting for loss of existing wetlands and the creation of new wetlands.
- Barrier shoreline model: Predicts how projects affect the shape, location, and elevation of barrier islands and the size of tidal inlets by accounting for land gains resulting from restoration and land loss due to wave erosion, sea level rise, and subsidence.
- Vegetation model: Predicts the effects of projects on coastal vegetation, including submerged aquatic vegetation.
- Ecosystem services models: Predicts the effects of projects for the provision of habitat for commercially and recreationally important species along the coast, as well as key ecosystem services, such as nitrogen uptake or freshwater availability.
- Storm surge/waves model: Predicts how projects affect storm surge height and wave depth across a range of sizes and intensities.
- Risk assessment model: Predicts consequences of projects in terms of asset damage resulting from storm surge flooding and waves.

Drawing from these predictive models and the outputs from the risk analysis, the following landscape prioritization tools were used to inform the selection of project sites:

American Alligator Habitat Suitability Index (HSI): This tool calculates HSI values for each $500m^2$ area. HSI values represent the effects of habitat type, water depth, water salinity, and marsh edge effect on the habitat quality of American Alligator. Based on observational data and a literature review, the model ranks areas highest that contained 60-80% emergent vegetation land cover (which provides ideal nesting area), large amounts of edge habitat (where prey are more plentiful), and low salinity (the American Alligator is a freshwater species). Factors and data sources representing these variables are provided in Table 1.[3]

Prioritization objectives assessed:

- Habitat quality

Table 1. CPRA calculated its American Alligator HSI based on the factors and data sources listed below.[3]

Factor used in analysis	**Data source(s)**
Depth relative to marsh surface	Eco-hydrology model; Wetland morphology model
Water salinity	Eco-hydrology model
Percentage land	Wetland morphology model
Marsh edge	Wetland morphology model
Habitat type	Vegetation model

Crawfish (wild caught) HSI: This tool calculates HSI values representing the effects of salinity, water temperature, water depth, vegetative habitat type, and seasonal water level fluctuations on the crawfish habitat quality for each $500m^2$ area. Based on a literature review, the model ranked areas highest that had lower salinity (crawfish are freshwater organisms), water temperatures that range from 20-26°C, water depths of 1.0-2.0m (shallower waters expose crawfish to heat and wading bird predation; deeper water to hypoxic conditions and fish predation), swamp or marsh vegetative classes, and large seasonal changes in water depth of more than three meters. Factors and data sources representing these variables are provided in Table 2.[4]

Prioritization objectives assessed:

- Habitat quality

Table 2. CPRA calculated its crawfish HSI based on the factors and data sources listed below.[4]

Factor used in analysis	**Data source(s)**
Water temperature	Eco-hydrology model
Water salinity	
Water depth	
Water level fluctuation	
Habitat classification data	Vegetation model

Eastern oyster HSI: This tool calculates HSI values representing the effects of three salinity-based variables and substrate on eastern oyster habitat quality for each 500m^2 area. Based on a literature review, the model ranked areas highest that had 50% or more hard substrate coverage (supporting a large percentage coverage of clutch), higher mean salinity during the spawning season (reflecting the higher optimal salinities for spawning compared to the salinity requirements of adults), higher minimum salinity (lower impact of freshwater diversions), mean salinity ranging from 10-15 ppt, and lower percentage of land. Factors and data sources representing these variables are provided in Table 3.[5]

Prioritization objectives assessed:

- Habitat quality

Table 3. CPRA calculated its eastern oyster HSI based on the factors and data sources listed below.[5]

<table>
<tr><th colspan="2">Factor used in analysis</th><th>Data source(s)</th></tr>
<tr><td colspan="2">Mean salinity during spawning season</td><td rowspan="3">Eco-hydrology model</td></tr>
<tr><td colspan="2">Annual mean salinity</td></tr>
<tr><td colspan="2">Minimum annual salinity</td></tr>
<tr><td rowspan="3">Percentage clutch</td><td>Reefs on public grounds</td><td>LDWF side scan surveys</td></tr>
<tr><td>Oyster leases</td><td>LDWF GIS data</td></tr>
<tr><td>Public grounds off of a mapped reef</td><td>LDWF side scan surveys</td></tr>
<tr><td colspan="2">Percentage land</td><td>N/A</td></tr>
</table>

LDWF = Louisiana Department of Wildlife and Fisheries

Largemouth bass HSI: This tool calculates HSI values representing the effects of various biotic and abiotic factors on largemouth bass habitat quality for each 500m^2 area. Based on a literature review, the model ranked areas highest that had coverage of emergent vegetation ranging from 30-50% (which afford suitable cover from predators and foraging opportunities without being too dense for swimming), average water temperatures ranging from 18-30 °C, salinity less than 8 ppt (largemouth bass evolved in a freshwater environment), low percentage coverage by submerged aquatic vegetation, and high primary productivity (concentration of chlorophyll *a*). Factors and data sources representing these variables are provided in Table 4.[6]

Prioritization objectives assessed:

- Habitat quality

Table 4. CPRA calculated its largemouth bass HSI based on the factors and data sources listed below.[6]

Factor used in analysis	Data source(s)
Average water temperature for April to August	Eco-hydrology model
Maximum yearly salinity for June to August	
Index value of primary productivity in open waters	
Percentage emergent vegetation per 500 m^2	Vegetation model
Percentage of cell that is Submerged Aquatic Vegetation (SAV) per 1 km^2	

Spotted sea trout HSI: This tool calculates HSI values representing the effects of food/cover and water quality environmental factors on spotted sea trout habitat quality for each 500m^2 area. Based on a literature review, the model ranked areas highest that had 25-80% marsh vegetation, a highest monthly mean summer salinity ranging from 10-25 ppt, a lowest monthly mean winter water temperature ranging from 20-30°C, and a highest monthly mean water temperature ranging from 20-30°C. Factors and data sources representing these variables are provided in Table 5.[7]

Prioritization objectives assessed:

- Habitat quality

Table 5. CPRA calculated its spotted sea trout HSI based on the factors and data sources listed below.[7]

Factor used in analysis	Data source(s)
Highest monthly mean summer salinity (ppt)	Eco-hydrology model
Lowest monthly mean winter water temperature (°C)	
Highest monthly mean summer water temperature (°C)	
Percentage area containing marsh vegetation	Vegetation model

Muskrat HSI: This tool calculates HSI values representing the effects of the ratio of land to water, water depth, and habitat type on muskrat habitat quality for each 500m^2 area. Based on a literature review, the model ranked areas highest that contained over 50% land (muskrats prefer marsh located farthest from ponds), water depth averaging 15cm below the marsh surface, and brackish marsh habitat type (with decreasing quality for intermediate marsh, fresh marsh, and swamp). Factors and data sources representing these variables are provided in Table 6.[8]

Prioritization objectives assessed:

- Habitat quality

Table 6. CPRA assessed muskrat habitat quality based on the factors and data sources listed below.[8]

Factor used in analysis	Data source(s)
Water depth relative to marsh surface	Eco-hydrology model; Wetland morphology model
Percentage land	Wetland morphology model
Habitat type	Vegetation model

River otter HSI: This tool calculates HSI values representing the effects of the ratio of land to water and water depth on river otter habitat quality for each $500m^2$ area. Based on existing data, the model ranked areas highest that contained 40-60% land, a water depth averaging 15cm below the marsh surface, brackish marsh habitat type (with swamp, fresh marsh, and intermediate marsh also ranked highly in the model), and a large amount of edge habitat. Factors and data sources representing these variables are provided in Table 7.[9]

Prioritization objectives assessed:

- Habitat quality

Table 7. CPRA assessed river otter habitat quality based on the factors and data sources listed below.[9]

<table>
<tr><th>Factor used in analysis</th><th>Data source(s)</th></tr>
<tr><td>Water depth relative to marsh surface</td><td>Eco-hydrology model; Wetland morphology model</td></tr>
<tr><td>Percentage land</td><td rowspan="2">Wetland morphology model</td></tr>
<tr><td>Marsh edge</td></tr>
<tr><td>Habitat type</td><td>Vegetation model</td></tr>
</table>

Roseate spoonbill (nesting) HSI: This tool calculates HSI values representing roseate spoonbill nesting habitat suitability for each $500m^2$ area. Based on existing data and literature, the model ranked areas highest that contained an island land mass less than 100 ha in size and surrounded completely by water, large percentage coverage of preferred habitat types, large percentage coverage of woody vegetation, and high availability of foraging habitat near nesting sites. Factors and data sources representing these variables are provided in Table 8.[10]

Prioritization objectives assessed:

- Roseate spoonbill

Table 8. CPRA assessed roseate spoonbill nesting habitat suitability based on the factors and data below.[10]

<table>
<tr><th colspan="2">Factor used in analysis</th><th>Data source(s)</th></tr>
<tr><td colspan="2">Proportion of cell that is near small, near-shore undeveloped island surrounded completely by water</td><td>GIS Shapefiles</td></tr>
<tr><td rowspan="2">Vegetation type</td><td>Proportion of cell that is swamp</td><td rowspan="2">Vegetation model</td></tr>
<tr><td>Proportion of cell that is represented by Delta Splay + Wax Myrtle + Cutgrass +</td></tr>
</table>

	Maidencane + Cattail + Sawgrass + Bulltongue	
	Proportion of cell that is intermediate, brackish, or saline habitat	
Presence of woody vegetation (percentage swamp forest + wax myrtle + mangrove + shrub scrub)		Vegetation model
Sum of available foraging habitat (where daily water depth is between 1 and 12 cm between February and July) from all cells in the 10-km radius of a nesting habitat cell divided by the total number of cells in the radius.		Eco-hydrology model; Wetland morphology model

<u>Roseate spoonbill (foraging) HSI:</u> This tool calculated HSI values representing roseate spoonbill foraging habitat suitability for each $500m^2$ area. Based on existing data and literature, the model ranked areas highest that contained a large coverage by water at depths optimal for foraging for a large proportion of days in the year and a large coverage by edge habitat. Factors and data sources representing these variables are provided in Table 9.[10]

Prioritization objectives assessed:

- Habitat quality

Table 9. CPRA assessed roseate spoonbill foraging habitat quality based on the factors and data below.[10]

Factor used in analysis	Data source(s)
Proportion of days water depth is 1-12 cm	Eco-hydrology model; Wetland morphology model
Portion of cell that is edge habitat (the area of water projecting 10m from the land/water interface)	Wetland morphology model

<u>Brown shrimp HSI:</u> This tool calculated HSI values representing brown shrimp habitat suitability based on water quality and food/cover characteristics for each $500m^2$ area. Drawing from existing data and literature, the model ranked areas highest that contained 25-80% coverage by marsh vegetation, a mean salinity for spring ranging from 10-20 ppt, and a mean water temperature for spring ranging from 20-30°C. Factors and data sources representing these variables are provided in Table 10.[11]

Prioritization objectives assessed:

- Habitat quality

Table 10. CPRA assessed brown shrimp habitat quality based on the factors and data sources listed below.[11]

Factor used in analysis	Data source(s)
Mean salinity for spring (February-May) (ppt)	Eco-hydrology model

Mean water temperature for spring (February-May) (°C)	
Percentage coverage by marsh vegetation	Vegetation model

White shrimp HSI: This tool calculated HSI values representing white shrimp habitat suitability based on water quality and food/cover characteristics for each 500m^2 area. Drawing from existing data and literature, the model ranked areas highest that contained 25-80% coverage by marsh vegetation, a mean salinity for summer ranging from 5-15 ppt, and a mean temperature for summer ranging from 20-30°C. Factors and data sources representing these variables are provided in Table 11.[12]

Prioritization objectives assessed:

- Habitat quality

Table 11. CPRA assessed white shrimp habitat quality based on the factors and data sources listed below.[12]

Factor used in analysis	Data source(s)
Mean salinity for summer (June-October) (ppt)	Eco-hydrology model
Mean water temperature for summer (June-October) (°C)	
Percentage marsh area	Vegetation model

Mottled duck (foraging) HSI: This tool calculated HSI values representing mottled duck foraging habitat suitability for each 500m^2 area. Drawing from existing data and literature, the model ranked areas highest that contained a large proportion of preferred habitat types (with fresh marsh being most preferred) and a large proportion of days per year that water depth was optimal for foraging. Factors and data sources representing these variables are provided in Table 12.[13]

Prioritization objectives assessed:

- Habitat quality

Table 12. CPRA assessed mottled duck foraging habitat quality based on the factors and data listed below.[13]

Factor used in analysis	Data source(s)
Proportion of cell occupied by mottled duck habitat	Wetland morphology model
Proportion of days per year that water depth is optimal for foraging (6-34cm)	Eco-hydrology model; Wetland morphology model

Green-wing teal HSI: This tool calculated HSI values representing green-wing teal habitat suitability for each 500m^2 area. Drawing from existing data and literature, the model ranked areas highest that contained a high proportion of preferred habitat types (with fresh marsh, brackish marsh, and intermediate marsh among those weighted highest) and a high proportion of days (September-March) with a water depth highly suitable for foraging (8-18cm). Factors and data sources representing these variables are provided in Table 13.[14]

Prioritization objectives assessed:

- Habitat quality

Table 13. CPRA assessed green wing teal habitat quality based on the factors and data sources listed below.[14]

Factor used in analysis	Data source(s)
Proportion of cell occupied by green-winged teal habitat	Wetland morphology model
Proportion of days September-March that the water depth (cm) provided suitable foraging habitat	Eco-hydrology model; Wetland morphology model

Gadwall HSI: This tool calculated HSI values representing gadwall habitat suitability for each $500m^2$ area. Drawing from existing data and literature, the model ranked areas highest that contained a high proportion of preferred habitat types (with intermediate and fresh marsh among those weighted highest), a high proportion (70-100%) coverage by water with Submerged Aquatic Vegetation (SAV), and a high proportion of days (September-March) with a water depth highly suitable for foraging (18-32cm). Factors and data sources representing these variables are provided in Table 14.[15]

Prioritization objectives assessed:

- Habitat quality

Table 14. CPRA assessed gadwall habitat quality based on the factors and data sources listed below.[15]

Factor used in analysis	Data source(s)
Proportion of cell occupied by gadwall habitat	Wetland morphology model
Percentage of cell that is water with SAV	Vegetation model
Proportion of days September-March that the water depth (cm) provided suitable foraging habitat	Eco-hydrology model; Wetland morphology model

Potential for freshwater availability: The freshwater suitability index estimates the effect of wetland restoration projects on the availability of freshwater for municipal and industrial use by urban areas and other facilities. The model assessed the potential for freshwater availability for each $500m^2$ cell by simulating the effects of salinity, distance from strategic assets, and distance from major population centers on the availability of freshwater. Factors and data sources representing these variables are provided in Table 15.[16]

Prioritization objectives assessed:

- Groundwater supply

Table 15. CPRA assessed potential for freshwater availability based on the factors and data listed below.[16]

Factor(s)	Data source(s)
Salinity (ppt)	Eco-hydrology model
Distance from strategic asset (m)	Calculated using GIS shapefiles
Distance from major population center (mi)	Calculated using GIS shapefiles

Storm surge/wave attenuation potential suitability index: This tool ranked each $500m^2$ cell in terms of a project's effect on the attenuation of storm surge/waves that would otherwise impact populated areas. The model ranked areas highest that contained areas near zones designated for a 100 or 500 year level risk reduction, a low percentage coverage by water, a high coverage by vegetation types that increase friction with waves (e.g., dense woods and brush), and high water depth/land height. Factors and data sources representing these variables are provided in Table 16.[17]

Prioritization objectives assessed:

- Flood mitigation

Table 16. CPRA assessed storm surge/wave attenuation based on the factors and data sources listed below.[17]

Factor used in analysis	Data source(s)
Distance from an area designated for 100- or 500-year level protection (km)	N/A
Percentage water	Wetland morphology model
Water depth/land height	
Vegetation type rated based on ability to increase friction with incoming waves	Vegetation model

<u>Nature Based Tourism Suitability Index:</u> This tool measured the potential for wetland projects to support nature-based tourism based on their ability to provide suitable and accessible habitat. It did so by scoring 500m^2 cells, assigning high index scores to cells containing areas close to major population centers, located short distances from points of interest, containing land cover types of high value to nature-based tourism (e.g., those classified as containing wax myrtle, cut-grass, etc.), located short distances to beaches, containing a high barrier island percentage land (an indicator of beach size), accessible by road (as opposed to boat only), and having a high habitat suitability index for a variety of aquatic species. Factors and data sources representing these variables are provided in Table 17.[18]

Prioritization objectives assessed:

- Social values

Table 17. CPRA assessed nature-based tourism based on the factors and data sources listed below.[18]

Factor using in analysis	Data source(s)
Distance from major population centers (mi)	GIS shapefiles
Distance from points of interest (mi)	
Distance to beaches (mi)	
Accessibility of nearby beaches (1=road access; 0.5=boat only)	
Barrier island percentage land	Output data from other 2012 Coastal Master Plan models
Quantity and quality of alligator, river otter, muskrat, roseate spoonbill, gadwall, green-winged teal, mottled duck, and neotropical migrant habitat	

<u>Nitrogen Uptake Spatial Statistical Approach:</u> This method estimates nitrogen removal due to denitrification resulting from wetland protection or restoration projects in two steps. In the first,

nitrogen removal was estimated for vegetation using the saline, brackish, intermediate, and freshwater habitat categories defined in the vegetation model. In the second step, benthic rates of denitrification were calculated by adjusting denitrification rates identified in the first step by salinity and temperature for each project site. Factors and data sources representing input variables for the model are listed in Table 18.[19]

Prioritization objectives assessed:

- Water quality

Table 18. CPRA assessed storm surge/wave attenuation based on the factors and data sources listed below.[19]

Factor used in analysis	**Data source(s)**
Denitrification rates for vegetation and open water habitats	Estimates of denitrification rates for several wetland vegetation habitats throughout coastal Louisiana (Rivera-Monroy, 2010)
Salinity	Eco-hydrology model
Temperature	

Soil Organic Carbon Storage Tool: The Wetland Morphology model estimated soil organic carbon storage for the upper meter of soils for potential restoration projects. The model ranked areas highest for carbon sequestration potential that had high soil bulk density, high organic matter content, and a high percentage of land. Factors and data sources representing input variables for the model are listed in Table 19.[20]

Prioritization objectives assessed:

- Carbon storage

Table 19. CPRA assessed carbon storage potential based on the factors and data sources listed below.[20]

Factor used in analysis	**Data source(s)**
Soil bulk density	Wetland morphology model
Organic matter	
Percentage land	

Relative Elevation Sub-Model: As part of its Wetland Morphology Model, CPRA measured the effect of aquatic resource restoration and conservation (among other flood mitigation measures) on land building using its relative elevation sub-model. This model redistributed the simulated sediment supply value from the Eco-Hydrology Model across the landscape by multiplying total sediment in each area by a sedimentation redistribution weighting surface. Vertical accretion within each $30m^2$ cell is calculated and the updated surface elevation compared to mean water level to calculate land building. Factors and data sources representing input variables for the model are listed in Table 20.[20]

Prioritization objectives assessed:

- Flood mitigation

Table 20. LACPRA applied its relative elevation sub-model to calculate the rise in land elevation resulting from aquatic resource restoration/conservation based on the following factors and data sources.[20]

Factor used in analysis	**Data source(s)**

Rate of vertical accumulation of sediment (cm/yr)	Eco-Hydrology Model
Mineral sediment accumulation rates (g/m^2/yr)	
Organic matter accumulation rates (g/m^2/yr)	
Soil bulk density (g/cm^2)	

Coastal Louisiana Risk Assessment (CLARA): CPRA used its CLARA model to estimate flood depths and damage for each of the approximately 35,500 census blocks that make up coastal Louisiana. CPRA calculated flood elevations for protected areas within each of its "basic hydrologic units," which it used to estimate flood depths within each census block. Flood depths for unprotected or semi-protected areas were then calculated based on surge and wave input values for each census block. CPRA calculated the total economic damage and risk within each census block due to flooding based on storms of category 3 or higher. Various scenario analyses were used to address uncertainty in the model and capture a wide range of possible outcomes. Factors and data sources representing input variables for the model are listed in Table 21.[21]

Prioritization objectives assessed:

- Flood mitigation

Table 21. CPRA assessed flood risk reduction based on the factors and data sources listed below.[21]

Factor used in analysis		**Data source(s)**
Flood depth module		
Surge hydrographs		Arcadis; Storm Surge/Wave Model
Wave period		Arcadis; Storm Surge/Wave Model
Significant wave height		Arcadis; Storm Surge/Wave Model
DEM of Louisiana		U.S. Geological Survey (USGS); Wetland Morphology Model
Wave free crest height		Arcadis; Storm Surge/Wave Model
Foreshore armor of protection structures		State of Louisiana/USACE
Presence of floodwall		State of Louisiana/USACE
Floodwall geometry		State of Louisiana/USACE
Length of protection structure's foreshore		State of Louisiana/USACE
Geotechnical data regarding protection system		State of Louisiana/USACE
Pumping rates for each BHU		Sewerage and Water Board of New Orleans
Rainfall		Arcadis; Storm Surge/Wave Model
Economic module		
Inventory	Number of structures	GNOCDC, ACS, LACPR, Hazus MH MR4
	Number of structures	LACPRA, Hazus, U.S. census
	Acreage of agricultural crops	LACPRA, NASS, LSU AgCenter
	Number of vehicles	LACPRA (adjusted by ACS)
	Inventory of roads and bridges	LACPRA
	Square footage	LACPRA, Hazus
Valuation	Structural characteristics for each asset class	Hazus
	Replacement cost per square foot	Hazus

	Proportion of structures by construction class (economy, average, custom, luxury)	Hazus
	CSVR	LACPRA
	Value of inventory per square foot	Hazus
	Repair costs per mile	LACPRA, Hazus
	Agriculture valuations	LACPR
	Proportion of structures by construction method (e.g., wood frame, masonry)	Hazus
	Flood elevations	Calculated by model
Damage	Structural elevation above grade	LACPRA, Road Home, HMGP
	Depth-restoration time curve	Hazus
	Depth-damage curves for structure	Hazus
	Depth-damage curves for contents	Hazus
	Depth-damage curves for inventory	Hazus
	Costs dependent on displacement time: lost income, lost wages, lost sales, disruption costs, relocation rental costs	LACPRA, Hazus
	Costs dependent on displacement time: evacuation and subsistence costs	LACPRA
	Post-flood response costs: landscaping repair, debris removal, other cleanup	LACPRA

Input data QA/QC: Workgroup leaders assigned to each predictive model (listed above) were responsible for conducting a quality review of all input datasets as well as all outputs generated by the model. In addition, external reviewers provided feedback on model logic and calculations for several models and a Predicative Model Technical Advisory Committee provided guidance on model assumptions, inputs, and other technical details.[1]

Validation of the landscape prioritization tool(s): Once the Master Plan is complete, Louisiana plans to improve and validate each predictive model using the U.S. Army Corps of Engineers Planning Model Certification procedure.[1]

Refinement of landscape priorities: In order to facilitate analysis of the outputs of the landscape prioritization tools described above, CPRA developed a computer-based Planning Tool. This tool allowed the state to systematically consider many variables for individual projects or groupings of projects, such as project costs, funding, landscape conditions, and stakeholder preferences. The Planning Tool allowed the team to analyze the effectiveness of hundreds of different groupings of projects and identify which groupings worked best together to achieve the state's goals.[1]

The team used the Planning Tool to carry out the following analyses and identify projects most suitable for incorporation into the Master Plan:[1]

1. The team assembled projects into two groups, those that maximized risk reduction and those that maximized land building. All subsequent decision criteria were considered alongside these two primary decision drivers.
2. The team then used the Planning Tool to assess how different allocations of funding between risk reduction (e.g., elevating housing) and restoration projects affected results. Based on these results it identified a 50/50 funding split as best balancing risk reduction and restoration benefits.
3. Next, the team assessed how funding should be allocated between restoration projects that deliver near-term versus long-term results in terms of land building. Using the Planning Tool, they selected a 50/50 split between projects that provided immediate land building results (important given the severity of Louisiana's land loss crisis) and those that reversed land loss and provided longer-term benefits.
4. In addition, the team used the Planning Tool to assess how different projects would perform under different projected future conditions. For example, the team evaluated how projects that performed well under moderate future conditions performed under poor future conditions. They found that projects built closer to existing land were more resilient to worsening future conditions than those built closer to the gulf.
5. The team also used the Planning Tool to identify other decision criteria that would not substantially affect the plan's ability to achieve its primary decision drivers of risk reduction and land building. These included: distribution of risk across socioeconomic groups, flood protection of historic properties, flood protection of strategic assets, operation and maintenance costs, use of natural processes, support of navigation, sustainability, support for cultural heritage, and support for oil and gas.
6. The team assessed ecosystem services (e.g., habitat suitability indices and other variables) to ensure that groups of projects considered did not have significant impacts on coastal ecosystem services.
7. The team evaluated the ability of sediment diversion projects to both maximize land building and reduce impacts to saltwater-dependent resources. Using the Planning Tool, the team found that sediment diversion projects were necessary for sustainable restoration of the coast.
8. The team used the Planning Tool to identify channel realignment strategies that were most effective for achieving land building goals, however further study was needed before this large-scale project could be implemented.

Based on the results of these analyses, which incorporated the results of the landscape prioritization tools described above, the team selected 109 restoration and structural protection projects and a coastwide non-structural program for the Coastal Master Plan. Of these, certain project types, such as levees and large-scale diversions, were found to be essential to the future of the coast. The team also found, however, that a variety of project types was necessary in certain targeted locations.[1]

Prioritization products: The Master Plan provides maps (e.g., Fig. 2) and tables detailing 109 specific projects that should be implemented to support the resiliency of the coastal system. The projects are presented by region (southwest coast, central coast, and southeast coast) and implementation period, with some projects planned for 2012-2031 and others planned for 2032-2061. For each project, the plan provides “fact sheets” in an appendix that incorporate modeling results to provide details for each selected project, as well as every project evaluated. These include projected cost estimates (planning/engineering and design, construction costs, operations and maintenance), projected land area gain/loss in the near-term and long-term, and a “scale of influence” (local, sub-basin, basin, regional).[1]

Fact sheets, in addition to other technical information for the Master Plan (e.g., details for each predictive model) are available from: http://www.coastalmasterplan.louisiana.gov/2012-master-plan/master-plan-appendices/.

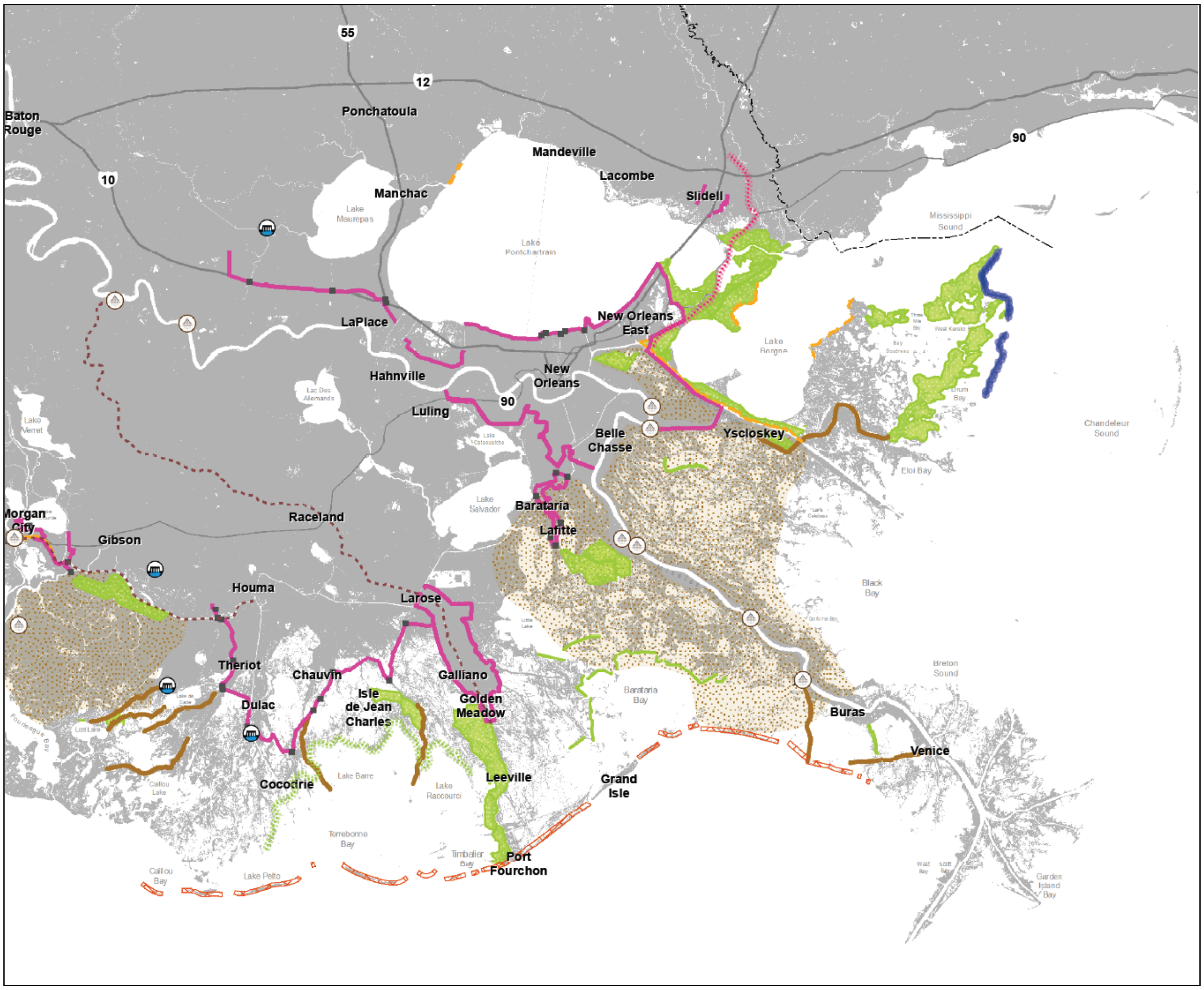

Figure 2. In this map of Louisiana's southeast coast, the team identified important projects to undertake to minimize risk and maximize land building. These include structural protection projects such as levees (shaded purple) as well as restoration projects such as marsh restorations (shaded green), ridges (shaded brown), barrier islands (shaded orange), and influence areas for diversions (dotted brown shading). Used with permission from Louisiana Coastal Protection and Restoration Authority.

IMPLEMENTATION

Regulatory/non-regulatory programs:

- Section 404 and state wetland mitigation programs: Priority sites identified in the Master Plan will inform selection of mitigation sites that contribute to the sustainability of coastal wetlands and communities. CPRA suggests that incentives be put in place for the mitigation banking community to locate banks in areas identified as priorities by the Master Plan, such as additional habitat credits or reduced obligation for bank maintenance. CPRA also suggests implementation of a robust in-lieu fee program as part of Louisiana's Mitigation Program and an effort to ensure that restoration projects highlighted by the Master Plan will receive mitigation credits.[22]

- State programs: Per Executive Order BJ 2008-7, *all state agencies shall administer their regulatory practices, programs, contracts, grants and all other functions vested in them in a manner consistent with the Master Plan and public interest to the maximum extent possible*.[23]
- Coastal zone use permitting: Any permit for activities in the coastal zone must be approved by Coastal Management. The Exective Order BJ 2008-7 requires that all permitted activities are consistent with the Master Plan.[22]
- The Atchafalaya Basin Program, which provides guidance on how the ecological health of the Atchafalaya can be maintained, benefits from the prioritization of wetland restoration and protection projects in the Coastal Master Plan.[1]
- The 2012 Coastal Master Plan will guide the Corps' development of its 7002 Comprehensive Plan. Both plans will be used together to guide federal investments in wetland restoration and protection.[1]
- Gulf Hypoxia Action Plan: By prioritizing sites to divert sediment from the Mississippi River into sediment and nutrient deprived wetlands, the Master Plan supports Louisiana's nutrient reduction strategy under the Gulf Hypoxia Action Plan.[1]
- Deepwater Horizon Oil Spill Natural Resource Damage Assessment (NRDA): Wetland restoration and protection projects identified as critical in the Master Plan will inform the design of projects to address environmental degradation caused by the spill. The state will use priority sites identified in the Master Plan to guide the allocation of $400-500 million in funding from NRDA and other sources (e.g., fines under the Clean Water Act or other payments to state agencies).[1]
- Carbon and nutrient credit programs. The Master Plan includes models for carbon sequestration and nutrient uptake that could provide basic information for developing incentives as part of a nutrient credit program. However, such programs are not yet developed.[22]

Transferability:

- The most transferable aspect is the Planning Tool, which is highly effective in using model outputs to evaluate different preferences for actions given multiple datasets and constraints.[22]

Data gaps:

- CPRA is currently in the process of obtaining information on data gaps from modelers. These gaps will be included in documentation on "lessons learned." With knowledge of data gaps in hand, CPRA will seek to collect monitoring data that fills gaps.[22]

Barriers:

- When developing the Master Plan, time was more of an issue than money. CPRA was obligated to complete the Master Plan by March 2012 due to a legislatively-mandated deadline. Additional time would have allowed CPRA to do more.[22]
- CPRA made an assumption that property rights would not be an issue in the development of the plan.[22] Future efforts, including the formation of a Landowner Focus Group, will look to address property rights issues.[24]
- Some models had lower resolutions due to the computation time necessary to complete the simulations of hundreds of proposed projects. For instance, with higher resolution, the

run time for the Eco-Hydrology model would have been too long. CPRA plans to initiate development of the next iteration of models for the Master Plan immediately. There will be fewer projects to run and more time available for this iteration; allowing for higher resolution results.[22]

Future goals:

- Over the next five years, CPRA would like to continue to develop its modeling tools and meet its next legislatively mandated deadline for the Master Plan.[22]
- A challenge for CPRA in achieving this will be remaining focused on the next iteration of the Master Plan and maintaining knowledge gained from the 2012 Master Plan so that CPRA does not have to start from zero the next time around. CPRA intends to apply a more streamlined process to Master Plan development for the 2012-2017 period as compared to previous iterations of the Master Plan.[22]
- Addressing data needs will be the most important factor to completing the next iteration of the Master Plan. Even after CPRA identifies data gaps, it will not be able to fill them all and will need to prioritize those that it will seek to fill – data limitations will always be an issue.[22]

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