2023 DRAFT COASTAL MASTER PLAN

PROJECT DEFINITION

ATTACHMENT F1

REPORT: VERSION 01
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COASTAL PROTECTION AND
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COASTAL PROTECTION AND RESTORATION AUTHORITY

This document was developed in support of the 2023 Coastal Master Plan being prepared by the Coastal Protection and Restoration Authority (CPRA). CPRA was established by the Louisiana Legislature in response to Hurricanes Katrina and Rita through Act 8 of the First Extraordinary Session of 2005. Act 8 of the First Extraordinary Session of 2005 expanded the membership, duties, and responsibilities of CPRA and charged the new authority to develop and implement a comprehensive coastal protection plan, consisting of a master plan (revised every six years) and annual plans. CPRA's mandate is to develop, implement, and enforce a comprehensive coastal protection and restoration master plan.

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EXECUTIVE SUMMARY

As coastal Louisiana faces increasing threats from flooding and sea level rise, there is a great need to advance our scientific understanding of the coast and how coastal Louisiana will need to adapt to future conditions. The Coastal Protection and Restoration Authority (CPRA) is undertaking this challenge through six-year updates of Louisiana's Comprehensive Master Plan for a Sustainable Coast. This document summarizes the process by which CPRA developed candidate projects for consideration in the 2023 Coastal Master Plan.

The 2023 Coastal Master Plan builds on past progress and establishes a clear vision for the future. It refines past plans by improving the methods used to ensure projects are evaluated as efficiently, consistently, and effectively as possible. These improvements include changes to the costing methodology and project structure, as well as the development of the Project Development Geodatabase (PDG), the Project Development Database (PDD), and an automated Project Costing Tool (PCT).

Each Project is now made up of distinct sections or reaches, called Elements, and each Element has a subgrouping of Components that comprise some feature of that Element (Figure ES 1). For example, Shoreline Protection rubble mound Elements include a geotextile base, riprap, navigational aids, and settlement plates as Components. Each Element is assigned a unique "Element Number"; however, multiple projects may reference the same Element (i.e., variations of the same Diversion project with different operation regimes). Geographic representations of Elements are stored in the PDG, and all other relevant physical attributes (such as crest width and elevation) are stored in the PDD. The PCT reads attributes from the PDD and calculates costs for each Element, which are then be summed for each Element within a Project.

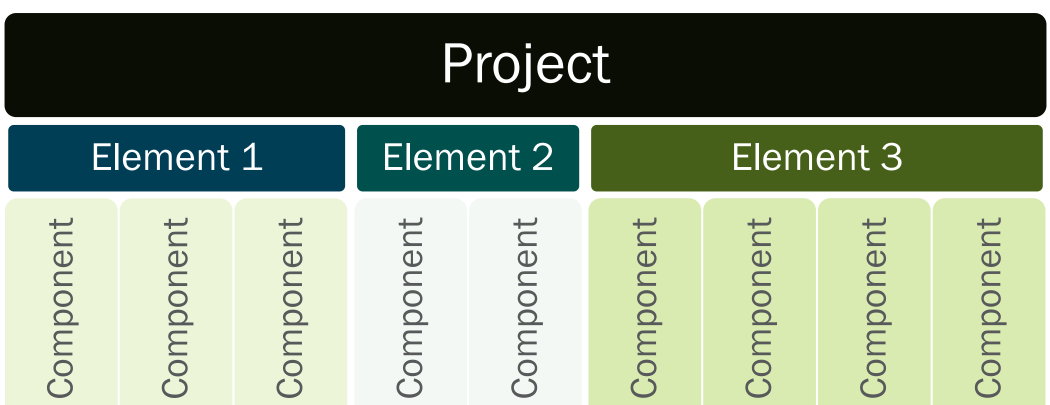

Figure ES-1. Project feature outline.

CPRA analyzed and refined project proposals from the 2017 Coastal Master Plan for inclusion in the 2023 plan, removing any that may already be in construction or have alternative means of funding (such as through programmatic efforts outside of the master plan). CPRA also solicited new project ideas and, where applicable, combined features of multiple project submittals to promote synergistic benefits to the landscape. Once the candidate project list was established, specific project details and Element attributes were developed to provide physical and monetary parameters needed by the Integrated Compartment Model (ICM), the Coastal Louisiana Risk Assessment (CLARA) model, the Advanced CIRCulation (ADCIRC) and Simulating WAves Nearshore (SWAN) model, and the Planning Tool. This document presents the principal assumptions for each of the seven main project types (Structural Risk Reduction, Diversions, Hydrologic Restoration, Marsh Creation, Ridge Restoration, Integrated Projects, and Nonstructural Risk Reduction) along with the 13 Element types that comprise projects (Proposed Levees, Improvements to Existing Levees, Proposed Floodwalls, Proposed Gates, Channel Creation, Marsh Creation, Gap Closures, Ridge Restoration, Shoreline Protection, Bank Stabilization, Oyster Barrier Reef, Miscellaneous Quantity, and Miscellaneous Lump Sums).

In addition, fact sheets describing each restoration and risk reduction project evaluated for the master plan are provided as an attachment to this document along with parish fact sheets that detail the potential impacts of future without action and future with implementation of the master plan at the parish level. More information regarding the technical aspects of the PDD, PDG, and PCT can also be found in corresponding attachments and supplemental materials to this report.

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LIST OF ABBREVIATIONS

ACB .... ARTICULATED CONCRETE BOCK
ADCIRC .... ADVANCED CIRCULATION
AEP .... ANNUAL EXCEEDANCE PROBABILITY
ASCE .... AMERICAN SOCIETY OF CIVIL ENGINEERS
BH .... BARRIER ISLAND/HEADLAND
BISM .... BARRIER ISLAND SYSTEM MANAGEMENT
BS .... BANK STABILIZATION
CFS .... CUBIC FT PER SECOND
CH .... CHANNEL CREATION
CLARA .... COASTAL LOUISIANA RISK ASSESSMENT
CPRA .... COASTAL PROTECTION AND RESTORATION AUTHORITY
CWPPRA...... COASTAL WETLANDS PLANNING, PROTECTION AND RESTORATION ACT
DEM .... DIGITAL ELEVATION MODEL
DI .... DIVERSION
ES .... ENVIRONMENTAL SCENARIO
FEMA .... FEDERAL EMERGENCY MANAGEMENT AGENCY
FMV .... FAIR MARKET VALUE
FWOA .... FUTURE WITHOUT ACTION
GIS .... GEOGRAPHIC INFORMATION SYSTEM
GIWW .... GULF INTRACOASTAL WATERWAY
HP .... HURRICANE PROTECTION
HR .... HYDROLOGIC RESTORATION
HSDRRS..................... HURRICANE AND STORM DAMAGE RISK REDUCTION SYSTEM
ICM .... INTEGRATED COMPARTMENT MODEL
LASARD .... LOUISIANA SAND RESOURCES DATABASE
LCA .... LOUISIANA COASTAL AREA
LFPG .... LOUISIANA FLOOD PROTECTION GUIDELINES
LGM .... LAROSE TO GOLDEN MEADOW
LRDG .... LOUISIANA RESTORATION DESIGN GUIDELINES

LS ....MISCELLANEOUS LUMP SUMS
LWI ....LOUISIANA WATERSHED INITIATIVE
MC ....MARSH CREATION
MRGO ....MISSISSIPPI RIVER GULF OUTLET
MRL.. MISSISSIPPI RIVER LEVEE
MR&T..MISSISSIPPI RIVER AND TRIBUTARIES
NAVD88 ....NORTH AMERICAN VERTICAL DATUM OF 1988
NDV ....NON-DEPRECIATED VALUES
NGOS .... NON GOVERNMENTAL ORGANIZATIONS
NOV .... NEW ORLEANS TO VENICE
NRDA ....NATURAL RESOURCE DAMAGE ASSESSMENT
NS...NONSTRUCTURAL RISK REDUCTION
O&M .... OPERATIONS AND MAINTENANCE
OR ....OYSTER BARRIER REEF
PCT .... PROJECT COSTING TOOL
PDD... PROJECT DEVELOPMENT DATABASE
PDG...PROJECT DEVELOPMENT GEODATABSE
P/E&D... PLANNING/ENGINEERING AND DESIGN
PT .... PLANNING TOOL
PW ....PROPOSED FLOODWALL
RR..RIDGE RESTORATION
SP ....SHORELINE PROTECTION
SR.. STRUCTURAL RISK REDUCTION
SWAN ....SIMULATING WAVES NEARSHORE
USACE ....U.S. ARMY CORPS OF ENGINEERS
UTM ....UNIVERSAL TRANSVERSE MERCATOR
XX...MISCELLANEOUS QUANTITIES

LIST OF ADDITIONAL MATERIALS

Attachment F2: Project Fact Sheets

Attachment F3: Parish Fact Sheets

Supplemental Material F1.1: 2023 Future Without Action (FWOA) Project List

Supplemental Material F1.2: 2023 Coastal Master Plan Project Development Solicitation Guidelines & Criteria

Supplemental Material F1.3: 2023 New Project Development FAQ

Supplemental Material F1.4: 2023 Coastal Master Plan Candidate Project List and Map

Supplemental Material F1.5: Available Sediment by Borrow Source

Supplemental Material F1.6: New Project Development Program Submissions

Attachment F6: Project Development Database Documentation

Attachment F7: Project Costing Tool Documentation

1.0 INTRODUCTION

As Louisiana faces increasing threats from coastal flooding and sea level rise, there is a great need to advance our scientific understanding of the coast and how coastal Louisiana will need to adapt to future conditions. The Coastal Protection and Restoration Authority (CPRA) is undertaking this challenge through six-year updates of Louisiana's Comprehensive Master Plan for a Sustainable Coast. The 2023 Coastal Master Plan builds on past progress and establishes a clear vision for the future. It refines past plans by improving the methods used to ensure projects are evaluated as efficiently, consistently, and effectively as possible.

This document describes the process by which CPRA developed the list of candidate projects and their associated attributes required to consider and evaluate each project in the 2023 Coastal Master Plan. In addition, fact sheets describing each restoration and risk reduction project evaluated as well as the parish-level impacts of chosen projects are provided in Attachments F3: Parish Fact Sheets and F2: Project Fact Sheets.

1.1 WHAT IS A PROJECT?

The aim of the Louisiana coastal master plan is to evaluate and prioritize a set of coastal restoration and risk reduction projects with the goal of reducing storm surge, building land, and reducing land loss, while also protecting the economic, ecologic, and cultural features of the coast. In previous master plans, candidate projects were categorized into and evaluated based on a small set of rigidly defined project types, including eight unique restoration project types (Bank Stabilization, Barrier Island Restoration, Hydrologic Restoration, Marsh Creation, Oyster Barrier Reef, Ridge Restoration, Diversions, and Shoreline Protection), and two types of risk reduction project types (Nonstructural Risk Reduction, comprising non-residential floodproofing, residential elevation, and voluntary acquisition measures, along with Structural Risk Reduction projects, composed of levees, floodwalls, and/or floodgates). Each project type had a unique template for costing project features based on inputted geometric and geographic attributes, such as crest elevation, length, and distance from a sediment source. Every candidate project fit into one of these ten types, and projects across all types competed against each other for prioritization and inclusion in the plan.

In the Louisiana coastal master plan nomenclature, a combination of unique projects of different types that are modeled together is called a Project Alternative. It was observed and reported in the 2017 plan that often the benefits of Project Alternatives were greater than the sum of the individual projects on their own. To allow for a more thorough investigation of such synergistic relationships, the 2023 Coastal Master Plan has introduced the Integrated Project (IP) project type, which is intended to allow stakeholders to propose unique projects composed of features from multiple project types. For example, an Integrated Project might include a marsh creation landbridge with bank stabilization and ridge restoration features. Additionally, in the 2017 Coastal Master Plan, Barrier Island Restoration, Oyster Barrier Reef, and small-scale Hydrologic Restoration project types were considered programmatically, meaning that they were not analyzed or selected individually through the master plan process, but instead were considered holistically so that they can be evaluated on a case by case basis through other initiatives or programs. CPRA will continue to evaluate these project types, along with Shoreline Protection projects, programmatically rather than prioritizing them in the 2023 Coastal Master Plan; however, features of these programmatic project types may be incorporated into new Integrated Projects.

Since the 2023 Coastal Master Plan is intended to tackle the analysis of even broader, more complicated projects than previous plans, a new system was devised for defining and assembling the building blocks used to fully describe a project, while also allowing for increased flexibility. Previous master plans required hundreds of Excel spreadsheets and ESRI shapefiles to measure, quantify, calculate, and aggregate information in repetitive and manual processes. For instance, data tables of unit costs were stored in hundreds of individual project spreadsheets rather than in one location to be referenced across all projects. Coupling the opportunity to streamline data and process repetition with the 2023 Coastal Master Plan's goal of examining broader regional projects presented a need to rethink attribute generation. Geospatial representations of all projects are now stored in Points, Lines, and Polygons feature classes within the Project Development Geodatabase (PDG), while other project attributes are stored in a centrally accessible PostgreSQL database, called the Project Development Database (PDD). A program called the Project Costing Tool (PCT) reads inputs from the PDG and PDD to calculate quantities and costs of each feature within a project. Ultimately, the PDD and PDG act as a central repository for tabular and basic geospatial data used and generated by the three primary master plan modeling teams: the Advanced CIRCulation (ADCIRC) and Simulating WAves Nearshore (SWAN) team, the Integrated Compartment Model (ICM) team, and the Coastal Louisiana Risk Assessment (CLARA) model team. Further information detailing the PDG and PDD schema along with a detailed explanation of the PCT can be found in Attachment F6: Project Development Database Documentation and Attachment F7: Project Costing Tool Documentation.

In previous master plans, the unique project identification number was arranged by "Planning Unit. Project Type. Sequential Number" (e.g., 001.MC.09) for restoration, structural risk reduction, and integrated projects and "Community. Sequential Number" (e.g., VER.02N) for Nonstructural Risk Reduction projects. The 2023 Coastal Master Plan utilizes a new project ID, comprising a sequential, three-digit Project Number and a letter Project Version, if applicable (i.e., "234" or "004a"). This nomenclature change intends to unify all projects that have been evaluated in any previous, current, or future master plan. A project version indicates variations on a proposed project, such as the multiple iterations of proposed Mid-Barataria Diversion projects that have the same footprint, but different operation regimes. The previous nomenclature is referenced as the "Legacy Project Number" within this document for convenience but is otherwise a deprecated terminology.

Each Project is now made up of distinct sections or reaches, called Elements, and each Element has a subgrouping of Components that comprise some feature of that Element (Figure 1). For example, Shoreline Protection rubble mound Elements include a geotextile base, riprap, navigational aids, and settlement plates as Components. Each Element is assigned a unique “Element Number,” however, multiple projects may reference the same Element (i.e., subsections of an Integrated Project might exist as their own distinct projects but share features with the primary project).

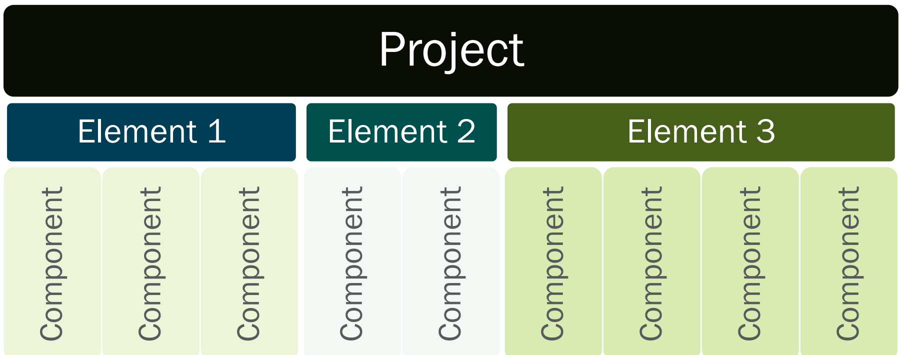

Figure 1. Project feature outline.

1.2 DEVELOPING A LIST OF PROJECTS

To develop a list of candidate projects for the 2023 Coastal Master Plan, CPRA started by reviewing and refining project ideas proposed for the 2017 Coastal Master Plan, including projects that were not chosen in the final master plan, and excluding those that have been or are expected to be funded for construction. CPRA also solicited new ideas from academia, state agencies, local parishes, and anyone else with an interest in protecting the Louisiana coast. Project types that generally do not impart large-scale regional impacts were considered programmatically rather than individually evaluated and incorporated into the 2023 plan. Nonstructural Risk Reduction projects are also considered programmatically for the 2023 Coastal Master Plan. This is because they are generally implemented on a smaller-scale, but also because multiple funding programs outside of CPRA are available, and they can leverage risk reduction information available in the 2023 Coastal Master Plan. Details on nonstructural risk reduction can be found in Appendix E3: Nonstructural Risk Reduction Evaluation Results.

REFINEMENT OF 2017 COASTAL MASTER PLAN PROJECTS

Projects or increments of projects in the 2017 Coastal Master Plan that have been constructed or had funding for construction as of December 31, 2020 were not part of the list of candidate projects for 2023 and will not compete for potential future funding and implementation. They instead were included as part of the future without action (FWOA) scenario. The FWOA condition is the baseline against which candidate projects were evaluated. A list of all projects included in FWOA can be found in Supplemental Material F1.1: 2023 Future Without Action (FWOA) Project List. In total, eight projects included in the 2017 Coastal Master Plan met this criterion (Table 1).

Table 1. 2017 projects moved to FWOA

Project ID	Legacy Project Number	Project Name	FWOA Project Number
015a	001.DI.21	Mississippi River Reintroduction into Maurepas Swamp	PO-0029
016c	001.DI.104	Mid-Breton Sound Diversion	BS-0030
027	001.SR.05	West Shore Lake Pontchartrain	PO-0062
068b	002.DI.102	Mid-Barataria Diversion	BA-0153
098	002.RR.02	Spanish Pass Ridge Restoration	BA-0203
105a	03a.DI.01	Bayou Lafourche Diversion	BA-0161
131	03a.RR.05	Bayou Terrebonne Ridge Restoration	TE-0139
149	03b.SR.13	Bayou Chene	AT-0017

Twenty-six additional 2017 Coastal Master Plan candidate projects were not included in the list of candidate projects based on information gained since the 2017 Coastal Master Plan was developed. All shoreline protection projects were removed from the master plan as they are now being treated programmatically. Other projects removed and their reason for removal from the 2023 Coastal Master Plan are described in Table 2.

Table 2. 2017 projects removed from 2023 consideration

Project ID	Legacy Project Number	Project Name	Reason for Removal
041	001.MC.09	Biloxi Marsh Creation	Overlaps with candidate project 310
049	001.MC.17	Eastern Lake Borgne Marsh Creation	Overlaps with candidate project 309
068e	002.DI.03a	Mid-Barataria Diversion	Preferred Mid-Barataria Diversion included in FWOA
092	002.MC.07	Barataria Bay Rim Marsh Creation	Excluded in favor of landbridge alternatives (325a-c)
093	002.MC.08	North Caminada Marsh Creation	Overlaps with candidate projects 330 and 123 (03a.MC.07)
154	03b.MC.03	Marsh Island Marsh Creation	Replaced with newly proposed project 346

Project ID	Legacy Project Number	Project Name	Reason for Removal
159	03b.MC.09	Point Au Fer Island Marsh Creation	Overlaps with candidate project 344
190	004.HR.06	Calcasieu Ship Channel Salinity Control Measures	Feasability level studies (CS-65) suggest alternative measures for this area
289	03b.MC.101	Southeast Marsh Island Marsh Creation	Overlaps with candidate project 346
299	004.MC.106	Cameron Meadows and Vicinity Marsh Creation	Overlaps with candidate project 218

Between the 2017 and 2023 Coastal Master Plans, several improvements to the costing algorithms, engineering assumptions, and project attributes were made while developing and validating the PCT to create more accurate and consistent project costs. Based on these changes, all 2017 projects included as candidates in the 2023 Coastal Master Plan were modified in some way, summarized below:

- During PCT development, some geometric calculations were corrected, including surface area formulas for Bank Stabilization (BS) projects and both surface area and volume calculations for Structural Risk Reduction (SR) projects.
- Standardized coastwide borrow-fill ratios for Ridge Restoration (RR) projects were implemented.
- Geotextile calculations, fish dip spacing, navigational aid and settlement plate requirements, as well as access and flotation channel draft requirements and bottom widths were standardized across all project types.
- Attributes related to Proposed FloodWall (PW) Elements as part of SR projects were standardized based on the height of the wall and the geographic location of the project footprint (see Section 4.2).
- Vegetative planting Components for Marsh Creation (MC) Elements were standardized to be brackish marsh plantings across all proposed MC elements.
- Hardwood planting Components were added to RR Elements along the crest of each ridge.
- Specific Operation and Maintenance (O&M) Component costs for RR Elements were replaced with the default assumption that O&M costs would equate to 5% of construction costs. Instead, a 25% overbuild factor was added to the ridge height to account for initial compaction of earth beneath the ridge and to offset the cost of potential future ridge lifts.
- O&M Costs for pump stations were escalated for Hydrologic Restoration (HR) projects in which pump stations would be functioning continuously, as opposed to the

periodic operation of drainage pump stations used in SR projects.

- Construction survey and mobilization costs were standardized as specific percentages of project construction costs.
- General spreadsheet errors, including measurement conversion errors and cell reference errors, were corrected in the development of the PCT, causing some changes to overall project costs.
- Unit costs were updated as available to better capture Component values, and all costs were scaled to 2023 U.S. dollars using the U.S. Army Corps of Engineers (USACE) Civil Works Construction Cost Index System (USACE, 2019a). Section 2.3 of this attachment describes cost escalation in more detail.
- Length and perimeter attributes were populated from feature classes in the PDG to eliminate errors caused by incorrect data entry or improper unit conversion.
- An updated state wide digital elevation model (DEM) along with levee survey data provided by USACE for the New Orleans to Venice (NOV), Morganza to the Gulf, St Tammany, and the Hurricane and Storm Damage Risk Reduction System (HSDRRS) levee systems were used to determine existing and design elevations of relevant project features.
- New Geographic Information System (GIS) tools were created and utilized to automate and standardize Component attributes for access channels, flotation channels, oil and gas pipeline relocations, road and railroad relocations, and dredge pipeline mobilization.
    - The access and flotation channel tools use bathymetric data from the state wide DEM to draw minimal-dredging access paths for barge-based construction equipment between applicable Elements and navigable water as well as to draw flotation channels along certain Elements that require access along the length of the feature.
    - The relocation GIS tools use feature classes of existing pipelines, roads, and railroads to identify instances where Element construction would require relocation of such features.
    - The dredge pipeline mobilization tool was developed to optimize designation of pipeline paths for transport of sediment from borrow sources to MC or RR Elements. This tool uses a land-water raster to prioritize pipeline placement in water or across known or previously used pipeline corridors, such as those used to cross levees and highways to access Mississippi River. This tool also creates dredge pipeline pathways from MC Elements to multiple nearby borrow sources, so that the Planning Tool can prioritize the use of limited sediment resources.

Other project-specific updates were made to 2017 projects based on local stakeholder feedback and interim reconnaissance and feasibility studies completed since the 2017 Coastal Master Plan, as described in Table 3. Projects from the 2017 Coastal Master Plan that were updated based on feedback from the New Project Development are discussed later in this section. In total, 67 restoration and risk reduction projects included in the 2017 Coastal Master Plan were evaluated as part of the 2023 Coastal Master Plan (Figure 2).

Table 3. Project specific updates to 2017 Coastal Master Plan projects

Project ID	Legacy Project Number	Project Name	Alteration
026	001.SR.04	Greater New Orleans High Level	Alignment updated based on completed construction
032	001.SR.13	Slidell Ring Levees	Alignment updated based on USACE St. Tammany Feasibility Study (USACE 2020)
037	001.MC.05	New Orleans East Land Bridge Restoration	Addition of MC cell from Pearl River Island Restoration Conversion to Integrated Project by addition of BS Element and Pine Island Ridge Restoration
082	002.SR.06	Upper Barataria Risk Reduction	Two pump stations removed
110b	03a.SR.02b	Morganza to the Gulf	Alignment updated based on USACE Adaptive Criteria Assessment report (2019b)
111	03a.SR.20	Larose to Golden Meadow	Alignment updated based on completed construction
146	03b.SR.10	Morgan City Back Levee	Alignment updated based on completed construction
210	004.MC.04	Mud Lake Marsh Creation	Additional MC cell added
248	001.MC.102	Pointe a la Hache and Carlisle Marsh Creation	Additional MC cell added from Carlisle MC Project
265	002.SR.101	St. Jude to City Price	Alignment updated for levee reaches NOV-05a and NOV-09
267	002.MC.100	North Barataria Bay Marsh Creation	Two Marsh Creation elements removed
288	03b.MC.100	Vermilion Bay Marsh Creation	Two Marsh Creation elements removed

Figure 2. 2017 Coastal Master Plan projects being considered for 2023.

IDENTIFYING CANDIDATE PROJECTS FROM 2017 FOR RECONSIDERATION

The 2023 Coastal Advisory Team and other stakeholders provided feedback on the 2017 Coastal Master Plan and asked CPRA to reconsider some projects that were evaluated but not selected for inclusion the final plan. CPRA developed a set of criteria to determine which projects could justifiably be reconsidered.

Projects not in the 2017 Coastal Master Plan but selected by the Planning Tool based on modeled benefits under the Modified Max Land Version 3, $50 billion, 50/50 Restoration/Protection funding split for either the Medium or High Environmental Scenario (ES) were reconsidered for analysis. This category of projects was proposed because these projects were the next highest performers based on the two primary 2017 Coastal Master Plan decision drivers: risk reduction and land building. This list of projects was then reviewed on a project-by-project basis to determine if there were any projects that overlapped or were duplicative with projects already being considered for 2023 or if any projects were no longer feasible to implement.

In addition to projects selected for the 2017 Coastal Master Plan, CPRA reconsidered 17 candidate projects from the 2017 Coastal Master Plan (Table 4).

Table 4. Additional candidate projects from 2017 for reconsideration

Project ID	Legacy Project Number	Project Name	Reason for Reconsideration	Note
035	001.MC.02	Hopedale Marsh Creation	Medium ES	Incorporated into 2023 plan as is
041	001.MC.09	Biloxi Marsh Creation	Medium ES	Subset of full project
049	001.MC.17	Eastern Lake Borgne Marsh Creation	Medium ES	Replaced with 309 (Western Biloxi Marsh Complex)
089b	002.MC.04a	Lower Barataria Marsh Creation - Component A	High ES	Subset of full project
092	002.MC.07	Barataria Bay Rim Marsh Creation	High ES	Replaced with 325a through c, Lower Barataria Landbridge
093	002.MC.08	North Caminada Marsh Creation	Medium ES	Subset of full project
127	03a.RR.01	Bayou DeCade Ridge Restoration	High ES	Incorporated into 2023 plan as is

Project ID	Legacy Project Number	Project Name	Reason for Reconsideration	Note
129	03a.RR.03	Small Bayou LaPointe Ridge Restoration	Medium ES	Incorporated into 2023 plan as is
157	03b.MC.07	East Rainey Marsh Creation	Medium ES	Subset of full project
229	004.MC.25	Kelso Bayou Marsh Creation	Medium ES	Incorporated into 2023 plan as is
246	001.MC.100	Sunrise Point Marsh Creation	High ES	Incorporated into 2023 plan as is
249	001.MC.103	Fritchie North Marsh Creation	Medium ES	Incorporated into 2023 plan as is
257	001.RR.102	Bayou Aux Chenes Ridge Restoration	Medium ES	Incorporated into 2023 plan as is
267	002.MC.100	North Barataria Bay Marsh Creation	High ES	Subset of full project
288	03b.MC.100	Vermilion Bay Marsh Creation	Medium ES	Subset of full project
298	004.MC.105	West Brown Lake Marsh Creation	Medium ES	Subset of full project
299	004.MC.106	Cameron Meadows and Vicinity Marsh Creation	Medium ES	Subset of full project

NEW PROJECT DEVELOPMENT PROGRAM

The 2023 Coastal Master Plan will build upon previous master plan efforts and strive to ensure that the collective effects of project investments reduce storm surge-based flood risk to communities, provide habitats to support an array of commercial and recreational activities, and support infrastructure critical to the working coast. This will be achieved by harnessing natural processes, focusing protection on key assets, and adapting to changing coastal conditions.

The 2017 Coastal Master Plan predictions of future coastal land loss and storm surge-based flood risk, even with plan implementation, demonstrated that isolated project investments often provide minimal benefits beyond their immediate footprint or local area. Synergistic interactions among projects of different types affecting the same region have been shown to produce greater and more sustainable benefits. Moreover, future predictions show the scale of the challenge facing coastal Louisiana and reinforce the need for the master plan process to focus on investments with beneficial effects at the sub-basin to regional scale.

CPRA held two public solicitations from September 2018 – March 2019 and from October 2019 – February 2020 for new project concept proposals to be considered for evaluation for the 2023 Coastal Master Plan[1,2]. The solicitations emphasized projects that will:

- Continue to provide benefit in the face of sea level rise and subsidence without continued maintenance,
- Contribute to maintaining estuarine gradients in future decades, and/or
- Provide risk reduction at the community or regional scale.

Proposals were accepted from any source, including academia, parishes, elected officials, agencies, non-governmental organizations (NGOs), landowners, business/industry, and the public. Projects that met the screening criteria were further developed over the course of several Regional Workgroup meetings to solidify project features before being incorporated into the PDD.

Overall, CPRA received 193 project ideas from nearly 80 unique project sponsors. Using the screening criteria above, 88 of the submissions were considered for inclusion in the 2023 Coastal Master Plan. From these submissions, projects were accepted in full, combined with other submittals, or modified to better reflect CPRA project, resulting in 62 new projects and 3 project alterations submitted through the new project development process being analyzed for the 2023 Coastal Master Plan (Figure 4). A full list of new development program submissions and their decision can be found in Supplemental Material F1.4: 2023 Coastal Master Plan Candidate Project List and Map.

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[1] Supplemental Material F1.2 for 2023 Coastal Master Plan Project Development Solicitation Guidelines & Criteria
[2] Supplemental Material F1.3 for 2023 New Project Development FAQ

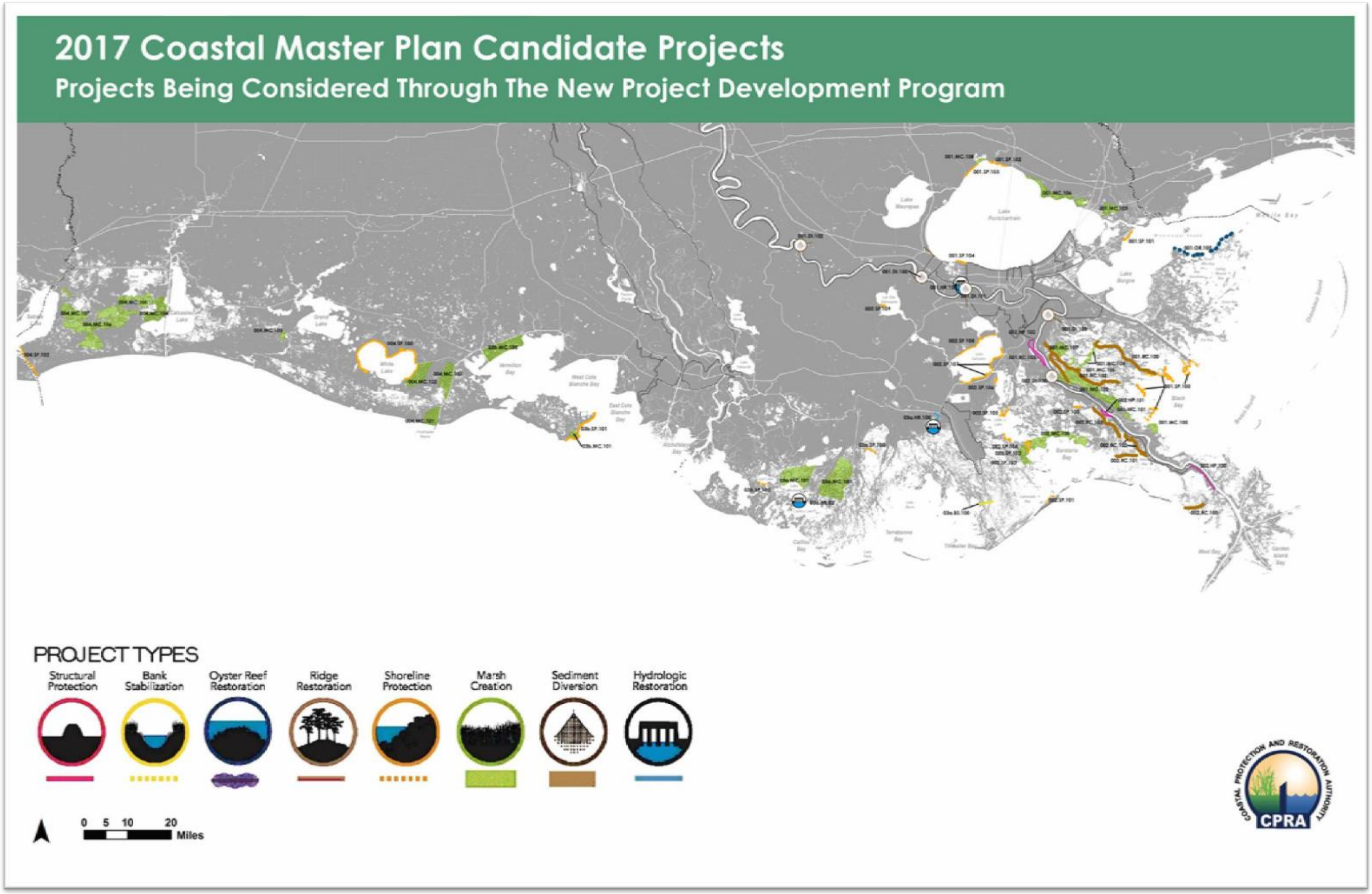

Figure 3. Projects considered through the New Project Development Program.

PROGRAMATIC MEASURES

Project types expected to have localized rather than sub-basin to regional scale benefits (i.e., Shoreline Protection, Oyster Reef Restoration, and small Hydrologic Restoration) will be considered programmatically in the 2023 Coastal Master Plan. As mentioned in Section 1.1, programmatic consideration means that project types are not analyzed or selected individually through the master plan process, but instead are considered holistically so that they can be evaluated on a case by case basis through other initiatives or programs (e.g., CWPPRA, Parish Matching Funds). CPRA often receives project submissions for local hydrologic control structures, oyster reef restoration/living shoreline, and conservation partnerships and has historically supported these efforts as evidenced through the Coastal Forest Conservation Initiative and other ongoing projects (e.g., Ducks Unlimited and North American Wetlands Conservation Act projects). CPRA intends to continue supporting and funding such projects in the future, and programmatic consideration simply allows for new projects to be prioritized through similar efforts.

While these types of projects often satisfy the objective of creating or maintaining land, the scale of the current models do not fully capture the effects of projects such as local flap-gated culverts for salinity control or small-scale living shoreline projects, and therefore these projects were largely not recommended in the 2017 Coastal Master Plan. However, hydrologic restoration and oyster reef/living shoreline projects are generally considered by CPRA to be consistent with the coastal master plan and the merit of and investment in these projects will continue to be strategically evaluated on a case by case basis within each appropriate coastal program outside the master plan process. restoration projects. Furthermore, complex Integrated Projects may include some Shoreline Protection or Oyster Reef features; further discussion on Integrated Projects can be found in Section 1.3 and Section 3.6.

Barrier Island Restoration will be addressed through CPRA's Barrier Island System Management (BISM) Program, whose goal is to inform how the entire barrier island chain is restored and maintained. Louisiana has invested hundreds of millions of dollars over the past two decades restoring its barrier islands and shorelines and plans to continue to invest in rebuilding these features. Unlike the 2012 Coastal Master Plan, which called for restoration of specific barrier islands, the 2017 Coastal Master Plan recommended funding Louisiana's BISM. Rather than recommending specific barrier island and shoreline projects and assigning them to a certain implementation period, CPRA intends to restore the Terrebonne, Timbalier, and Barataria barrier islands and shorelines as part of a routine renourishment program. This will allow monitoring and assessment of these critical features to drive project investment and enable CPRA to nimbly react when catastrophic events like future hurricanes impact these areas. Of the $25 billion restoration budget, $2.5 billion has been identified to fund programmatic restoration projects including Barrier Island Renourishment Program, small-scale hydrologic restoration, shoreline protection, and oyster reef restoration.

NONSTRUCTURAL RISK REDUCTION

Nonstructural Risk Reduction projects include non-residential floodproofing, residential elevation, and voluntary residential acquisition. These projects are addressed programmatically in the 2023 Coastal Master Plan, but the analysis also informed the structural project selection process to identify where nonstructural mitigation could be a better solution. Details can be found in Appendix E: Nonstructural Risk Reduction Evaluation Results. The potential for nonstructural projects to contribute to coastal flood risk mitigation, and the associated costs and benefits, was characterized across the coast to define an appropriate level of investment for nonstructural activities across the coast.

The 2023 Coastal Master Plan analysis used a higher resolution definition of communities to support a more precise understanding of risk and the effectiveness of risk reduction measures. Rather than competing nonstructural mitigation projects against each other and potentially not selecting truly beneficial projects due to budget constrains; treating them programmatically can support and inform other programs both inside and outside of CPRA.

There are currently multiple federally funded programs managed by different state agencies that support nonstructural flood risk mitigation in Louisiana. These include The Governor's Office of Homeland Security and Emergency Preparedness Hazard Mitigation Grant Program, funded through FEMA, and the Office of Community Development Community Development Block Grant Mitigation program (funded through the Department of Housing and Urban Development). Each federal grant program has unique requirements that dictate how funds can be used. These differing program requirements limit where and on what program funds can be spent. The master plan analysis of nonstructural mitigation also focuses only on flood risk from coastal storms. Most other nonstructural funding programs support mitigation regardless of whether the flooding is from rainfall, coastal surge, riverine flooding, or the combined effects of these.

In order to overcome some of these limitations and maximize the effectiveness of flood risk mitigation activities, Louisiana is moving to a coordinated approach to place identified mitigation projects in the most appropriate programs and stretch available funds as far as possible. For example, each program's lead state agencies participate in the Louisiana Watershed Initiative (LWI), which is working to improve coordination across programs. Properly coordinated and managed, every mitigation project can be funded by the most appropriate program, providing maximum flexibility to remaining programs funds.

For the 2023 Coastal Master Plan, nonstructural risk reduction was considered in two ways:

- Nonstructural projects benefits were compared to those of structural protection projects for each community.
- This level of funding, and the range of flood risk reduction benefits that it could deliver, were identified as part of the 2023 Coastal Master Plan but it will not be associated with specific nonstructural projects, thus allowing more flexibility for

alignment with the potential funding programs described above.

This approach assisted in selecting cost effective projects, both structural and nonstructural, it also provides a storm surge- based flood risk inventory for coastal tropical storms that can be used to support the development and prioritization of projects in a much broader context.

1.3 THE PROJECT LIST

Through the processes described above, 141 candidate projects have been identified for consideration in the 2023 Coastal Master Plan (Figure 4): 62 from the 2017 Coastal Master Plan, 17 being reconsidered from 2017, 62 through the New Project Development Program and 291 Nonstructural Risk Reduction projects. Supplemental Material F1.4 presents the candidate projects evaluated in the 2023 Coastal Master Plan.

Projects are sorted into four primary categories, described throughout this section: Structural Risk Reduction Projects, Restoration Projects, Integrated Projects, and Nonstructural Risk Reduction Projects.

STRUCTURAL RISK REDUCTION PROJECTS

Structural Risk Reduction (SR) projects (formerly called Hurricane Protection, or HP projects in previous plans) reduce storm surge and coastal flood risk in coastal communities by acting as a physical barrier against storm surge. The 18 SR projects evaluated in the 2023 Coastal Master Plan typically include one or more of the following basic features:

- **Earthen Levee**: The principal feature of each SR project is the earthen levee. These structures consist of trapezoidal banks of compacted earth that provide a barrier against storm surge for coastal communities or assets. Levees can either be linear or ring levees. Ring levees form a closed risk reduction system that encircles a protected area (referred to as a polder). Linear levees create a closed system by tying into other linear levees or by extending inland to high ground.
- **Floodwall:** Floodwalls are typically located at points along an earthen levee that have a high potential for erosion or insufficient space for the wide slopes of an earthen levee. Floodwalls are also found surrounding floodgates and pump stations.
- **Floodgate:** Floodgates are needed where levees or floodwalls cross a road or railroad or where they intersect waterways.
- **Drainage Pumps:** Pumps are needed in enclosed risk reduction systems to allow water that enters a polder to be pumped out.
- **Other Features:** SR projects may also include other project-specific features or considerations, such as repairs to existing features or utility relocations.

Additional information about the SR projects evaluated in the master plan is presented in Section 3.1.

RESTORATION PROJECTS

Restoration projects are those projects whose features restore degraded sections of Louisiana's coastal ecosystem by re-establishing natural processes or through mechanical means such as the placement of dredged material. Restoration projects are grouped into the following general categories:

- Diversions (13 projects)
- Hydrologic Restoration (10 projects)
- Marsh Creation (52 projects)
- Ridge Restoration (22 projects)

A total of 97 restoration projects were evaluated for the 2023 Coastal Master Plan. Additional information about the restoration projects evaluated in the 2023 Coastal Master Plan is presented in Sections 3.2, 3.3, 3.4, and 3.5.

INTEGRATED PROJECTS

For the 2023 Coastal Master Plan, there is a focus on projects of regional scale and impact. To facilitate the analysis of larger, more complex project proposals, a new project type has been added and is termed the Integrated Project (IP). This project type will be used to examine proposed projects which comprise two or more of the traditional Restoration or Structural Risk Reduction project types listed above. Integrated projects may also include features from project types now considered programmatically, including Bank Stabilization (BS), Oyster Barrier Reefs (OR), or Shoreline Protection (SP) projects. Additionally, IP projects may include modified Marsh Creation (MC) Elements specifically designed for landbridge projects, which create or restore marsh in areas at depths deeper than the standard 2.5 ft. Twenty-six Integrated Projects were evaluated for the 2023 Coastal Master Plan, and additional information regarding project-level assumptions is presented in Section 3.6.

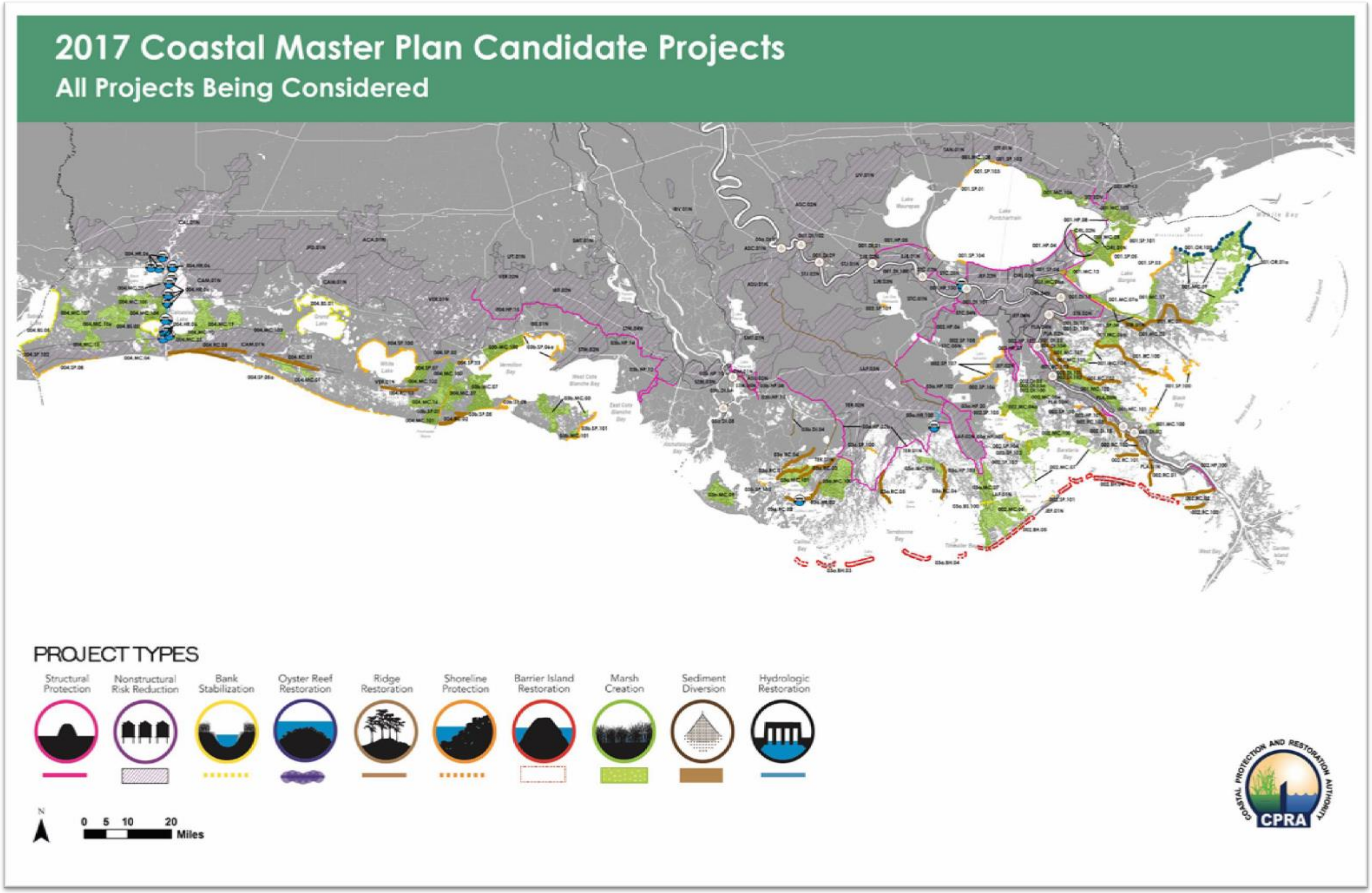

Figure 4. All projects being considered.

NONSTRUCTURAL RISK REDUCTION PROJECTS

Nonstructural Risk Reduction projects include non-residential floodproofing, residential elevation, and voluntary residential acquisition. These projects are based on the Federal Emergency Management Agency (FEMA) Base Flood Elevation plus 2 ft of freeboard or CPRA's recommended elevation height (1% annual exceedance probability (AEP) [e.g., 1-in-100-year] flood depths plus 2 ft freeboard), whichever is higher, to add a wider safety margin for future flood risk. They include:

- Floodproofing non-residential properties where the 1% AEP flood depth is 1-3 ft.
- Elevating residential properties where 1% AEP flood depths are 12 ft.
- Voluntary acquisition of residential properties where 1% AEP flood depths are greater than 12 ft.
- Common Attributes and Assumptions

2.0 COMMON ATTRIBUTES AND ASSUMPTIONS

Following development of the candidate projects list, specific project details were required to define project features affecting the landscape and hydrology in the coastal system. This was accomplished by the development of specific attributes for each candidate project to provide parameters needed both for the predictive models and for the Planning Tool. Key attributes and assumptions for all projects evaluated are presented in this section. The implementation of master plan projects should adhere to the most current version of the Louisiana Flood Protection Design Guidelines (2015b) and the Marsh Creation Design Guidelines (2017).

2.1 METADATA AND MODEL ATTRIBUTES

The following list of metadata attributes is common for each candidate Restoration, Structural Risk Reduction, and Integrated Project. Attributes designated with an asterisk (*) are also applicable to Nonstructural Risk Reduction projects.

1. **Project ID*:** Combination of Project Number and Project Version, creating a unique project identifier (e.g., 006 or 013b).
    a. **Project Number***: A three-digit number assigned to each project, incrementing from the first project proposed in the 2012 Coastal Master Plan.
    b. **Project Version***: A letter indicating a variation of a proposed project where the first alternate version is denoted with a “b” (e.g., 014b) and the original project is assigned an “a” (e.g., 014a). Project IDs for those without multiple versions will remain the three-digit Project Number.
2. **Legacy Project Number*:** A unique project identification number used in previous master plans, arranged by “Planning Unit. Project Type. Sequential Number” (e.g., 001.MC.09) for restoration, structural risk reduction, and integrated projects and “Community. Sequential Number” (e.g., VER.02N) for Nonstructural Risk Reduction projects.
3. **Project Name*:** A unique name for each project.
4. **Project Type*:** Identifier indicating one of the seven major project types: SR (Structural Risk Reduction), DI (Diversion), HR (Hydrologic Restoration), MC (Marsh Creation), RR (Ridge Restoration), IP (Integrated Project), or NS (Nonstructural Risk Reduction).
5. **Description:** Brief description of project features and intent.
6. **ProposalName:** Project name as specified in the original proposal/source document.

7. **MasterPlanSource:** Source plan, document, program, or organization from which the project idea was brought to the Master Plan team.
8. **Geographic Footprint*:** GIS footprint of the project, expressed in the Universal Transverse Mercator (UTM) Zone 15N spatial reference.

Similarly, the following list of metadata attributes is common to each Element within a Project, regardless of Element or Project Type.

1. **Element Number:** A unique identification number, arranged by "Legacy Project Number. Sequential Number" (e.g., 001.MC.09.12) for restoration, structural risk reduction and integrated projects
2. **Element Name:** A unique name for each Element.
3. **Primary Project ID:** Elements that are common between multiple projects will have a Primary Project ID identifying the project where the Element originated.
4. **Parish:** Parish(es) in which the Element footprint is located.
5. **Element Type:** Identifier indicating one of the thirteen major Element types: BS (Bank Stabilization), CH (Channel Creation), CL (Gap Closure Features), EL (Improvements to Existing Levees), GA (Gates), LS (Miscellaneous Lump Sums), MC (Marsh Creation), OR (Oyster Reef), PL (Proposed Levee), PW (Proposed Floodwall), RR (Ridge Restoration), SP (Shoreline Protection), or XX (Miscellaneous Quantities).
6. **GIS Type:** Identifies how the Element is represented in GIS (e.g., "Line", "Polygon", "Point", or "None").

Additionally, Marsh Creation Elements specifically have two additional metadata attributes – environmental scenario and implementation period – because required sediment volumes and marsh footprint areas (and therefore associated Element costs) vary over time due to sea level rise and changing land conditions.

1. **Environmental Scenario (ES):** The relevant ES with which the marsh area and marsh volume attributes are associated.
2. **Implementation Period:** The relevant Implementation Period with which the marsh area and marsh volume attributes are associated.

Certain additional metadata attributes, required as part of ICM, CLARA, ADCIRC/SWAN, and Planning Tool modeling, include:

1. **Model Group:** Identifier to track and name model outputs. Multiple projects that are geographically distant from each other and therefore do not have overlapping effects on the landscape may be modeled together in the same simulation, and therefore have the same Model Group.

2. **Planning/Engineering and Design (P/E&D) Duration:** Estimated duration of P/E&D phase, further discussed in Section 2.5.
3. **Construction Duration:** Estimated duration of construction phase, further discussed in Section 2.5.
4. **Prerequisites:** List of other projects that would need to be implemented before the candidate project would be implemented.
5. **Mutually Exclusive Projects:** List of other projects that would not be included in the master plan should the current project be selected.

2.2 COST ATTRIBUTES

Project cost estimates were developed for each project and are typically based on the conceptual design of known project features. The conceptual restoration and protection feature design templates, historical bid and cost data, and cost methodology were researched and developed by the CPRA Engineering Division. When applicable, unit costs from recently bid projects or completed studies were used to develop unit cost parameters. All cost estimates are reported in 2023 dollars as discussed in Section 2.3 for additional information. Costs were estimated based on the low, most likely, and high bid item unit costs, as discussed in Section 2.4. More information on cost estimation methodology and assumptions can be found in Sections 3.0 and 4.0.

Project costs are broken down into Construction, Construction Management (CM), Contingency, Planning/Engineering and Design (P/E&D), and Operations and Maintenance (O&M) costs (Figure 5) and are presented in the Project Fact Sheets in Attachment F2.

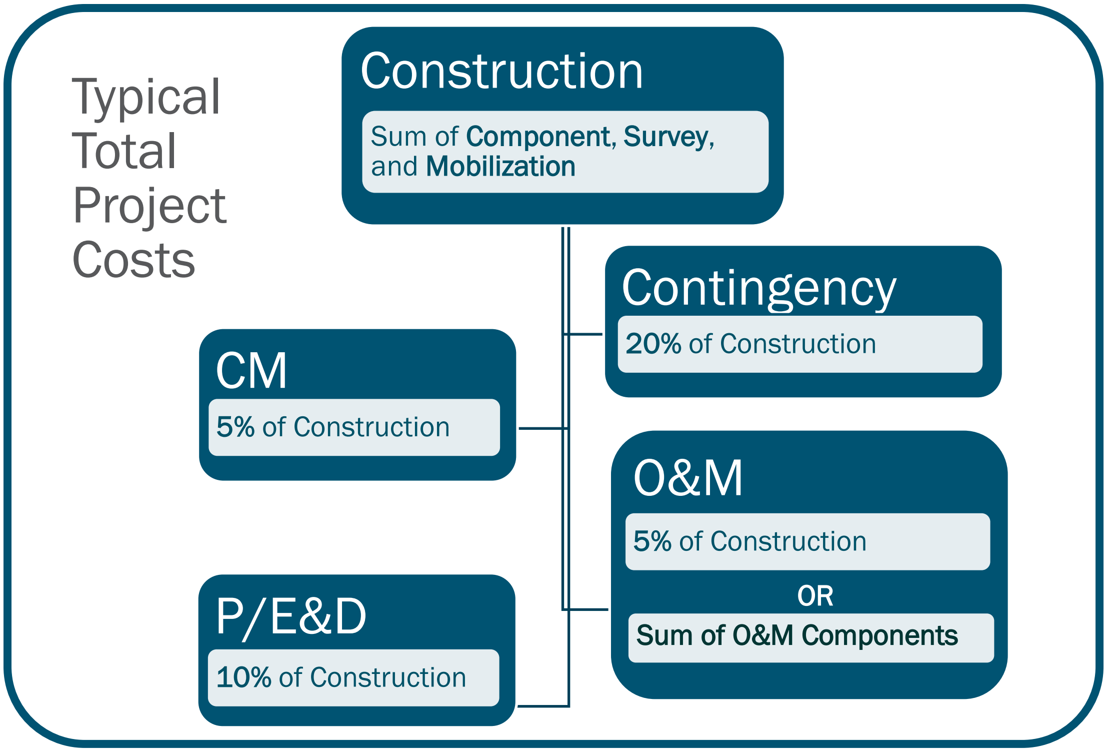

Figure 5. Typical project cost breakdown.

The following list of costs is common for each candidate Restoration, Structural Risk Reduction, and Integrated Project:

- **Estimated Construction Cost:** Total estimated cost associated with all aspects of construction phase, estimated as the sum of costs of project Components, along with an additional 2.5% of the total Component cost to account for construction surveys and 5% of the sum of Component and survey costs to account for mobilization expenses (unless the mobilization expenses are explicitly calculated for dredge material, see Section 4.5). See construction cost breakdown in Figure 6. Component costs are estimated based on estimated unit price multiplied by the estimated quantities of material. Details of estimated construction costs by Project and Element Type are outlined in Sections 3.0 and 4.0.

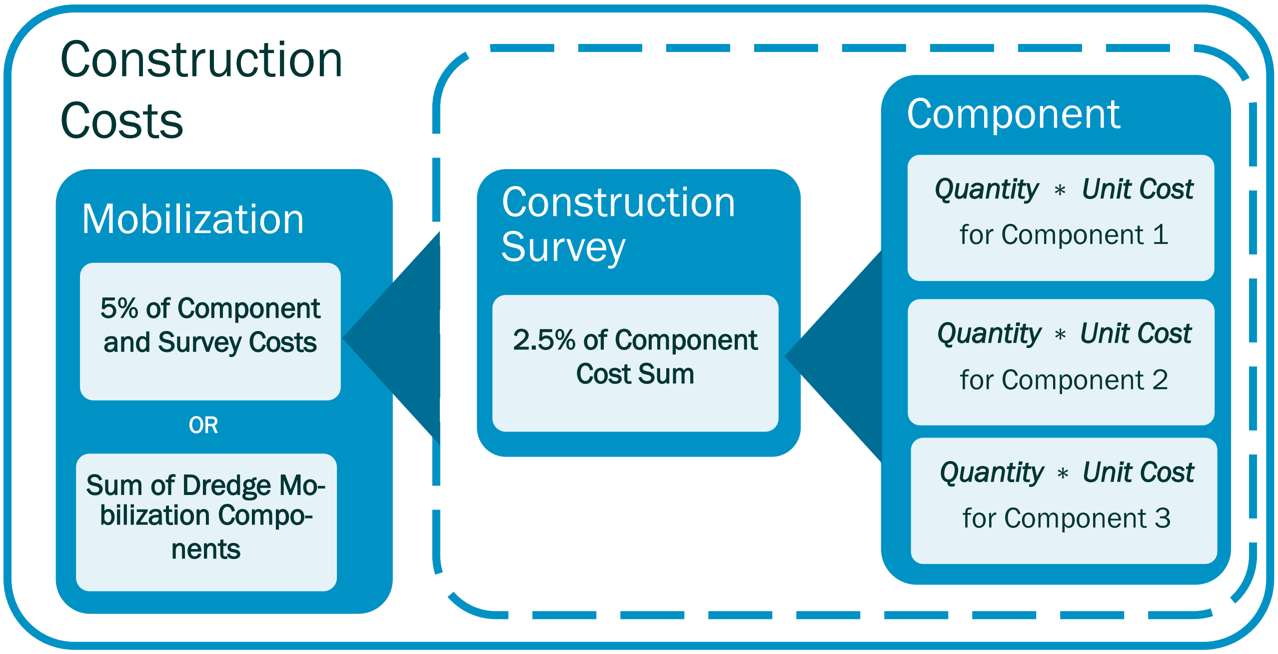

Figure 6. Construction cost breakdown.

- **Estimated Construction Management (CM) Cost:** Total estimated cost associated with the oversight of construction. Construction management cost is a cost for professional services during construction to monitor contractor compliance with contract requirements and to monitor schedules and costs. This cost is 5% of the estimated construction cost before contingency unless otherwise explicitly specified for a given project and is included with the estimated construction cost when used in the Planning Tool.
- **Contingency Cost:** Generally assumed as 20% of the Construction Cost. Contingency is a dollar amount intended to provide an allowance for costs expected to be part of a project total, but that have not been specifically identified or for which no quantities have been estimated. Using professional opinion, some projects are assigned a higher contingency at the project level. Additional factors to address uncertainty at the bid item level are discussed in Section 2.4.
- **Estimated P/E&D Cost:** Total estimated cost associated with all aspects of P/E&D phase, including engineering, surveying, hydraulic modeling, geotechnical work, wetland delineations, land rights, and cultural resources investigation. For the 2023 Coastal Master Plan, it is estimated uniformly as 10% across all Project and/or Unit types unless otherwise explicitly specified for a given project. Estimated P/E&D Cost is not applicable for NS projects.
- **Estimated Operations and Maintenance (O&M) Cost:** Total estimated cost associated

with all aspects of the annual O&M associated with a project. It is estimated as a default 5% of the construction cost over a 50-year period before contingency unless otherwise explicitly specified for a given project. Certain Project and/or Element Types have a more detailed O&M analysis, as discussed in Sections 3.0 and 4.0.

2.3 COST ESCALATION

To account for inflation and increases in construction costs over time, unit costs for each item are escalated to 2023 dollars using the USACE's Civil Works Construction Cost Index System (USACE, 2019a). Each bid item is assigned to one of the 20 civil works categories identified by USACE, listed below. The unit cost for the bid item is then multiplied by a scaling factor, equal to the 2023 cost index for that category divided by the cost index for that category in the year associated with the source of the bid item unit cost.

1. Relocations
2. Reservoirs
3. Dams
4. Locks
5. Fish & Wildlife Facilities
6. Power Plant
7. Roads Railroads & Bridges
8. Channels & Canals
9. Breakwater & Seawalls
10. Levees & Floodwalls
11. Navigation Ports & Harbors
12. Pumping Plant
13. Recreation Facilities
14. Floodway Control & Diversion Structure
15. Bank Stabilization
16. Beach Replenishment
17. Cultural Resource Preservation
18. Buildings Grounds & Utilities
19. Permanent Operating Equipment
20. Composite Index (Weighted Average)

2.4 COST UNCERTAINTY

The cost uncertainty factor represents the uncertainty associated with the estimated construction cost. It is based on the availability of unit cost information as well as the relative cost stability of each individual bid item within a project. Cost uncertainty factors are not applicable for NS projects.

The cost uncertainty factor acknowledges that project features are not fully developed and defined at the planning level, that projects may be more complex and costly than proposed, and that selected costs may be higher or lower than anticipated. The range of uncertainty defines an anticipated window within which costs are expected to fall based on the project complexity and outside influences.

To identify uncertainty factors, each bid item was ranked on a scale of 1 to 5, based on the relative confidence in the unit cost given the general availability of bid data. Those scores were mapped to corresponding uncertainty percentages derived from an investigation of typical ranges in bids from various restoration projects (Table 5). Project costs based on escalated unit costs were deemed to represent the “most likely” cost. Additional “low” and “high” project cost estimates using escalated values plus or minus the uncertainty percentage were also calculated to determine an estimated cost range.

Table 5. Cost uncertainty scores

Score	Cost Uncertainty
1	5%
2	7%
3	9%
4	10%
5	22%

2.5 DURATIONS

The estimated project durations represent the expected length of time to complete all planning, engineering, and design (P/E&D) and construction activities based on average historical data or previous study data of similar projects. Durations inform the Planning Tool of the lag time required between project selection and realization of a project and its impacts on the landscape; the implementation year is calculated by adding the engineering duration and the construction duration to the base year of the implementation period. Projects are screened based in durations when formulating an alternative so that resources are not allocated in the Planning Tool to an infeasible project (e.g., projects selected for the third implementation period whose construction duration is longer than the number of years in that period).

P/E&D duration includes the time and efforts associated with obtaining landowner agreements, servitudes, environmental regulatory compliance permits, and contracting agreements, but are not applicable attributes for Nonstructural Risk Reduction projects. Durations were estimated based on the project size and complexity, and specific duration assumptions are discussed by project and Element type in Table 6. In general, duration estimation accounted for activities typically associated with those project types such as mobilization/demobilization of equipment, preconstruction, magnetometer surveying, production rate of typical equipment, and project acceptance. While these assumptions are generally used to determine durations, values may be overridden for specific projects when additional information or considerations are relevant.

Marsh creation cells are assumed to be built in serial. Levee and wall reaches as part of SR projects are assumed to be built in serial, but gates within the same SR project may have some overlap in construction time. For Integrated Projects, the longest construction duration from each of its unique parts was used, with the idea that each project piece would be constructed in parallel. However, if the limiting construction duration was less than or equal to five years, an extra year was added to account for any additional complexities that occur when combining multiple restoration types.

Table 6. Duration ranges

CATEGORY	TYPE	DETERMINING FEATURE	METRIC	P/E&D DURATION (YEARS)	CONSTRUCTION DURATION (YEARS)
ELEMENT	BANK STABILIZATION	LENGTH	< 15 MILES	2	1
			15 – 40 MILES	3	2
			> 40 MILES	3	4
ELEMENT	OYSTER REEF	LENGTH	≤ 10 MILES	2	2
			> 10 MILES	3	3
ELEMENT	RIDGE RESTORATION	LENGTH	< 8 MILES	2	2
			8 – 30 MILES	2	3
			>30 MILES	3	4
		SEDIMENT SOURCE	HYDRAULICALLY IMPORTED SAND	+ 1 YEAR	+ 1 YEAR
ELEMENT	SHORELINE PROTECTION	LENGTH	< 8 MILES	2	2
			8 – 20 MILES	3	3
			>20 MILES	3	4
ELEMENT OR PROJECT	MARSH CREATION	NUMBER OF CELLS	≤ 3	2	1 PER CELL, WITH A MIN OF 2 YEARS
			> 3	3	
PROJECT	STRUCTURAL RISK REDUCTION	LENGTH	≤ 20 MILES	2	2
			≤ 40 MILES	3	3
			≤ 60 MILES		4
			≤ 80 MILES		5
			> 80 MILES		6
		GATE COUNT	1 – 10 GATES	N/A	+ 1 YEAR
			≥ 10 GATES	+ 1 YEAR	+ 2 YEARS
		GATE TYPE	ANY LARGE OR EXTRA-LARGE GATE PRESENT	N/A	+ 2 YEARS
PROJECT	INTEGRATED PROJECT	ELEMENT TYPE	MAX DURATION OF ALL ELEMENTS INCLUDED IN PROJECT	3	+1 YEAR IF MAX DURATION IS ≤ 5 YEARS
PROJECT	DIVERSION	CAPACITY	≤ 5,000 CFS	4	2
			≤ 50,000 CFS	5	3
			≤ 250,000 CFS	6	4
PROJECT	HYDROLOGIC RESTORATION	ALL PROJECTS		1-3	1-5
PROJECT	NON-STRUCTURAL (COMMUNITY SCALE)	ALL PROJECTS		1	10

3.0 ASSUMPTIONS BY PROJECT TYPE

The following sections present information about the attribute assumptions for the primary project types (SR, DI, HR, MC, RR, IP, and NS) that are evaluated in the master plan. Many of these project types include features from multiple Element Types; Section 4.0 provides more detailed assumptions of features at the Element level, along with Element-specific attributes.

3.1 STRUCTURAL RISK REDUCTION (SR)

Structural Risk Reduction projects are designed to reduce risk from storm surge-based damage. Structural Risk Reduction projects evaluated in the 2023 Coastal Master Plan include one or more of the following basic features: improvements to existing earthen levees (EL), proposed (completely new) earthen levees (PL), and proposed (completely new) concrete T-walls (PW). Items such as floodgates (typically constructed at road, railroad, and water body crossings), pump stations (included in the interior of ring levees), and other miscellaneous features (like improvements to existing floodwalls) may also be included as GA, XX or LS Elements.

Occasionally, SR projects may involve the need to elevate an existing highway. Costs for highway elevations are incurred via a combination of a simple PL Element perpendicular to the highway with a crest width of 500 ft and slopes of 100H:1V, and an XX Element for a loaded per-square-yard cost for highway removal and construction, assuming an 82-foot-wide highway.

Project attributes were developed for candidate SR projects using data from recently studied, designed, or constructed projects. Examples include the Morganza to the Gulf Adaptive Criteria Assessment (2019b) and the Southwest Coastal Louisiana Revised Integrated Draft Feasibility Report and Environmental Impact Statement (2015). O&M costs were based upon the RAND Corporation's technical report concerning the operation and maintenance of hurricane protection infrastructure in the state of Louisiana (RAND, 2012).

3.2 DIVERSIONS (DI)

Diversion projects create new conveyance channels to divert freshwater and sediment from coastal Louisiana's rivers into adjacent basins to stabilize or restore salinity gradients, nourish existing wetlands, and support land building. DI projects evaluated in the 2023 Coastal Master Plan typically include the following basic features: intake, outfall, and conveyance channels (CH), earthen levees or rock berms on either side of channels (PL or SP), intake structures (XX or LS), and outfall structures (XX or LS). Items such as roadwork and relocations, pipeline crossings, and levee tie-ins may also be included as XX or LS, or PW Elements.

Diversion projects are primarily located near the Mississippi River and rely on sediment and nutrients present in freshwater flows to deliver benefits to the outfall area. Conceptual design templates were developed for candidate diversion projects with flows typically between 1,000 and 250,000 cfs (Figure 7 and Figure 8). Costs are based on current studies conducted within CPRA. For candidate projects which do not have direct design reports or studies, unit costs derived and scaled from existing design reports were used. The cost of a diversion is affected by river stage, outfall stage, sediment data, dredging requirements, inflow and outfall channel geometry and lengths, infrastructure crossings, control structure type, and operational plan.

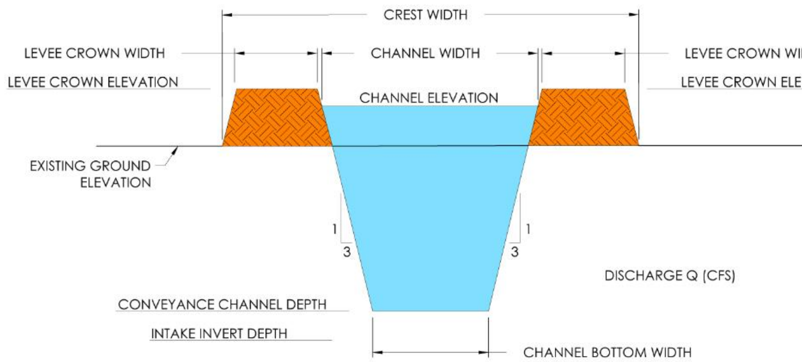

Figure 7. Diversion cross-section conceptual design template.

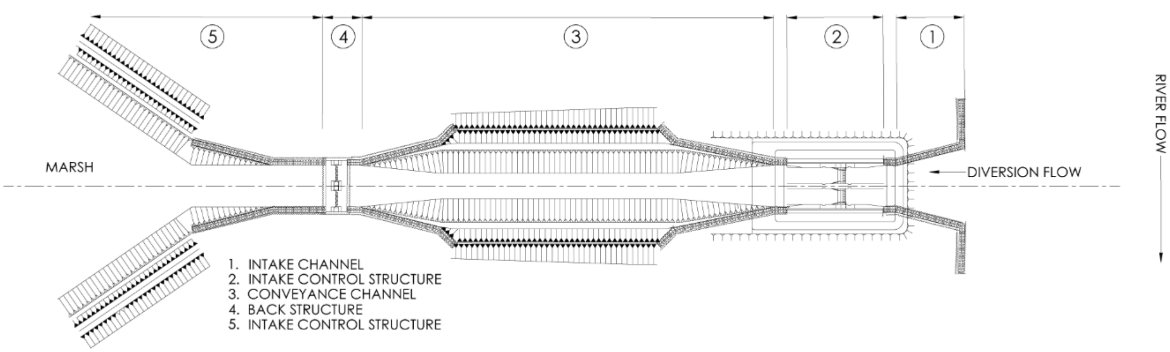

Figure 8. Diversion plan view conceptual design template.

Each diversion has at least one operational regime describing the operational strategies and triggers for each structure. When flow notations are associated with diversions in project descriptions, they refer to the peak design flow through the structure and channel (e.g., linear rating curve defined by 0 cfs diverted at 200,000 cfs river flows and 50,000 cfs diverted at 1,000,000 cfs river flows).

Each diversion also has a unique opening geometry, which describes the flow area at the intake structure (used in the ICM). In general, gated box culverts are assumed for capacities less than

15,000 cfs and tainter gates for capacities greater than 15,000 cfs. Detailed descriptions of the opening type of the intake structure using information from existing planning or feasibility-level studies are included for each project. For projects where existing information was not available, the dimensions and geometric shape of the control structure opening were calculated based on peak design flow and a scaling of similar projects in the area which have undergone some level of feasibility and/or design.

Diversions with more than a 15,000 cfs flow capacity were assumed to have a velocity of 8 ft per second for the conveyance channel. They assume ACB channel armoring for the entire conveyance channel. Diversions with less than a 15,000 cfs flow capacity were assumed to have a maximum velocity of 3 ft per second for the conveyance channel. They are assumed to have riprap channel armoring only for the conveyance channel portions falling within leveed areas. All channel armoring sizing and thickness is based upon the velocity assumptions for each project.

Diversion intake channels vary in length relative to the intake structure and source waterbody's positions. Diversion outfall channels are assumed to extend 500 to 1,000 ft into the receiving basin and/or beyond the existing basin side structural risk reduction system. A 24-inch riprap scour protection layer (with a 10% spillage factor) underlain with non-woven geotextile is assumed for the intake and outfall channels on a case by case basis.

Earthen guide levees are assumed on both sides of the conveyance channel; earthen levee tie-ins to the federal levee system are assumed for Mississippi River diversions. They are assumed to have a 12-foot crown width and 4H:1V side slopes.

O&M costs for diversions are set on a project-by-project basis and are informed by from recent design updates from the ongoing Mid-Barataria, Mid-Breton, and Maurepas Diversion design efforts. These costs range from 5-25% of the construction cost.

3.3 HYDROLOGIC RESTORATION (HR)

Hydrologic Restoration projects are primarily used to convey freshwater to proposed outfall areas, improve drainage in impounded areas, or to improve water circulation and reduce saltwater intrusion within a hydrologic system. These projects may consist of any combination of channels (CH), control structures (GA, XX, or LS), rock dike (SP), sluice gate (GA), barge gate (GA), channel impediments such as a weir (CL, XX, or LS), or other relevant structure (XX or LS). Conceptual design templates were developed for candidate HR projects on a per-project basis using past projects and proposals. The cost of an HR project is influenced by the water stage, inflow and outfall channel dimensions and lengths, project scale, control structure type, and operational plan.

Conveyance channels were sized on a project-by-project basis. Typically, HR channels will not be armored, but the need to armor the channel or its banks was also determined on a project-by-project basis.

3.4 MARSH CREATION (MC)

Marsh Creation projects create wetlands in open water areas or areas with deteriorated marsh through placement of dredged material and vegetative plantings to restore landscape and ecosystem processes and provide additional storm surge attenuation. Marsh Creation projects generally consist of only MC Elements, described in more detail in Section 4.5.

3.5 RIDGE RESTORATION (RR)

Ridge Restoration projects (formerly denoted as Ridge Creation or RC projects in previous plans) are intended to re-establish historical ridges through sediment placement and vegetative plantings to provide additional storm surge attenuation and restore forested maritime habitat.

RR projects typically assume an in-situ source (i.e., material immediately adjacent to project site), with a borrow-fill ratio of 1.5. Some larger projects (such as the chenier restoration in Cameron Parish) require more sediment than is available via in-situ sources and must be mobilized from nearby borrow sources. This approach is described in greater detail in Section 4.7.

Ridge Restoration projects generally comprise one or many RR Elements, though some RR projects may include an additional cost for closures, included as a separate CL Element (Section 4.6).

3.6 INTEGRATED PROJECTS (IP)

Integrated Projects are those that include a complex combination of multiple Element types, often including at least one MC Element intended as a landbridge feature (meaning it is filled to deeper water than traditional MC Elements) along with some type of additional armoring around one or many MC Cells, such as BS or OR Elements. In some landbridge projects, some channels are maintained to preserve a hydraulic connection between basins – in these cases, additional BS Elements are added as channel armoring. In other cases, channels are intentionally closed off, and CL elements may also be included.

When BS Elements are used to armor MC Elements in some Integrated Projects, the BS Elements use ACB armoring, MC containment dike geometries, and do not require access channels.

In general, Integrated Projects take on the assumptions of their Elements.

3.7 NONSTRUCTURAL RISK REDUCTION (NS)

The 2023 Coastal Master Plan refines the Nonstructural Risk Reduction project attributes used in project modeling and analysis to provide additional details that will aid parishes and residents in evaluating and moving forward with potential flood mitigation projects.

The following narrative presents the primary components, assumptions (on size and cost development), unit price ranges, and comparisons to unit prices developed for previous planning efforts for each Nonstructural Risk Reduction mitigation measure. These estimated costs were used in the Coastal Louisiana Risk Assessment (CLARA) model to provide a comparison of candidate Nonstructural Risk Reduction projects and to assemble groups of mitigation measures based on cost-effectiveness. These cost estimates will also be beneficial in the Phase II Initial Assessment application for the Flood Risk and Resilience Program.

Nonstructural Risk Reduction measures are voluntary in nature. The anticipated participation rates are a critical component of the evaluation process. While CPRA will make every effort to include as many property owners as possible, experience with nonstructural projects indicates that the participation rate will be less than 100%. For the 2023 Coastal Master Plan, participation rates of 75% were used.

ELEVATION PROJECTS

Elevation project cost estimating involves several components:

- Design, engineering, structural feasibility analysis, and cost estimate preparation (10% of construction costs).
- Surveying and soil sampling.
- Permitting and title search.
- Inspections, elevation certificate, and other legal fees.
- Physical lifting and lowering of the structure onto new foundation (shoring and excavation).
- Demolition and disposal of old foundation.
- Construction of a new elevated foundation that complies with CPRA elevation requirements and/or local flood ordinance(s), whichever is higher.
- Construction of typical builder's grade new stairs, landings, and railings.
- Disconnection, elevation of, and reconnection of utilities.
- Basic landscape restoration.
- Debris disposal, site cleanup, and erosion control.
- Reasonable living expenses while temporarily relocated in general area during elevation construction.

The following subsection presents notes and assumptions associated with elevation cost estimating.

NOTES AND ASSUMPTIONS FOR ELEVATION COSTS

1. Unit price estimates are developed using data and approaches provided in RSMeans® Building Construction Cost Data 2014, 72nd Annual Edition. A geographic adjustment factor is applied to adjust cost based on variable economic conditions in different types of areas (e.g., generally higher labor rates in/near urban areas associated with higher costs of living). A geographic

adjustment factor (relevant to a mix of development types) is applied to coastal Louisiana localities within one hour of urban areas. The geographic adjustment factor applies a multiplier of 0.88 to the overall projected construction cost to account for slightly more expensive labor/materials typical of the economies in more urbanized areas.

2. The estimates are also based on information in FEMA documents P-499 (2010) and P-550 (2009). The estimates assume that elevated structures fit within two rectangular modules, each of which is a minimum size of 28 ft wide by 24 ft long. Unusual structure floor plans will require more engineering and thus will have additional costs.
3. Structures are assumed to be in the 500 to 3,000 sq ft range with an average size of 2,000 square ft.
4. It is assumed that existing structures are single family, ranch style, timber-framed homes built on shallow concrete foundations. The first floor is a concrete slab-on-grade that will be included in the lift. Notes: 1) elevated structures over a crawl space are less expensive to lift, 2) the cost of raising a two-story structure is based on the first-floor sq ftage, and 3) the estimates are not applicable for homes more than two stories in height.
5. It is assumed that elevated framing is built on new timber piles. The required depth of the piles is assumed to be 40 ft. For structures elevated more than 10 ft (per FEMA P-550), concrete grade beams and columns are required in combination with the timber piles to resist anticipated loads. For timber pile installation, the existing home will need to be lifted and temporarily moved. It is assumed that adequate space is available for moving the existing structure.
6. Two means of egress are provided, each with a 4 foot by 6 foot deck at the home entryway.
7. The new space under the elevated foundation must be open, consisting of piles, piers, and columns with knee or x-bracing.
8. Materials used solely for the elevation process are assumed to have a 75% salvage value.
9. These cost estimates are valid for elevations up to 14 ft above the existing grade elevation.
10. The estimates include basic landscape restoration, debris removal, and site cleanup, as well as removal and restoration of 300 square ft of concrete driveway ($1,250). This assumption pertains to the part of the driveway near the house where construction activity would take place. The cost for removing and restoring a driveway was derived from RSMeans® 2014 using a cost of $4.18 per sq ft.
11. The structure is not located in a V Zone.
12. Several elements are not included in this cost estimate because they are

contingency items allowable only where specific conditions exist. These include:

a. Ramps/elevators for Americans with Disabilities Act access when an occupant of the structure has a permanent physical handicap and a physician's written certification.
b. Historical/architectural considerations if required by the State Historic Preservation Office.
c. Code upgrades other than elevation costs are subject to a case by case determination and approval, in writing, by CPRA if they are determined to be allowable.

ELEVATION PROJECT COST ESTIMATES

Table 7 shows the residential elevation costs for an average-sized structure (2,000 square ft) for different elevation height ranges.

Table 7. Elevation cost estimates

Component Description	Estimated Unit Price (for a 2,000 sq ft structure)
Cost to elevate over 3 ft up to 7 ft	$82.50/sq ft
Cost to elevate over 7 ft up to 10 ft	$86.25/sq ft
Cost to elevate over 10 ft up to 14 ft*	$103.75/sq ft
Temporary occupant relocation costs during construction, reimbursable by CPRA	$3,500/structure
Estimated permitting cost	$2,175/structure
Inspection cost	$4,300/structure
Survey	$470
Title search	$300
Project administration and construction management	$10,000 flat fee (based on an estimated 200 hours of work)

*10- to 14-foot elevation above grade will require concrete columns; more than 14-foot elevation above grade will require acquisition.

COMPARISON TO OTHER ELEVATION COST ESTIMATING EFFORTS

- USACE methodology results in costs that ranged from $59 per sq ft to $80 per sq ft (USACE, 2010).
- The 2012 Coastal Master Plan provided the following cost estimates for different elevation height ranges: a) over 3 ft up to 7 ft – $85 per sq ft; b) over 7 ft up to 14 ft – $95 per sq ft; and c) over 4 ft up to 18 ft – $100 per sq ft (CPRA, 2012).
- Actual project results from Terrebonne Parish show costs that range from $55 per sq ft to $106 per sq ft.

ACQUISITION PROJECTS

Acquisition project cost estimating involves three components: 1) an engineering estimate for the demolition; 2) an estimate of typical real estate transaction costs in Louisiana; and 3) a Fair Market Value (FMV) purchase price for the structure and land. The FMV is calculated using structure value data with no depreciation from the FEMA Hazus Structure Database. The Hazus data include a multiplier to bring it closer to FMV.

NOTES AND ASSUMPTIONS FOR DEMOLITION COSTS

1. Estimates are based on unit price data developed using data and approaches provided in RSMeans® Building Construction Cost Data 2014, 72nd Annual Edition.
2. Most residential acquisition projects will likely occur in rural areas of Louisiana. These areas have a geographic adjustment factor that uses a 0.81 multiplier to the projected demolition cost to account for less expensive labor/materials typical of the economies in such areas.
3. Given that the project areas are assumed to be rural, there will not be an additional cost for confined space (e.g., dense urban area) for demolition.
4. Demolition estimates include basic site restoration such as grading.
5. Demolition estimates do not include removal of hazardous materials.
6. Demolition estimates do not include removal of driveways, separate structures, or underground storage tanks/wells on the property.
7. The formulas provided are effective for 1,500 to 3,000 sq ft homes.

To account for variations in housing types and degree of foundation removal, six options are presented below:

Option A:

- Ranch home built on concrete slab-on-grade with shallow concrete footings; includes complete removal of the foundation.
- The cost of demolition = $13.75 x floor area in sq ft.

Option B:

- Ranch home built on concrete slab-on-grade, with shallow concrete footings. The cost estimate is applicable for demolition of either a partial concrete foundation or foundation walls consisting of masonry block.
- The ranch home is built over a crawl space without concrete slab. The cost estimate includes complete shallow concrete foundation removal.
- The cost of demolition = $12.00 x floor area in sq ft.

Option C:

- Two-story home built on concrete slab-on-grade with shallow concrete footings; includes complete removal of the foundation. (The first floor and second floor areas are assumed to be equal.)
- The cost of demolition = $10.75 x floor area in sq ft.

Option D:

- Multi-family, three-story home (small multi-family) constructed on concrete slab-on-grade with shallow concrete footings; includes complete foundation removal. (All floor areas are assumed to be equal.)
- The cost of demolition = $11.25 x floor area in sq ft.

Option E:

- Multi-family, three-story apartment building (large multi-family) assumed to have a 4,000 sq ft footprint and 12 units (1,000 sq ft each). It is constructed on concrete slab-on-grade with shallow concrete footings; includes complete foundation removal. (All floor areas are assumed to be equal.)
- The cost of demolition = $6.67 x floor area in sq ft.

Option F:

- Manufactured home constructed on concrete slab-on-grade.
- The cost of demolition = $8.83 x floor area in sq ft.

ESTIMATED TYPICAL REAL ESTATE TRANSACTION COSTS IN LOUISIANA AND OTHER PROJECT COSTS FOR ACQUISITION PROJECTS

The following costs (Table 8) are typically required of real estate transactions (minus the underwriting and lending fee because the community is the buyer with grant funds), as well as other project costs (e.g., environmental assessment, project management).

Table 8. Acquisition project cost estimate components and estimated costs

Component Description	Estimated Unit Price
Appraisal	$425
Survey	$470
Title search (Note: Title insurance is optional unless required by a lending institution to provide protection against title claims post-purchase. A	$300

Component Description	Estimated Unit Price
general estimate of the cost (not included in this estimate) is 0.05%.)	
Real estate transaction fees including attorney closing fee or settlement	$490 (Note: This is generally calculated at $2 per $1,000 of purchase price, plus $250)
Deed recordation/deed restriction costs	$90
Demolition – see Options A through F earlier in this section	-
Site restoration costs	Part of demolition costs
Environmental site assessment/asbestos inspection	$500
Abatement of asbestos/asbestos disposal (if necessary)	Add $3 to $5 per sq ft to demolition costs
Lead-based paint removal/disposal (if necessary)	No additional cost beyond demolition
Project management fee for property owner coordination and management of the various acquisition components (e.g., appraisals, surveys, title searches, offers, contracts, closings). This is typically a flat fee per structure instead of percentage based.	$5,000 per structure (based on an estimated 100 hours of work)

The estimated FMV employs a multiplier on the non-depreciated values (NDV) for each structure classification from the FEMA Hazus Database. These values are based on RSMeans® replacement values and are periodically updated.

Based on the costs detailed above, the overall cost estimation for acquisition projects includes FMV (NDV times multiplier) plus demolition costs (using sq ftage costs earlier in this section) plus $7,275 in fixed costs (totaled from above), which does not include title insurance or asbestos abatement. Multi-family buildings are assumed to have one owner and therefore only one transaction cost for purchase.

Itemized costs vary greatly for real estate transactions and structure demolition. Typical real estate transactions (e.g., appraisals, surveys, title work) will differ from one region to another, and even by parish within the state, depending on available resources. Additional factors impacting these costs include structure size (sq ftage), age, location (rural vs. urban), price range, value, and lot size. As a result, it is difficult to assign a single value that will accurately portray the standard costs for an entire region. Best available estimates or averages for southern Louisiana are based on an analysis of multiple reliable resources, as noted below:

- Real Estate Fees – Louisiana closing costs for approximate costs for appraisals, title search, closing fees, surveys, and deed recordation (Bankrate, 2015). Additional references include Properties Closing Cost Explained (for appraisal and title search) (Bonano ND) and Charting your Course to Home Ownership (for closings costs such as survey and attorney fees) (LSU AgCenter, 2008).

- Asbestos Abatement and Disposal – the following sources were reviewed:
  - Houston Chronicle: "How to Determine Building Demolition Costs"
  - Ohio Environmental Protection Agency (2015) Fee Schedule (p. 7)
  - Asbestos Inspection and Testing Cost (Fixr, No Date)
- Lead-Based Paint Removal/Disposal – During demolition of an entire building, debris is considered a nonhazardous waste, even with lead-based paint, given the large ratio ofthe total amount of debris to the relatively small amount of lead-based paint:
  - Nevada Department of Conservation and Natural Resources, Division of Environmental Protection (2007) Lead-Based Paint Fact Sheet.
  - USEPA Landfill Lead-Based Paint Ruling

ACQUISITION PROJECT COST ESTIMATES BY STRUCTURE TYPE

Table 9 shows the acquisition costs for different types of residential structures and a cost for vacant lots.

Table 9. Acquisition project cost estimate components

Structure Type	Acquisition Multiplier	Total Cost* (NDV = Non-Depreciated Value)
Single Family	1.6	NDV x 1.6 + Demolition by sq ft (Options A, B, or C) + $7,275
Small Multi-Family	1.7	NDV x 1.7 + Demolition by sq ft (Option D) + $7,275
Large Multi-Family	1.8	NDV x 1.8 + Demolition by sq ft (Option E) + $7,275
Vacant Lots	N/A	$72,500

*Assumes no asbestos removal needed.

COMPARISON TO OTHER ACQUISITION COST ESTIMATING EFFORTS

USACE Estimates (USACE, 2010)

- FMV Multiplier for Residential is 1.18

(Note: It is assumed that the USACE multiplier accounts for fixed costs. This is subject to verification.)

FLOODPROOFING PROJECTS

Floodproofing encompasses two broad categories: dry and wet floodproofing. Due to its greater range of applicability, only dry floodproofing techniques will be employed for the purposes of cost estimating.

Dry floodproofing project cost estimating involves multiple components, as follows:

- Flood shields for all doors and windows at or below the flood protection level on exterior walls.
- Use of flood-resistant materials on interior of building up to the level where water is expected to accumulate due to seepage (spray-on cement for waterproofing in this estimate).
- Labor and materials to install floodproofing (excavation, mobilization, and asphalt).
- Code-required egress above flood elevation.
- Sewage backflow preventer.
- Internal drainage system for seepage.
- Survey and title search.
- Permitting and final inspection.
- Project administration and construction management.
- Engineering design costs (10% of construction costs).

The following subsection presents notes and assumptions associated with floodproofing cost estimating.

NOTES AND ASSUMPTIONS

1. Estimating methods include USACE-provided costs and unit price data developed using data and approaches provided in RSMeans® Building Construction Cost Data 2014, 72nd Annual Edition.
2. Based on a coastal Louisiana locality within one hour of an urban area, floodproofing projects use a coastwide geographic adjustment factor to apply a 0.88 multiplier to the projected construction costs to account for slightly more expensive labor/materials typical of the economies in more urbanized areas.
3. Estimates are for dry floodproofing non-residential structures and limited to floodproofing of 3 ft or less above-ground.
4. Cost estimates are developed using the perimeter footprint (not straight square footage).
5. Design requirements are based on FEMA P-259, part 5D (FEMA, 2012) and state building requirements presented in the American Society of Civil Engineers (ASCE) 24 (ASCE, 2014).
6. Dry floodproofing methods assume that the existing structure (wall, foundation, and slab) and sanitary system can resist the hydraulic forces imposed by the flood.

7. The existing structure's wall material should be conducive to receiving floodproofing material. Acceptable examples include concrete masonry units, masonry, and brick.
8. The concrete slab-on-grade is water-tight.
9. The existing sanitary pipe system must add a backflow preventer. It is assumed that the existing plumbing will be capable of resisting the hydraulic flood forces.
10. The flood shields at the doorways (and windows less than three ft above-ground) will require manual activation and, once in place, will prohibit egress from the facility.
11. A means of egress above the design flood-protection elevation is required in case local code requires freeboard. For example, if a building is floodproofed to 3 ft, then egress is needed (e.g., window, door) above 3 ft, given that floodproofed doors will be blocked.
12. This floodproofing methodology is subject to impacts due to flood depth and duration and may only be effective for a few hours.
13. The floodproofing requirements are based on FEMA P-259 Part 5D (FEMA, 2012).
14. The building code requirements prescribed in ASCE 24-05 (requirement of the International Building Code 2012, adopted in Louisiana 1/1/2014) further limit dry floodproofing methods in Coastal A Zone and V Zone high-wave velocity areas (ASCE, 2006). Also, a method for egress is required above the flood elevation (ASCE, 2010). The required egress is previously mentioned in Item 10 in this list.
15. Estimates are based on actual quantities in lieu of a facility location to represent the actual conditions of the facility more closely.
16. Estimates do not include the following elements which may be required (case by case):
    - Landscaping restoration.
    - Walkway or driveway demolition and restoration.
    - Shoring for structure during installation.

FLOODPROOFING PROJECT COST ESTIMATES

Table 10 shows the dry floodproofing costs for a representative non-residential structure (6,000 square ft) and a summary cost per sq ft in the last row. Table 11 provides a comparison of key costs with USACE estimated costs.

Table 10. Dry floodproofing cost estimate components and cost per sq ft

Component Description	Estimated Unit Price (for representative non-residential 6,000 sq ft structure)
Code-required egress above the design flood protection elevation	$6,800/each
Backflow preventer (required to be regularly maintained, assumes plumbing can withstand the hydraulic forces)	$6,200/each
Flood shields (metal), maximum three ft wide (assumed), require adequate structure for fastening shield. Cost does not include bracket installation. (Note: any windows below the design flood protection elevation will also require a flood shield.)	$135/sq ft of doors/windows below flood elevation
Spray-on cement (1/8-inch-thick); existing structure must be of cementitious material (i.e., not applicable for timber/metal siding)	$5.50/sq ft
Asphalt (two coats below grade); see periphery drainage below for excavation requirements	$3/sq ft
Periphery drainage, includes excavation (see notes below)	$30/linear foot
Sump pump and back-up power required for addressing seepage	Sump pump – $360; Back-up power (from gas-powered generator delivering 277/480 volts) – $8,260
Survey and title search	$770 (same as acquisition survey and title search cost)
Permitting and inspection	$6,475 (same as elevation permitting and inspection cost)
Project administration and construction management	$7,500 flat fee (based on an estimated 150 hours of work)
Engineering design costs	10% of construction costs
Floodproofing costs per sq ft	$19.40/sq ft

*Assumes structure requires no shoring, that excavated soils can be used for backfilling, and that landscaping restoration and concrete walkway demolition/restoration is not needed.

COMPARISON TO OTHER FLOODPROOFING COST ESTIMATING EFFORTS

Table 11 provides key floodproofing costs compared to USACE-estimated costs.

Table 11. Key floodproofing costs versus USACE-estimated costs

Required Components	USACE Cost (National Costs - USACE, 2010)	CPRA 2017 Coastal Master Plan Costs
Required egress	N/A	$6,800 each
Backflow valve	N/A	$6,200 each
Flood shield	$110 each	$135/sq ft of door or window openings below flood elevation
Spray-on cement	$5/sq ft	$5.50/sq ft
Asphalt	$2/sq ft	$3/sq ft
Periphery drainage	$35/sq ft	$30/linear foot
Sump pump/back-up power	N/A	Sump pump – $360; Back-up power generator – $8,260

4.0 ATTRIBUTES AND ASSUMPTIONS BY ELEMENT TYPE

The following sections present information about the attributes and corresponding assumptions for each Element Type that compose the projects proposed in the 2023 Coastal Master Plan. Section 3.0 provides additional project-level assumptions that become relevant when multiple Element types are combined within a Project Type.

Element Types for Bank Stabilization (BS), Oyster Reef (OR), Shoreline Protection (SP), and Ridge Restoration (RR) projects are representative of the corresponding 2017 Project Types, whereas Structural Risk Reduction (SR), Diversion (DI), Marsh Creation (MC), and Hydrologic Restoration (HR) projects have been subdivided into multiple Element Types, listed in Table 12. Miscellaneous Quantity (XX) and Lump Sum (LS) Element Types have also been added for costing complex features which do not lend themselves to detailed attribute generation or cost estimation for this coastwide, planning level process. Examples of XX Elements include structures such as pump stations and diversion outfalls, while LS Elements represent additional costs unable to be otherwise captured by the PCT, typically originating from project-specific design reports. Integrated Projects can be made up of any combination of Element types.

As mentioned earlier in this report, each Element has a subgrouping of Components that comprise some feature of that Element. For example, Shoreline Protection rubble mound Elements include a geotextile base, riprap, navigational aids, and settlement plates as Components. A Component list for each Element type is listed in Table 12.

Table 12. Element type summary

Element Type	Label	Description	Applicable Project Types	Components
Proposed Levee	PL	Levee reaches in areas with no previous levees (PL) or located on top of existing levees (EL)	SR, DI, IP	• Levee embankment and compaction • Clearing and grubbing • Access roads (geotextile and crushed stone) • Surface area coverings (turf or HPTRM) • Stormwater pollution prevention plan
Improvements to Existing Levee	EL			
Proposed Floodwall	PW	Newly proposed T-wall reaches	SR, DI, IP	• Concrete • Clearing and grubbing • Excavation • Steel piles • Sheet pile cut-off walls • Three-bulb waterstops
Proposed Gates	GA	Flood gates	SR, DI, IP	• Highway gates • Railroad gates • Sector gates • Sluice gates • Locks
Channel Creation	CH	Dug or excavated channels	HR, DI, IP	• Channel dredging or excavation • Armoring • Clear and grub
Marsh Creation	MC	Wetland creation from dredged material	MC, IP	• Sediment for marsh creation • Earthen containment dikes • Settlement plates • Vegetative plantings

Element Type	Label	Description	Applicable Project Types	Components
Gap Closure Features	CL	Features intended to entirely or partially block canals or marsh channels	IP, RR, HR	• Sheet pile weir
Ridge Restoration	RR	Reestablishment of historical ridges	RR, IP	• Ridge creation • Access channel dredging • Vegetative plantings
Shoreline Protection	SP	Nearshore segmented rock breakwaters	DI, IP	• Access and flotation channel dredging • Geotextile • Navigational aids • Riprap • Settlement plates
Bank Stabilization	BS	Onshore earthen fill and vegetative plantings	IP	• Bank stabilization • Access channel dredging • Armoring
Oyster Barrier Reef	OR	Bioengineered oyster reefs	IP	• Oyster reef • Access and flotation channel dredging • Geotextile • Navigational aids
Miscellaneous Quantities	XX	Any additional features	SR, HR, DI, IP	• Diversion intake structures • Road Relocations • Gates • Miscellaneous additions
Miscellaneous Lump Sums	LS	Any additional costs	SR, HR, DI, IP	• Diversion intake structures • Road Relocations • Gates • Miscellaneous additions

4.1 PROPOSED LEVEES (PL) AND IMPROVEMENTS TO EXISTING LEVEES (EL)

PL and EL Elements consist of levee embankment and compaction, clearing and grubbing, access roads (composed of geotextile and crushed stone), turf plantings or high-performance turf reinforcement mats (HPTRM), and stormwater pollution prevention plan (SWPPP) Components. The volume of sediment used in the levee embankment and compaction Component, the volume of clearing and grubbing Component along the footprint of the Element, and the area of the turf or HPTRM Component along the surface of the Element are all calculated based on the design template shown in Figure 9. Clearing and grubbing is expected to remove 0.5 ft of material across the entire levee footprint, adding some volume to the levee embankment and compaction Component.

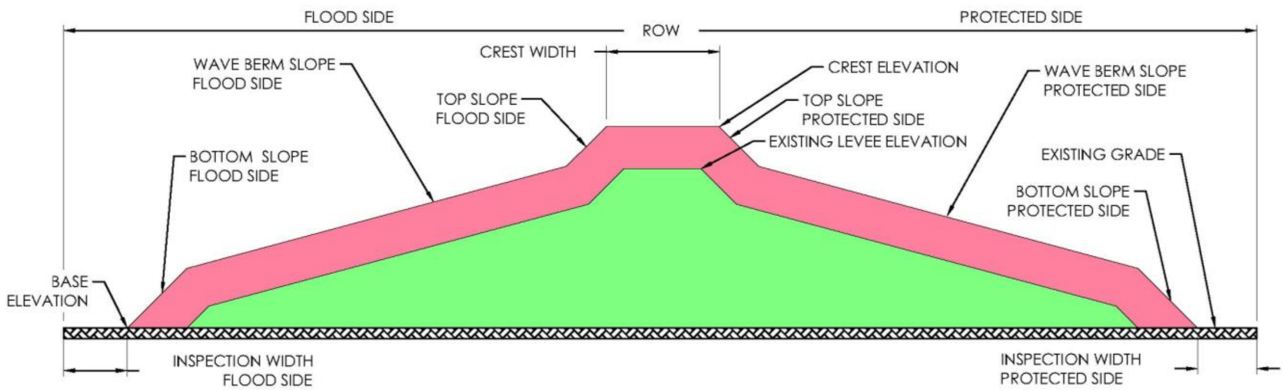

Figure 9. Levee conceptual design template.

The calculated fill volume for levees incorporates a 25% overbuild factor added to the levee height to account for initial compaction of earth beneath the levee (not long-term subsidence). Levee fill unit prices vary on a per-project basis based on analysis of recently constructed projects and planning study estimates. Variation in price accounts for proximity to suitable borrow material. Specific locations for fill material were not identified as part of this effort.

Based on local geotechnical and hydraulic conditions, some levee templates include stability berms on the protected side and wave berms on the flood side of levees. CPRA's Louisiana Flood Protection Design Guidelines (July, 2015b) were used when applicable to inform levee geometry selections when not made explicit in a source report or document.

Woven geotextile (in the form of multiple 100-foot panels) is assumed to be placed under all rock, with 5 ft of overlap along each panel and 5 ft of overhang along each end of the rock feature, with an additional 5% of panel area to account for overage.

The Estimated O&M Cost for all PL Elements includes routine inspections and reporting, vegetative plantings, gravel access road maintenance, mowing, varmint control, surveys, and other typical maintenance items, itemized as a weighted value per acre of levee footprint.

There is no assumption of maintenance lifts for any levee system other than the HSDRRS surrounding New Orleans and the Mississippi River and Tributaries (MR&T) levees along the Mississippi and Atchafalaya Rivers. This assumption was made because there is no guarantee of dedicated maintenance or improvement funds for lifts of systems (other than HSDRRS and MR&T) to account for combating relative sea level rise and maintain a consistent or improved level of risk reduction. Maintenance lifts to maintain present levels of risk reduction are considered local responsibility and therefore are not considered projects with dedicated costs in the master plan. While scheduled HSDRRS and MR&T maintenance lifts were reflected in the storm surge models over the 50-year modeling timeframe so that the present level of risk reduction was maintained over the entire 50 years in the face of increasing relative sea level rise rates, costs associated with these maintenance lifts were not included in the overall Element costs.

The following list of attributes is common for each EL and PL Element. Attributes designated with an asterisk (*) are provided separately for both the proposed and existing levee feature (if applicable) for the PCT to appropriately calculate required quantities of materials.

1. **Length:** The length along the centerline of the Element. Alignments were obtained from previous reports or project proposals and used to identify reasonable tie-in points to other existing projects and natural features.
2. **Base Elevation:** The average base elevation/existing ground elevation as measured from the DEM along the alignment centerline, provided by the project proposer, or taken from other available survey data.
3. **Crest Elevation*:** The crest elevation(s) of the proposed levee and of the existing levee, if applicable. This elevation is predetermined by the project proposer and may or may not be based upon a given level of protection/storm recurrence frequency.
4. **Crest Width*:** The crest width of an existing levee proposed for improvement, typically 10 ft.
5. **Top Slopes (Protected and Flood Side)*:** The main embankment slopes of an existing levee proposed for improvement, typically equal to 3H:1V or 4H:1V. Protected and flood side slopes are not necessarily equal.
6. **Berm Slopes (Protected and Flood Side)*:** The stability berm slope of the protected side of a levee and the wave berm slope on the flood side, if berms are present in the proposed or existing levee; typically a 10H:1V slope. Protected and flood side slopes are not necessarily equal.
7. **Bottom Slopes (Protected and Flood Side)*:** The toe slopes of the protected and flood side of an existing levee proposed for improvement (if present), typically a

3H:1V or 4H:1V slope. Protected and flood side slopes are not necessarily equal.

8. **Berm Top Elevation*:** The elevation of the top of a wave or stability berm as part of the overall level feature if berms are present in the proposed or existing levee.
9. **Berm Bottom Elevation*:** The elevation of the bottom of a wave or stability berm as part of the overall level feature if berms are present in the proposed or existing levee.
10. **Inspection Width (Protected and Flood Side):** The width of any present inspection corridor adjacent to the protected or flood side toe of a proposed levee, typically 10 ft wide, but can vary project by project. Protected and flood side inspection widths are not necessarily equal.
11. **Access Road Width:** The width of haul road required for proposed levee construction, typically 20 ft, but can vary project by project.
12. **Levee Material Unit Cost:** A code representing the unit cost of levee material, ranging from low ($32 per CY) to extra high ($52 per CY).
13. **Levee Covering Type:** A code representing the type of covering over the surface area of the levee, generally turf for SR projects and HPTRM for DI projects.
14. **Base Width:** The width of the entire feature (including access roads and inspection corridors) from flood side toe to protected side toe, calculated in the PCT.

4.2 PROPOSED FLOODWALLS (PW)

PW Elements consist of concrete, steel piles, sheet pile cut-off walls, three-bulb waterstop, clearing and grubbing excavation Components. The volume of concrete, the amount of steel piles, and area of sheet pile cutoff walls are all calculated based on the design template shown in Figure 10.

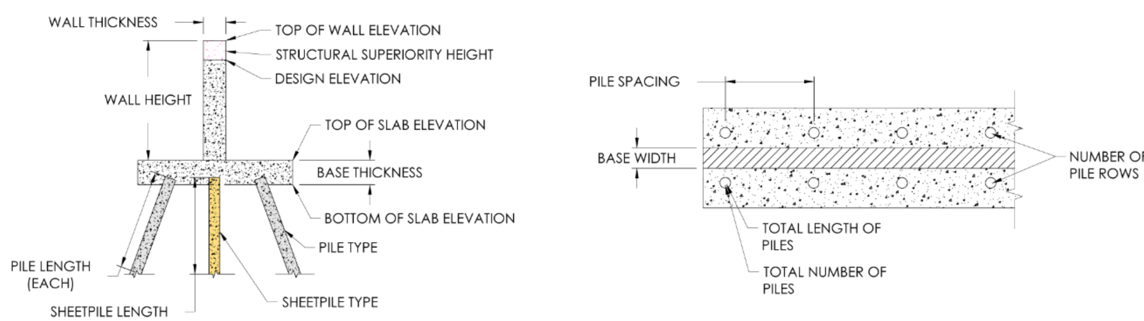

Figure 10. Floodwall conceptual design template.

Although floodwalls may be constructed at various locations along a flood protection system, for the purposes of this analysis, it is assumed that they would primarily be constructed at locations with limited right of way, locations of high erosion potential, junctions with water crossings, railroads, and major roadways (i.e., interstates and state highways). In SR projects, PW Elements are assumed to extend 200 ft on either side of a proposed floodgate and 120 ft on each side of a railroad or major road crossing.

The Estimated Operation and Maintenance Cost for all PW Elements includes routine inspections and reporting and floodwall maintenance, itemized as a weighted value per linear foot of wall.

The following list of attributes is common for each PW Element.

1. **Length:** The length along the centerline of the Element. Alignments were obtained from previous reports or project proposals and used to identify reasonable tie-in points to other existing projects and natural features.
2. **Base Elevation:** The base/existing ground elevation of the proposed floodwall as measured from the DEM along the alignment centerline, provided by the project proposer, or taken from other available survey data.
3. **Crest Elevation**: The elevation of the top of the flood wall stem. For standalone PW Elements, this elevation is predetermined by the project proposer and may or may not be based upon a given level of protection/storm recurrence frequency. In cases where a flood wall ties into an earthen flood protection feature, the crest elevation is 1 to 2 ft higher than the adjoining earthen levee height. An additional foot is added to the defined crest elevation when calculating concrete volume to account for structural superiority.
4. **Wall Base Thickness:** The base thickness of the proposed floodwall. The default base thickness depends on the height of wall stem required; walls under 10 ft have a base thickness of 2.5 ft, walls greater than 20 ft high have a base thickness of 6 ft, and values are linearly interpolated for walls between 10 and 20 ft, with values rounded to the nearest 0.25 ft.
5. **Wall Base Width:** The width of the base of the proposed floodwall. By default, if a wall is located on top of a levee, the base width is equal to the wall height. Otherwise, the base width is generally equivalent to 75% of the wall height.
6. **Wall Thickness**: The stem thickness of the proposed floodwall. By default, if a wall height is under 10 ft, the wall thickness is 2 ft; if a wall height is between 10 and 20 ft, the wall thickness is 3 ft, and if a wall is greater than 20 ft, the wall thickness is 4 ft.
7. **Pile Length:** The assumed length of all steel H-piles supporting the proposed floodwall. By default, pile lengths for projects west of the Atchafalaya River are equal to 60 ft, while pile lengths for projects east of the Atchafalaya are equal to 100 ft.
8. **Pile Rows:** The number of assumed rows of steel H-piles required to support the flood wall base. By default, walls under 10 ft high have 2 rows of piles, and an extra row of piles is added for every 5-foot increment in height.
9. **Pile Spacing: T**he center-to-center spacing of the steel H-piles piles required to

support the flood wall base, typically equal to 6 ft.

10. **Sheet Pile Length:** The length of the steel sheet piles used for the seepage cutoff under the proposed floodwall. The sheet pile length is typically 20 ft.
11. **Base Width:** The width of the entire feature (including access roads and inspection corridors).

4.3 PROPOSED GATES (GA)

Floodgates are needed where levees cross a road, railroad, or waterway. GA Elements comprise all highway gate, railroad gate, sector gates, sluice gates, or lock features within a project, and may represent multiple gates in the same Element. Only major roads were assumed to require gates, and GA Elements were not assigned to these minor road crossings because these features typically require earthen embankment crossings.

The Estimated Operation and Maintenance Cost for all GA Elements includes a generalized maintenance cost applied per gate as opposed to the default O&M assumption of 5% of the Construction cost.

The following attributes are used to describe GA Elements:

1. **Gate type**: Swing or roller gates were assumed at all railroad, interstate, and state highway crossings. Either a sector gate, stop log gate, swing gate, barge gate, or lock was assumed at waterways or canals. Gate type was dictated by the source study or report for the alignment when available.
2. **Width:** Gate width varied by gate type. The width of swing and roller gates is based on GIS data and set to an opening size of either 30 or 40 ft to accommodate road/railroad traffic. Sector gate lengths ranged from 30 to 250 ft, barge gates ranged from 30 to 250 ft, stop log gates ranged from 20 to 30 ft, and swing gates ranged from 25 to 40 ft. The width of gates is determined by the anticipated traffic loads in the waterway and authorized dimensions of the channel.
3. **Invert Elevation:** Elevation at the bottom of the gate.
4. **Design Elevation:** Elevation at the top of the gate. All gate heights are assumed to be 1 to 2 ft higher than the adjoining levee or T-wall height.
5. **Gate Count**: The number of individual gates within a GA Element.

4.4 CHANNEL CREATION (CH)

Several project types involve some form of channel creation, whether it be for a diversion or a hydrologic control channel. CH Elements consist of three main Components: dredging or excavating a trapezoidal channel, channel armoring, and clearing and grubbing land before excavation. Clearing and grubbing costs are only applicable to channels that are excavated from previously undisturbed land and are not present for dredged existing channels. When dredging an existing channel, all existing channels are assumed to have a 3H:1V slope.

The following attributes are used to describe CH Elements. Attributes designated with an asterisk (*) are provided for both the proposed and existing channel feature, if applicable.

1. **Length**: Total length of the Element's centerline as measured in GIS.
2. **Invert Elevation*:** The bottom elevation of a given channel in NAVD88.
3. **Base Elevation**: The existing ground elevation of the land to be excavated or of the bank immediately adjacent to an existing channel, as measured in GIS from the DEM.
4. **Bottom Width**: Total width of the bottom of the channel, varied on a project-by-project basis.
5. **Slope**: Slope of the proposed trapezoidal channel, generally equal to 3H:1V.
6. **Top Width***: Total width of the top of a channel at existing ground elevation, as calculated by the PCT and/or provided for an existing channel, if applicable.
7. **Channel Type**: An indication of whether the channel is an intake, conveyance, or outfall channel, and whether the channel is dredged or excavated.
8. **Armoring Type**: The type of armoring used to protect against erosion, generally either articulated concrete block (ACB) mat or riprap.
9. **Scour Protection Thickness**: If riprap is provided as scour protection, a thickness of required riprap is provided, generally assumed as 2 ft.
10. **Geotextile Type:** An indication of whether woven or nonwoven geotextile (or no geotextile) is assumed to line the channel bottom. If added, geotextile panels (100-foot length) are assumed to line the channel bottom, with 5 ft of overlap along each panel and 5 ft over overhang along each end of the channel, with an additional 5% of panel area to account for overage.

4.5 MARSH CREATIONS (MC)

As mentioned in Section 3.0, Marsh Creation Elements create wetlands in open water areas or areas with deteriorated marsh through placement of dredged material and vegetative plantings to restore landscape and ecosystem processes and provide additional storm surge attenuation. MC Components include sediment to build the marsh, earthen containment dikes, vegetative plantings, and settlement plates (Figure 11). Costs pertaining to oyster lease acquisition are not explicitly defined, but are assumed to be covered by the P/E&D and CM costs.

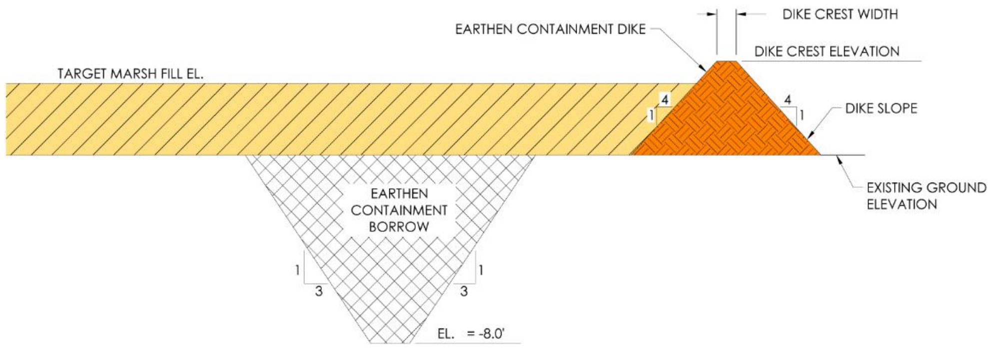

Figure 11. Marsh creation conceptual design template.

Each MC Element is broken down into multiple Cells, each about 2,000 acres in area, to capture dredge pipeline mobilization and containment dike costs more accurately for a single Element. The 2,000-acre threshold was determined through the Draft Feasibility Report, Innovative Dredging Initiative (Arcadis, 2011) as well as through study of common industry practice and lessons learned from past CPRA projects. This allowed the analysis team to approach vast projects on a scale that is relatable to the scale found in previously constructed CPRA hydraulic fill projects.

Fill volumes for marsh are determined by the ICM for each environmental scenario and implementation period by superimposing the design template over the master plan DEM and evaluating the volume of material required. For standard MC Elements, all areas within the Element polygon with a depth less than 2.5 ft below mean sea level (MSL) were filled to with sediment to create land; this new land was then built to a project-specific target elevation that varies by environmental scenario and implementation period to account for sea level rise and subsidence. Open water areas deeper than 2.5 ft were not filled unless the Element was flagged specifically to be used as part of a landbridge project. In landbridge projects, the entire area of the MC Element was filled to the target elevation, regardless of the water depth. Areas with elevations greater than the design elevation had no material placed on top. Likewise, marsh area attributes used to cost plantings and settlement plates were derived from the spatial extent of created marsh based on the same elevation thresholds. The area and volumes used for final cost estimation correspond to the relevant environmental scenario and implementation period within which a project is picked by the Planning Tool.

Unit costs for sediment represent pay-on-the-fill values and are applied directly to the volumes reported to the PCT by the ICM. These unit costs were estimated using relationships between pumping distance and sediment type based on recent dredging projects conducted by CPRA (Figure 12). If an offshore borrow source more than 24 miles away from the project was used to obtain dredge material, mobilization costs assume a hopper dredge was used to obtain material; otherwise, a cutterhead suction dredge was assumed. A booster was added for every 15,000 ft of dredging distance over 25,000 ft.

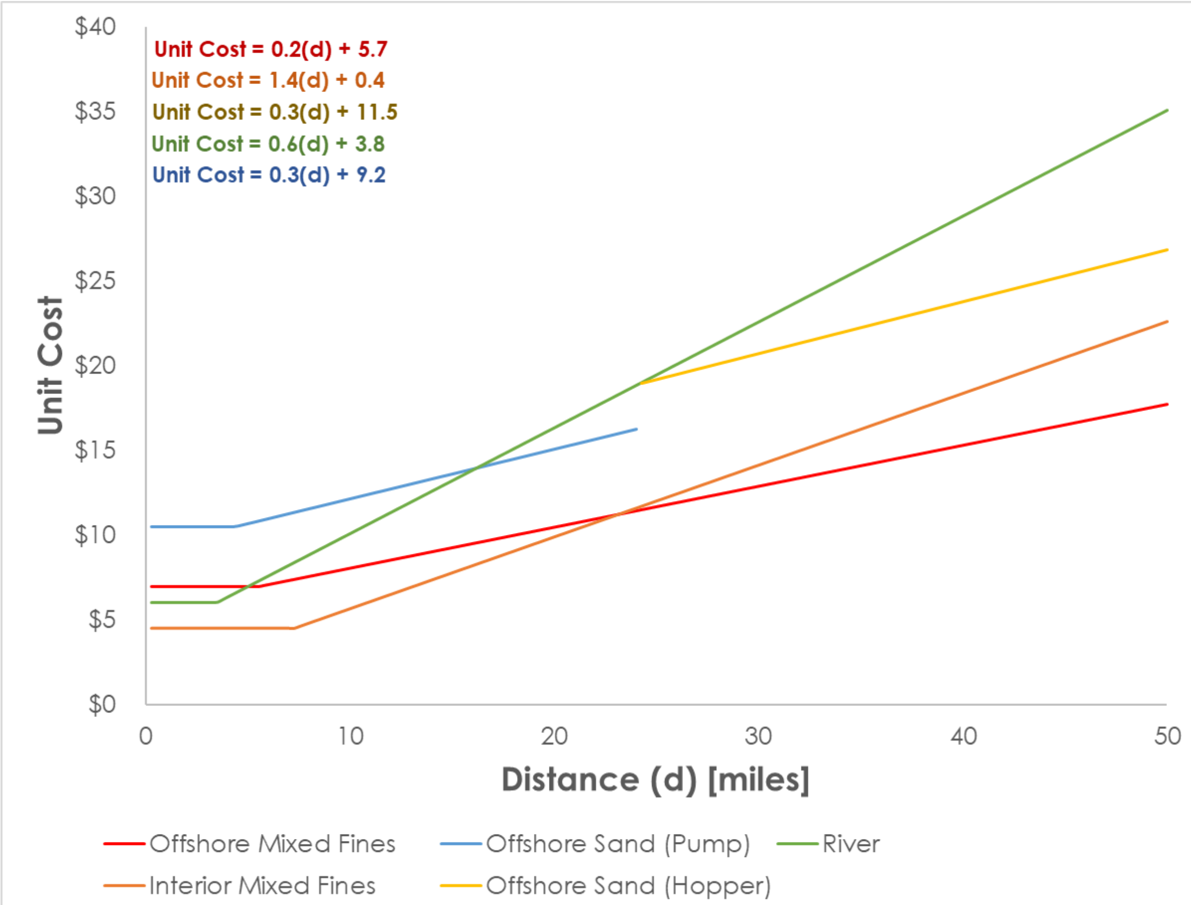

Figure 12. Pumping cost versus distance pumped by sediment type.

Each MC Element has costs associated with each nearby borrow source in its region. From these options, one or many borrow sources can be chosen by the Planning Tool for each MC Element based on sediment availability and cost. Typically, the borrow source is the nearest available and suitable borrow source to the marsh area boundary. Borrow sources were selected from those identified in the Report on Louisiana Surficial Sediment Distribution Maps Compilation (Larenas et al., 2015), the Louisiana Sand Resources Database (LASARD) (CPRA, 2020), and additional CPRA-defined inland sources. Borrow sources are categorized by location and sediment type, and unique cut-to-fill ratios were assigned to each source. Cut-to-fill ratios were developed via a settlement analysis performed by CPRA and informed by professional engineering judgement (Table 13). Each source was also assigned a replenishment rate, determined based on the assumption that enough sediment will be deposited in river, maintenance dredging, and Lake Calcasieu interior borrow sources to fully replenish the borrow source in 10 years, whereas other interior sources and offshore sources have no means of replenishment. A full list of utilized borrow sources, along with fill volumes and replenishment rates for each source are included in Supplemental Material F1.5: Available Sediment by Borrow Source.

Table 13. Cut fill ratios by borrow area type

Borrow Area Type	Cut-to-Fill Ratio
River (Mississippi and Atchafalaya)	1.1
Interior	1.3
Offshore – Deltaic Plain	1.2
Offshore – Cheniere Plain	1.1
Maintenance Dredging	1.2

Because dredge costs vary greatly by distance, mobilization costs for MC Elements are calculated based on the length of dredge pipeline and the types of dredging equipment required rather than a flat 5% of the construction cost. A GIS tool was developed to determine efficient pipeline corridor paths to link each project to nearby borrow sources. This tool first draws a path from a borrow source to an Element or a group of Elements, and then draws paths to the farthest distance of each individual Cell within the group. This tool then determines the amount and types of conveyance pipe required by comparing the route to the initial land/water raster from the ICM; the dredge pipeline corridor is split into subline (under water), shoreline (over land), and pontoon (3,000 ft of floating line required behind the dredge). The pipeline is then further divided into segments that must be placed before dredging can begin (prelay) and those sections that would require pickup when dredging is complete. The pipeline corridor is assumed to be maintained throughout construction.

If the Planning Tool determines that multiple borrow sources are required to build an MC Element based on sediment availability, the Component and Survey costs of the MC Element are scaled based on the percentage of sediment volume coming from each borrow source, but full mobilization costs are incurred for each borrow source utilized.

Containment dikes are assumed to have a crest width of 5 ft, side slopes of 4H:1V, and a crown elevation of +4.5 ft MSL. Dikes are assumed to be maintained during construction using in-situ material and constructed via marsh buggy backhoe or a barge-mounted bucket dredge. A loaded unit cost per foot is applied to the total sum of the perimeters of all Cells within an Element.

The annual O&M costs (estimated as 5% of the construction costs) assume three vegetative plantings (at Years 5, 15, and 25), containment dike gapping (at Years 1, 3, and 5), and profile surveys (at Years 5, 15, 25, 35, and 50).

The following attributes are used to describe MC Elements. Attributes designated with an asterisk (*) vary by both environmental scenario and implementation period to account for sea level rise and subsidence. Attributes designated with two asterisks (**) vary with Borrow Source to account for sediment availability and are determined at a Cell-level and then aggregated within an Element.

1. Marsh Elevation*: The target elevation for consolidated fill material after one year of settlement. The initial target marsh fill elevation is set to a height above

mean water level at the year of implementation. The height above MWL was set following internal marsh creation guidelines at CPRA and was intended to have the marsh platform settle into tidal range within 10-years post construction. This was calculated using: CPRA-project derived settlement curves, spatially varied rates of subsidence, initial condition-derived rates of and organic matter accretion, and rates of eustatic sea level rise that are timing- and scenario-specific rates. Marsh elevation, above mean water level, is therefore specific to location, environmental scenario, and implementation year of the project.

2. **Marsh Fill Area*:** Marsh acreages provided based on surface footprint of filled Element areas.
3. **Marsh Fill Volume***: The total estimated volume of marsh fill material required to construct the project feature using one initial lift based on the construction grade elevation.
4. **Deep Water Flag**: Indication that the MC Element should be filled with sediment even when the elevation within the footprint was less than -2.5 ft MSL. This flag is raised for MC Elements that are part of a landbridge project intended to reduce the tidal prism in a basin.
5. **Containment Dike Length**: Total perimeter of all marsh Cells within an Element.
6. **Cell Count**: The number of cells within a single MC Element.
7. **Marsh Vegetation Type**: An indication of the appropriate starter vegetation post-construction depending on local environmental conditions; Assumed brackish for all 2023 Coastal Master Plan candidate projects.
8. **Borrow Source**: Any borrow source that the MC Element may draw sediment from. The borrow source correlating to the lowest-cost and best sediment availability for the Element is dubbed the **Preferred Borrow Source**.
9. **Dredge Subline Prelay**:** The length of dredge pipeline required to be placed under water before dredging could begin. This generally represents the least-dredging distance between the borrow source and the edge of an Element.
10. **Dredge Shoreline Prelay**:** The length of dredge pipeline required to be placed on land before dredging could begin. This generally represents most of the distance from the edge of an Element or Element group closest to a borrow source to the farthest point of each Cell within an Element.
11. **Dredge Shoreline Pickup**:** The length of dredge pipeline required to be picked up after dredging is finished. This is generally equal to the length of the Dredge Shoreline Prelay, minus the length of pipeline laid within the boundaries of a given Cell.
12. **Average Fill to Borrow Length**:** The average distance between a borrow source and the Cells within each Element, used to determine the unit cost per cubic yard of sediment.

4.6 GAP CLOSURES (CL)

Several project ideas submitted as part of the 2023 New Project Development Program included ideas to constrict the tidal prism by building landbridge features and closing off numerous channels through the marsh (both natural and manmade). To accommodate these ideas, a new Element type has been included: the Gap Closure Element (CL). CL Elements are based upon existing designs for weirs in the marsh and consist of a sheet pile closure Component. Some assume a small craft navigation opening and some do not, on a project-by-project basis. All navigation openings are 40 ft wide by 8 ft deep (Figure 13).

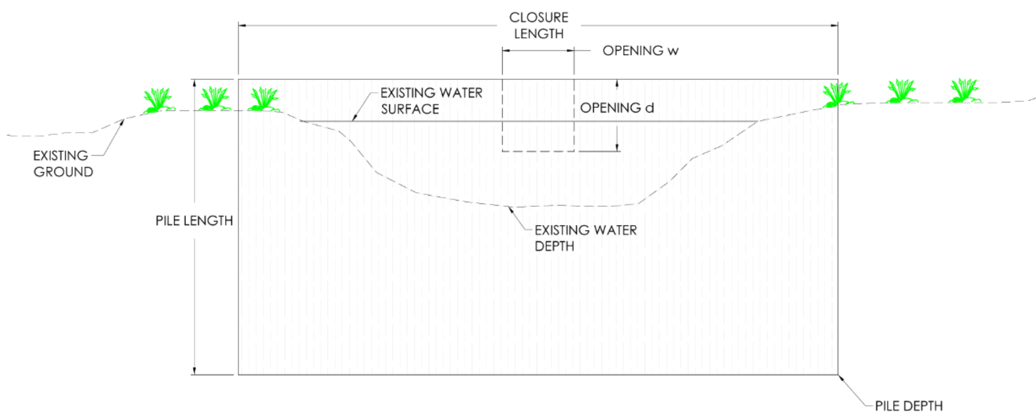

Figure 13. Gap closure conceptual design template.

The following attributes are used to describe CL Elements:

1. **Length:** Total bank-to-bank length of the Element's centerline as measured in GIS perpendicular to the channel being closed.
2. **Crest Elevation:** Top of the sheet pile wall elevation of the Element, typically equal to the crest elevation of the surrounding Marsh Creation Element.
3. **Base Elevation**: The base elevation/existing ground elevation as measured in GIS from the master plan DEM along the alignment centerline. Sheet piles are assumed to follow a general rule of 1/3 of their total length sticking up in a cantilever fashion (either in water or air) and 2/3 of their total length buried, as measured from the channel invert.
4. **Navigation Flag**: A binary flag to denote if a navigation opening is present.

4.7 RIDGE RESTORATION (RR)

Ridge Restoration Elements (formerly denoted as RC projects in previously plans) are intended to reestablish historical ridges through sediment placement and vegetative plantings to provide additional storm surge attenuation and restore forested maritime habitat. Components for RR Elements include sediment for ridge creation, access channel dredging, and vegetative plantings (Figure 14).

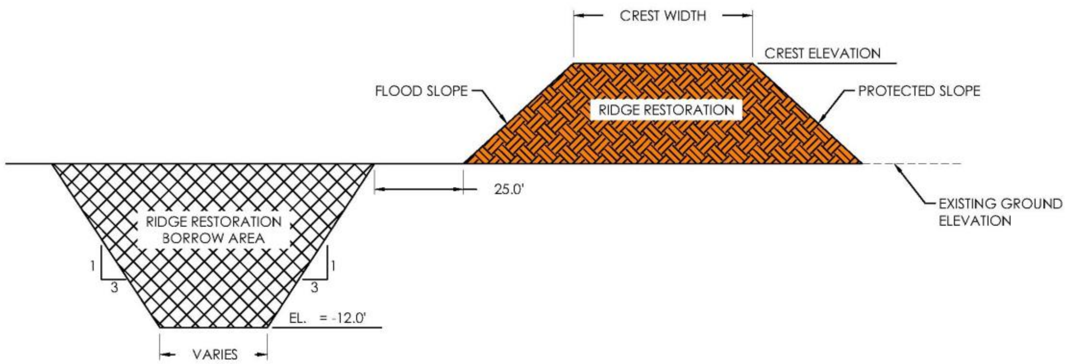

Figure 14. Ridge restoration conceptual design template (in situ).

Saline vegetative plantings are applied on a cost-per-acre, assuming a 60% coverage of the surface area of the ridge above 1.5 ft NAVD88, to install the appropriate starter vegetation post-construction. Additionally, the area along the crest of the ridge is planted with hardwood trees.

The calculated fill volume for ridges incorporates a 25% overbuild factor to account for initial compaction of earth beneath the ridge and to offset the cost of potential future ridge lifts. RR Elements are typically built with in-situ sediment using either marsh buckets or mechanical dredges. Bucket dredges are used when the Element is located parallel to a water body, while marsh buggies are used for interior ridge construction. Some larger projects require additional sediment that must be mobilized from nearby borrow sources. This generally follows the same approach as MC Elements (Section 4.5); however, it is assumed that RR Elements can be built with a single sediment source and that borrow material used for RR Elements has a negligible impact on sediment available for MC Elements.

O&M costs for a 50-year project lifespan (estimated as 5% of the construction costs) assume profile surveys and additional vegetative plantings.

The following attributes are used to describe RR Elements:

1. **Length**: Total length of the Element's centerline as measured in GIS.
2. **Crest Elevation**: Top of crown elevation of the Element, typically +5.0 ft NAVD88 (geoid 12a) to be maintained for the duration of the project.
3. **Crest Width**: Total width at top of Element perpendicular to the centerline, typically 50 ft.

4. **Base Elevation**: The existing ground elevation as measured in GIS from the master plan DEM along the alignment centerline.
5. **Base Width**: Total width at base of Element perpendicular to the centerline, as calculated by the PCT.
6. **Slope**: The slope of the fill expressed as the ratio of horizontal distance to vertical distance on flood side of project, typically 5H:1V.
7. **Construction Type:** The type of construction used to build the ridge (marsh buggy, bucket, or hydraulic dredge).
8. **Access Channel:** Length and existing elevation of access channels (if required). Access channels are those that connect the project to the nearest navigable waters for barge-based construction equipment access. Access channels were required where existing depths preclude barge access for Elements constructed by bucket dredges. Access channels require an 8-foot depth, 3H:1V side slopes, and a bottom width of 60 ft.

4.8 SHORELINE PROTECTION (SP)

Shoreline Protection Elements are defined as near-shore segmented rock breakwaters and are primarily used to reduce wave energies on shorelines in open bays, lakes, sounds, and natural and manmade channels. SP Elements consist of riprap mounds, geotextile, navigational aids, settlement plates, access channel dredging, and flotation channel dredging Components (Figure 15). In the 2017 Coastal Master Plan, two templates for SP projects were presented: an inshore version and a Gulf shoreline version (see Louisiana Shoreline Erosion Reduction Evaluation for Segmented Rock Breakwaters Technical Memorandum (Technical Memorandum; CPRA, 2014). However, since Shoreline Protection is now considered programmatically, only the inshore version is discussed, as it may be included as an Element in other Integrated Projects.

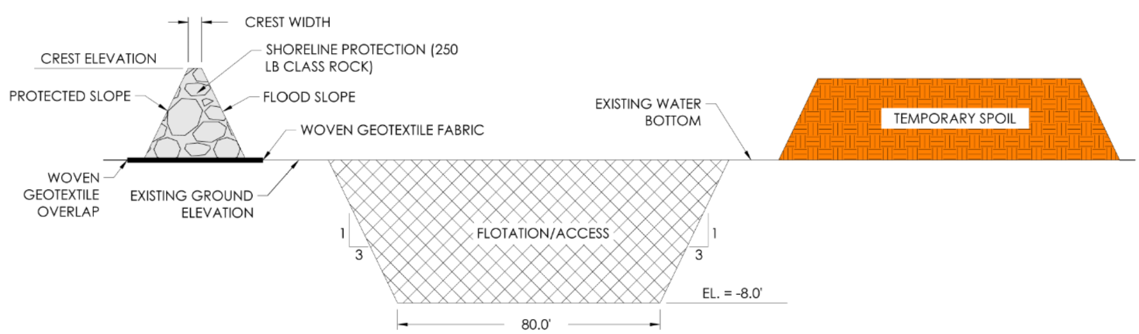

Figure 15. Shoreline Protection conceptual design template.

A rock tons-to-cubic yard ratio of 1.55 and a 10% rock spillage value (i.e., 10% of rock volume assumed to spill into adjacent areas) were used to determine the rock volume. The height of the rock feature was increased by 20% to account for settlement. A stone class of 250 pounds was assumed in most instances due to the mean stone diameters and the stone mass required to resist wave forces.

Woven geotextile (in the form of multiple 100-foot panels) is assumed to be placed under all rock, with 5 ft of overlap along each panel and 5 ft over overhang along each end of the rock feature, with an additional 5% of panel area to account for overage.

A 50-foot fish access is assumed to be placed every 1,000 ft. Settlement plates and navigation aids are also assumed to be placed every 1,000 ft.

Additional material is usually required during the construction phase and during the O&M phase due to weak soil conditions. O&M Costs include three O&M events at Years 5, 15, and 25, comprising rock lifts (50%, 25%, and 10% of the SP feature volume, respectively), access channel dredging, and flotation channel dredging.

The following attributes are used to describe SP Elements:

1. **Length**: Total length of the Element's centerline as measured in GIS.
2. **Effective Length**: The effective length is the total length minus all the required openings for fish gaps, pipelines crossing openings, or other openings required.
3. **Crest Elevation**: Top of crown elevation of the Element, typically 3.5 ft NAVD88 (geoid 12a), to be maintained for the duration of the project.
4. **Crest Width**: Total width at top of Element perpendicular to the centerline, typically 4 ft.
5. **Base Elevation**: The existing ground elevation of the feature, assumed to be placed at the 2.0-foot NAVD88 contour.
6. **Base Width**: Total width at base of Element perpendicular to the centerline, as calculated by the PCT.
7. **Slope**: The slope of the rock feature expressed as the ratio of horizontal distance to vertical distance on flood side of project, typically 3H:1V.
8. **Pipeline Crossings:** Number of intersections between Element and existing oil and gas lines crossing the proposed feature alignment were determined from Strategic Online Resource Information System (http://www.sonris.com/). Openings were assumed to be 100 ft wide.
9. **Riprap Type**: As noted previously 250-pound class riprap is the standard assumption. On a project-by-project basis, certain projects were assigned a larger stone size (500-pound class) if exposed to particularly high energy environments.
10. **Access Channel:** Length and existing elevation of access channels (if required). Access channels are those that connect the project to the nearest navigable waters for barge-based construction equipment access. Access channels require an 8-foot depth, 3H:1V side slopes, and a bottom width of 60 ft.
11. **Flotation Channel:** Length and existing elevation of flotation channels (if

required). Flotation channels are those that run parallel to the Element to allow for the placement of stone from barges. Flotation channels require an 8-foot depth, 3H:1V side slopes, and a bottom width of 80 ft.

4.9 BANK STABILIZATION (BS)

Bank Stabilization Elements are defined as the onshore placement of armored earthen fill and are primarily used to reduce wave energies and maintain shorelines in open bays, lakes, and natural and artificial channels. BS Elements comprise sediment, access channel dredging, and armoring Components (Figure 16).

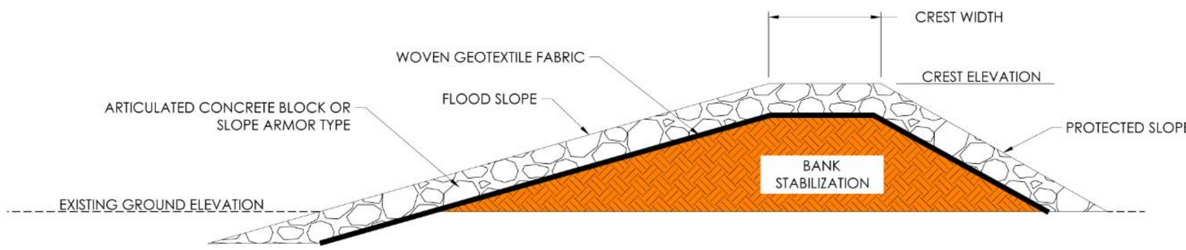

Figure 16. Bank stabilization design template.

BS Elements typically assume an in-situ source (i.e., material immediately adjacent to project site), with a borrow-fill ratio of 1.5. Armoring is placed over the surface area of the feature and extended an additional foot below the base along the flood side of the feature to protect against erosion.

BS Elements are sometimes used to armor MC Elements in some Integrated Projects. These Elements use ACB armoring, MC containment dike geometries, and do not require access channels.

O&M costs include the following Components: one 20% lift, additional armoring, and profile survey.

The following attributes are used to describe BS Elements:

1. **Length:** Total length of the Element's centerline as measured in GIS.
2. **Crest Elevation:** Top of crown elevation of the Element, typically +4.0 ft NAVD88 (geoid 12a) to be maintained for the duration of the project.
3. **Crest Width:** Total width at top of Element perpendicular to the centerline, typically 20 ft for standalone BS Elements and 5 ft for Elements used as containment dikes for MC Cells in IP projects.
4. **Base Elevation**: The existing ground elevation as measured in GIS from the master plan DEM along the alignment centerline.
5. **Base Width:** Total width at base of Element perpendicular to the centerline, as calculated by the PCT.

6. **Side Slope Flood:** The slope of the fill expressed as the ratio of horizontal distance to vertical distance on flood side of project, typically 20H:1V for standalone BS Elements and 4H:1:V for Elements used as containment dikes for MC Cells in IP projects.
7. **Side Slope Protected:** The slope of the fill expressed as the ratio of horizontal distanceto vertical distance on protected side of project, typically 10H:1V for standalone BS Elements and 4H:1:V for Elements used as containment dikes for MC Cells in IP projects.
8. **Armoring Type:** The type of armoring used to protect against erosion, typically either ACB or HPTRM.
9. **Borrow Volume:** Total dredge volume required for project, as calculated in the PCT.
10. **Access Channel:** Length and existing elevation of access channels (if required). Access channels are those that connect the project to the nearest navigable waters for barge-based construction equipment access. Access channels require an 8-foot depth, 3H:1V side slopes, and a bottom width of 60 ft.

4.10 OYSTER BARRIER REEF (OR)

Oyster Barrier Reef Elements are defined as bioengineered oyster reefs to improve oyster cultivation and to reduce wave energies on shorelines in open bays and lakes. Components for OR Elements include a linear oyster reef feature, access and flotation channel dredging, geotextile, and navigational aids (Figure 17).

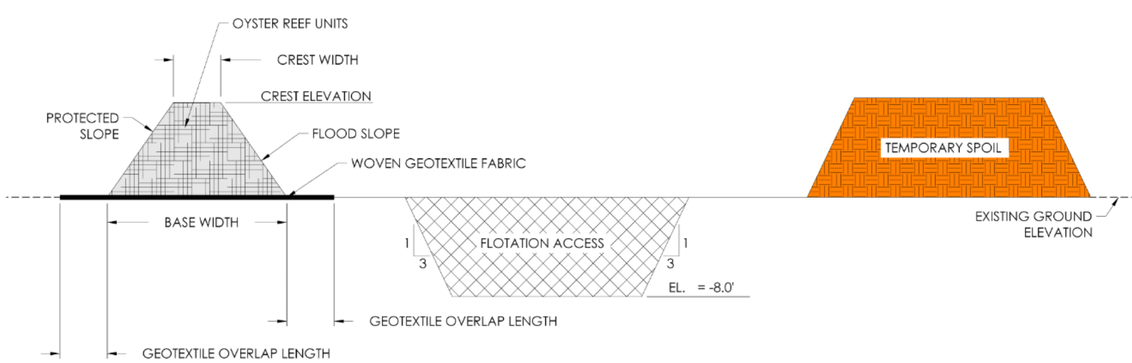

Figure 17. Oyster reef conceptual design template.

The reef material is assumed to be concrete armor units capable of resisting wave forces and supporting oysters. A 50-foot fish access is assumed to be placed every 1,000 ft. Navigation aids are also assumed to be placed every 1,000 ft.

Woven geotextile (in the form of multiple 100-foot panels) is assumed to be placed under all oyster reef features, with 5 ft of overlap along each panel and 5 ft over overhang along each end of the rock feature, with an additional 5% of panel area to account for overage.

The following attributes are used to describe OR Elements:

1. **Length:** Total length of the Element's centerline as measured in GIS.
2. **Effective Length**: The effective length is the total length minus all the required openings for fish gaps, pipelines crossing openings, or other openings required.
3. **Crest Elevation:** Top of crown elevation of the Element, typically +2.0 ft NAVD88 (geoid 12a) to be maintained for the duration of the project.
4. **Base Width:** Total width at base of Element perpendicular to the centerline, typically 50 ft.
5. **Pipeline Crossings:** Number of intersections between Element and existing oil and gas lines crossing the proposed feature alignment were determined from Strategic Online Resource Information System (http://www.sonris.com/). Openings were assumed to be 100 ft wide.
6. **Access Channel:** Length and existing elevation of access channels (if required). Access channels are those that connect the project to the nearest navigable waters for barge-based construction equipment access. Access channels require an 8-foot depth, 3H:1V side slopes, and a bottom width of 60 ft.
7. **Flotation Channel:** Length and existing elevation of flotation channels (if required). Flotation channels are those that run parallel to the Element to allow for the placement of stone from barges. Flotation channels require an 8-foot depth, 3H:1V side slopes, and a bottom width of 80 ft.

4.11 MISCELLANEOUS (XX AND LS)

As noted previously in this report, some features of projects are unable to be built out in the same amount of detail as other Element types due to their complexity and to the coastwide, planning level of the analysis. These features are typically assigned a single lump-sum cost or a loaded parametric cost to be assigned based on a given quantity. An example of a lump-sum cost assignment for a LS Element feature would be $10 M for a specific floodgate, which captures the cost to construct the steel gate, all mechanical and electrical equipment required to operate the gate, as well as the gate's accompanying base and tie-in features which connect it to adjacent levees or banks. An example of a parametric cost assignment for an XX Element feature would be assigning a dollars-per-linear-foot to place a bridge over a planned channel.

As discussed in Section 2.3, unit costs are escalated for each item based on the item's cost category and the year of the source cost estimate. LS Elements therefore include attributes for cost category, source, and source year to document the original cost estimate and facilitate cost escalation.

When the XX Component is a pump station, O&M cost includes an itemized value for pump repair. Pump stations that are continuously operated for HR projects have a higher O&M cost than those operated intermittently for drainage in SR projects. Otherwise, O&M for XX and LS Elements remains 5% of the construction cost.

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