ST. TAMMANY PARISH COASTAL PROTECTION
GAP ANALYSIS
MARCH 2020

CONTRACT NO. 18-019 (PO-167) – TASK II
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CHAPTER 1 - EXECUTIVE SUMMARY

St. Tammany Parish’s approach to flood risk reduction is evolving since Hurricanes Katrina and Rita made landfall in St. Tammany in 2005. For the State of Louisiana, the 2005 storms prompted stricter building codes, adoption of safer flood levels and the formation of the Louisiana Coastal Protection and Restoration Authority (CPRA), which produces and updates the Coastal Master Plan.

The Coastal Master Plan — a $50 billion, 50-year coastal restoration and flood risk reduction effort — is Louisiana’s cornerstone response to coastal (storm-surge based) flooding and land loss. Even with its full implementation over the next 50-years, St. Tammany Parish will be faced with increased coastal flood risk. St. Tammany Parish will remain highly flood prone in both its coastal zone and areas north of the coastal zone. Its flood risks extend to all three types of flooding – coastal (surge and tidal), fluvial (riverine) and pluvial (intense rain causing surface flooding). While structural interventions like levees, pumps and floodgates are vital to reducing flood risks, adaptation to this new flood risk reality is also necessary. Adaptation includes structural risk reduction systems and ecological restoration efforts.

This Gap Analysis Report is Task II of the St. Tammany Parish Coastal Protection Project (PO-167), a collaborative effort between St. Tammany Parish Government (STPG) and the St. Tammany Levee, Drainage and Conservation District (STLDCD), with funding from CPRA through an Intergovernmental Agreement. Neel-Schaffer’s Team is assisting in this effort. Neel-Schaffer’s scope of services is divided into three tasks. Task I consist of collecting and organizing existing flood control assets and associated project data. Task II is a gap analysis and Task III is a project feasibility analyses and engineering design.

This Gap Analysis Report describes the overall gap analysis process and provides recommendations for further study/actions to address gap areas. Areas in the St. Tammany Parish Coastal Zone vulnerable to tidal surge, flooding due to inadequate conveyance, and/or wetland loss/reduction were mapped and overlaid with the flood control assets, projects and repetitive loss data from Task I in order to identify potential gaps. These geographic gaps are areas in the St. Tammany Coastal Zone that are vulnerable to tidal surge, flooding due to inadequate conveyance, and/or wetland loss/reduction and lack either the assets or projects to address the concerns.

In addition to geographic gaps, the team evaluated data gaps associated with the coastal modeling. Appendix A is the coastal modeling data gap analysis for St. Tammany Parish. This modeling gap analysis report summarizes existing coastal modeling data sets for St. Tammany Parish and their usefulness for coastal storm surge and wave modeling at a scale that is useful for local planning and decision making.

This report also provides projects that can be considered for inclusion in the conceptual project alternatives to mitigate risks in identified gap areas, as defined in Task III. To restrict the number of measures considered, the projects selected are based on the Multiple Lines of Defense Principle (MLDP) framework developed by e.g. (Lopez and Davis 2011; Lopez et al. 2009). This framework includes a wide range of protective elements, namely: barrier islands (synthetic or natural), marsh restoration (to reduce wave action and surge level during a storm), flood gates and levees and pump stations, each with their own limitations, advantages and scope of action. As such, it provides a solid basis for reviewing tentative measures to be deployed in St. Tammany Parish. The acceptability of the project is also an element that
was considered, in addition to if the project is sound technically, environmentally, economically and socially. For instance, some flood control measures are technically feasible (notwithstanding cost issues) yet are unpopular. Unpractical or downright unfeasible plans and measures were dropped altogether. Projects that pass these initial criteria are provided herein for consideration the STPG and STLDCD.

Appendix B provides details for projects considered for inclusion in the conceptual project alternatives as defined in Task III of the St. Tammany Parish Coastal Protection Project (PO-167). These projects are the result of the gap analysis process and workshops with the St. Tammany Parish Government and the St. Tammany Parish Levee, Drainage and Conservation District. The St. Tammany Parish Government and the St. Tammany Parish Levee, Drainage and Conservation District can review these initial concepts and consider additional concepts to recommend for further study and actions.

For projects selected and recommended for further study and actions, Task III of the St. Tammany Parish Coastal Protection Project (PO-167) includes the following scope of work:

- Develop conceptual project alternatives, including estimated costs for areas defined in the Task II.
- Perform benefit/cost analysis for each project approved by the St. Tammany Parish Government and St. Tammany Levee, Drainage and Conservation District. Include engineering analyses, evaluation of existing flood control assets, impact of existing flood control structures on surrounding areas, engineering design, cost estimates, and other information as necessary to provide an acceptable BCA.
- Prepare a feasibility report of recommended project alternatives for each project identified including a prioritization of projects based on Benefit/Cost Analysis, Need and Community Input.
CHAPTER 2 - INTRODUCTION

St. Tammany Parish, located northeast of New Orleans along the shores of Lake Pontchartrain, is the state’s fifth most populous parish and one of Louisiana’s fastest-growing. The Parish’s growth along Lake Pontchartrain south of Interstate 12 (defining the Parish’s coastal zone-Figure 2-1), has experienced numerous flood events. Whether caused by seasonal heavy rains, tropical rain events or storm surge-based flooding, these events impact St. Tammany Parish’s businesses, citizens, property values, and infrastructure.

Hurricanes and heavy rain events are a part of this region’s history. Flooding events over the past 40+ years coupled with the continued growth of the Parish necessitate enhanced planning to provide a holistic approach for resiliency and long-term sustainability. Accordingly, prevention of any additional contribution to flooding is identified as one of the top four priorities for future land use decisions in the Parish’s New Directions 2025 document, adopted in 2000.

In 2012, CPRA, St. Tammany Parish Government, Tangipahoa Parish Government, and Gulf Environmental Consultants (GEC), teamed to assess flood risk; evaluate existing coastal/flood protection projects; look at long term growth; and, prioritize future projects. The resulting Hurricane/Flood Protection and Restoration Plan was considered a reconnaissance and guidance document for state and local officials seeking to gain a better understanding of the dynamic interface between the natural, anthropogenic, and hazard environments of the region by summarizing existing conditions, identifying vulnerability, categorizing protection projects, analyzing gaps, establishing project benefits/justification, and offering a path forward. The primary goal stated in the 2012 plan was to identify hot-spots of flood activity, the source of this activity, and potential projects or mitigation plans which will help ameliorate these flood issues.
Additionally, in 2017 CPRA published the current version of Louisiana’s Comprehensive Master Plan for a Sustainable Coast. This Master Plan included a collection of Structural Protection, Non-Structural Protection and Marsh Creation projects in St Tammany Parish.

In 2018, the Parish received State funding for a comprehensive flood protection project (St. Tammany Parish Coastal Protection Project PO-167) building upon the data collected in the 2017 Master Plan and the 2012 Hurricane/Flood Protection and Restoration Plan. This project is a collaborative effort between St. Tammany Parish Government (STPG) and the St. Tammany Levee, Drainage and Conservation District (STLDCD), with funding from the Coastal Protection and Restoration Authority (CPRA) through an Intergovernmental Agreement. Neel-Schaffer’s Team is assisting in this effort.

The scope of services for this project is divided into three tasks. Task I consist of collecting and organizing existing flood control assets and associated project data and was completed in November of 2019. Task II is a gap analysis and Task III is a project feasibility analyses and engineering design.

This Gap Analysis Report describes the overall gap analysis process and provides recommendations for further study/actions to address both geographic, structural protection, restoration and data gaps. It also provides projects that can be considered for inclusion in the conceptual project alternatives as defined in Task III.

The first two chapters are the Executive Summary and Introduction to this Gap Analysis Report. The third chapter describes the overall Gap Analysis Process and identifies the Gap areas that require further feasibility analyses. Chapter 4 provides projects that can be considered for inclusion in the conceptual project alternatives as part of Task III.
CHAPTER 3 – GAP ANALYSIS

3.1. DATA COLLECTION
The first task of this project was the collection and organization of existing flood control assets and associated project data. The NSI Team met with Parish Departments of Public Works and Technology staff; STLDCD representatives; local, state and Federal personnel to review and compile major flood control and protection projects for each of the three coastal zone regions. This data was accessed, reviewed, cataloged and provided to the Parish in a report titled St. Tammany Parish Coastal Protection Collection and Organization of Existing Flood Control Assets and Project Data. The data includes but is not limited to:

- Coastal and Wetland Restoration Projects;
- Drainage Conveyance Improvements;
- Retention/Detention Ponds;
- Levee and Shoreline Protection;
- Structure Elevation Programs;
- Flood Protection/Drainage Pump Stations; and
- Drainage / Flood Risk Reduction Studies.

For each asset and project, the following data was collected to the extent it was available:

- Project Purpose;
- Jurisdictional authority/owner;
- Scope of work;
- Supporting Existing Conditions Data (surveys, soil borings, pump curves, etc.);
- Construction status (completed, current, planned future);
- Project benefits, including whether a FEMA flood map change or revisions would be applicable;
- Cost / estimated cost;
- Funding status and source; and
- Design documentation.

Figure 3-1 is a map of the coastal projects identified in Task 1. Details of the projects are included in the St. Tammany Parish Coastal Protection Collection and Organization of Existing Flood Control Assets and Project Data. This collection of flood control assets and data is subsequently being used in this gap analysis.

3.2. GAP ANALYSIS PROCESS
The gap analysis process first consisted of identifying areas in the St. Tammany Parish Coastal that are vulnerable to tidal surge, flooding due to inadequate conveyance, and/or wetland loss/reduction. These vulnerable areas were mapped and overlaid with the flood control assets, projects and repetitive loss data from Task I in order to identify potential geographic gaps. The geographic gaps are areas in the St. Tammany Coastal Zone that are vulnerable to tidal surge, flooding due to inadequate conveyance, and/or wetland loss/reduction and lack either the assets or projects to address the concerns.

The repetitive loss data documents areas with recurring flooding based on buildings on FEMA’s list of repetitive losses (RL) and severe repetitive losses (SRL). A RL property is any insurable building for which two or more flood-related claims of more than $1,000 were paid by the National Flood Insurance Program.
The two losses must be within 10 years of each other and be at least 10 days apart. A SRL property is when there are at least four losses each exceeding $5,000 or when there are two or more losses where the building payments exceed the property value. If the structure was mitigated per FEMA, it was scrubbed from the repetitive losses for this mapping. The remaining repetitive and severe repetitive loss information delineated for the coastal zone is shown in Figure 3-2 and includes 4,707 RL occurrences from 1978-2016 (Table 3-1). The communities in Table 3-1 include unincorporated St. Tammany Parish and not just the city or town limits.

Table 3-1. Repetitive and Severe Repetitive Loss Properties, 1978-2016

<table>
<thead>
<tr>
<th>Community (1)</th>
<th>Total RL/SRL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covington</td>
<td>249</td>
</tr>
<tr>
<td>Lacombe</td>
<td>532</td>
</tr>
<tr>
<td>Madisonville</td>
<td>159</td>
</tr>
<tr>
<td>Mandeville</td>
<td>513</td>
</tr>
<tr>
<td>Slidell</td>
<td>3,254</td>
</tr>
<tr>
<td><strong>TOTAL COASTAL ZONE</strong></td>
<td><strong>4,707</strong></td>
</tr>
</tbody>
</table>

(1) Community includes unincorporated areas of St. Tammany Parish

This data along with the DFIRMS shown in Figure 3-3 and the Flood Depths in Figure 3-4 was used to evaluate the potential gaps for the coastal zone.

3.3. COASTAL MODELING GAP ANALYSIS

A coastal modeling data gap analysis for St. Tammany Parish is provided as Appendix A. This modeling gap analysis report summarizes existing coastal modeling data sets for St. Tammany Parish and their usefulness for coastal storm surge and wave modeling at a scale that is useful for local planning and decision making. This analysis includes review of Advanced Circulation (ADCIRC), Simulating Waves Nearshore (SWAN) and, Wave Height Analysis for Flood Insurance Studies (WHAFIS) models provided for relevancy, completeness, and technical sufficiency in order to determine gaps in model domain and model technology. The report focuses mainly on ADCIRC and SWAN modeling performed as part of the 2017 Louisiana Coastal Protection and Restoration Authority (CPRA) Master Plan and Federal Emergency Management Agency (FEMA) Wave Height Analysis for Flood Insurance Studies modeling performed by the St. Tammany Parish as part of the re-analysis of their Base Flood Elevations (BFEs).

The modeling data gap analysis showed that coastal storm surge and wave modeling techniques used for the 2017 CPRA Master Plan were adequate for capturing the dynamics of hurricane driven waves and storm surge. The analysis did identify several levee segments that are missing from the grids utilized in the Master Plan storm surge models along with some levee elevations discrepancies, as these levee systems were built after the grids were developed. Although the grids were developed with fine resolutions for coastal channels and tributaries, they cover a broad domain including the entire Gulf of Mexico and the Atlantic Ocean which results in limited resolution in some areas of the Parish. The recommendations for the hydrodynamic model include updating the grids to include georeferenced data that was not available until after the grid was developed prior to 2014. The required data updates identified in the modeling data gap analysis include the addition of newly completed levee segments;
raised existing levee segments; some refinement of the grids to resolve critical areas within the Parish; and added coastal features. The overland wave propagation model (WHAFIS) utilized data from the Federal Emergency Management Administration’s (FEMA) 2008 Flood Insurance Study for Southeastern Parishes in Louisiana. This data included transects, still water levels and wave conditions. Based on the modeling data gap analysis, it has been determined that WHAFIS modeling should be updated with the most recent surge, wave and topography data available for the Parish.

3.4. **POSSIBLE MITIGATION ACTIONS**

Four project types are identified to increase resilience to disasters and reduce or eliminate the long-term risks by lessening the impact of future disasters, to address the identified gaps.

a. **RESTORATION PROJECTS**

Restoration projects are those projects whose features restore degraded components of St. Tammany Parish’s coastal ecosystem by re-establishing natural processes or through mechanical means such as the placement of dredged material. Restoration projects in St. Tammany Parish include the following general categories:

- Bank Stabilization
- Hydrologic Restoration
- Marsh Creation
- Living Shorelines
- Shoreline Protection
- Terracing
- Vegetative planting

These projects are typically funded through the Coastal Wetlands Planning, Protection and Restoration Act, (CWPPRA). CWPPRA is federal legislation enacted in 1990 that is designed to identify, prepare, and fund construction of coastal wetlands restoration projects. The annual budget for CWPPRA funded restoration has varied through the twenty-five year life span of the Act. The budget has ranged between approximately $30 million per year to nearly $80 million per year. The managing agencies for CWPPRA projects are CPRA, Army Corps of Engineers, Environmental Protection Agency, U.S. Fish & Wildlife Service, National Resources Conservation Service and the National Oceanic and Atmospheric Administration.

Only one restoration project, West Shoreline Protection, in the *St. Tammany Parish Government Coastal Masterplan 2016-2020* was not accepted in the CPRA 2017 Coastal Masterplan. However, CPRA plans to include shoreline protection as a statewide programmatic issue in the next master plan. Under this scenario, all coastal areas of the Parish will be eligible for state coastal funding.

Figures 3-5, 3-6, 3-7 and 3-8 shows the shoreline protection and restoration features that are in the 2017 Masterplan as well as potential shoreline protection, living shoreline and marsh creation projects identified in this gap analysis. Further details of these conceptual project alternatives for consideration are included in Chapter 4 and Appendix B of this report.
b. **Non-Structural Projects**

Nonstructural Risk Reduction projects include non-residential floodproofing, residential elevation, and residential voluntary acquisition. The 2017 CPRA Masterplan includes a project to mitigate flood risk in St. Tammany Parish applying nonstructural solutions. These include floodproofing non-residential properties where 100-year flood depths are projected 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet. For St. Tammany Parish, the 2017 Masterplan includes:

- 375 Floodproofing non-residential structures
- 4,605 Elevation of residential structures
- 889 Voluntary acquisitions

Total of 5,869 properties totaling $1,611.3 million. The cost estimate does not represent specific residential or commercial structures to be mitigated.

As part of the State of Louisiana’s Watershed Initiative (LWI), the state will conduct large-area buyouts (on the block or neighborhood scale) for families within repetitive loss areas, areas subject to moderate or high flood risk and/or within FEMA designated floodways. Such buyout programs will include provisions for community-oriented assistance to homeowners in order to facilitate a successful transition to a location of lower flood risk outside of SFHAs. Where feasible, relocations will be outside of 0.2% AEP flood event areas or mitigated to the 0.2% AEP flood standard. Property acquired through program buyouts will be restored to natural floodplain conditions and may be further enhanced through the use of blue and green infrastructure. In order to preserve communities that, for reasons of geography or natural resource dependence, cannot relocate to <0.2% AEP flood event areas and maintain important social and cultural standards, the state may also administer residential elevations or other traditional nonstructural flood risk mitigation activities. The state will administer residential elevations justified by cost-benefit and cost reasonable analyses relative to other mitigation measures and the results of watershed modeling. This program will prioritize project funding that benefits low- to moderate- income residents and uses predictive watershed modeling to produce measurable reductions in residents’ exposure to flood risk.

Rising flood insurance costs threaten the cohesiveness of many Louisiana communities as residents are “priced out” of their homes where flood insurance coverage is required as a condition of their mortgage. On a broader scale, rising NFIP premiums pose a threat to local economies and real-estate markets, as properties gradually lose their resale value as flood risks become more pronounced. St. Tammany Parish’s participation in the Community Rating System (CRS), including the implementation of higher regulatory floodplain standards, is an effective tool to mitigate the impact of rising flood insurance costs.

Since 2005, St. Tammany Parish has completed mitigation on residential properties either through elevation or acquisition in both the Hazard Mitigation Grant Program and Flood Mitigation Assistance (FMA) programs. The Parish has approximately $38 million in active grant funding to mitigate properties in unincorporated St. Tammany and submit a competitive application annually for an additional FMA funding. To date St. Tammany has mitigated approximately 450 homes.
c. **Structural Protection**

Structural Protection projects reduce hurricane flood risk in coastal communities by acting as a physical barrier against storm surge. Structural Protection projects typically include one or more of the following basic components:

- **Earthen Levee:** The principal component of each Structural Protection project is the earthen levee. These structures consist of pyramidal 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. Linear levees create a closed system by tying into other linear levees or by extending inland to high ground.

- **Concrete T-wall:** T-walls 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.

- **Floodgate:** Floodgates are needed where levees or T-walls cross a road or railroad or where they intersect waterways.

- **Ring Pumps (Internal to Levees):** Pumps are needed in enclosed risk reduction systems to allow water that enters a ringed levee system to be pumped out.

The National Flood Insurance Program (NFIP) requires all new or substantially improved residential and commercial structures in the mapped SFHAs to be constructed at or above the elevation of the 1-percent-annual-chance flood, including SFHAs landward of levees.

While a small percentage of levees on a national basis are built and/or maintained by the USACE, the majority of levees are not owned or maintained by any Federal agency. Presently, all the levees in St. Tammany Parish are locally owned and maintained and are not part of the USACE Levee Safety Program.

FEMA levee responsibilities include identifying flood hazards and assessing flood risks in levee-affected areas. More specifically, FEMA determines and establishes appropriate flood risk zone designations in areas landward of levees and reflects those zones on FIRMs. On the FIRM, FEMA only accredits levees that have met and continue to meet the minimum regulatory standards cited in Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44 CFR 65.10) and associated with the 1-percent-annual-chance flood.

The area landward of an accredited levee system is shown on the FIRM as a moderate-risk area, labeled Zone X (shaded), except for areas of interior drainage flooding - such as ponding areas, which will be shown as high-risk areas, SFHAs. Flood insurance is not mandatory in Zone X (shaded) areas, but it is mandatory in SFHAs.

Communities with non-accredited levee systems can provide input so that FEMA may select analysis and mapping procedures that better reflect the communities’ unique circumstances and better characterize local flood hazards. FEMA represents the uncertainty of the hazards associated with non-accredited levee systems through use of the Zone D designation. FEMA uses the Zone D designation to identify areas of undetermined, but possible, flood hazards. St. Tammany Parish is collaborating with FEMA in the Levee Analysis and Mapping Program (LAMP) to characterize the levee reaches in the Parish. This program is ongoing.
The State’s 2017 Coastal Master Plan includes two levee systems that provide protection for St. Tammany Parish. The first is The Lake Pontchartrain Barrier which provides closure gates and weirs to an elevation of 2 feet NAVD88 across the passes at Chef Menteur and the Rigolets for storm surge risk reduction within the Lake Pontchartrain Basin. Project features approximately 5,200 fee of earthen levee, 630 feet of combi-wall weir constructed to 2 feet, a 150-foot closure gate at each pass for navigation, and multiple vertical lift gates to maintain tidal exchange through the passes. The Lake Pontchartrain Barrier is the result of several studies including the 2012 New Orleans East Land Bridge Study, 2016 Lake Pontchartrain Barrier Evaluation and, 2017 Reducing Coastal Flood Risk with a Lake Pontchartrain Barrier study. Among the findings, these studies found:

- With gates there is a significant reduction in storm surge elevation in Lake Pontchartrain. Added hydraulic burden placed on adjacent levee system is equally appreciable with local increase of up to 3 feet on Mississippi coast and 4 feet in the Lake Borgne area at 100 level.
- An open pass levee reduces the 100-YRP surge in Lake Pontchartrain by approximately 1 foot. This levee structure limits the impacts to Mississippi and Lake Borne.
- Gate structures at Rigolets and Chef Menteur are very effective.
- Additional protections such as 10 or 24 foot barriers along HWY 90 or CSX does not considerably increase protection.
- No gate alignment is not effective.

The 2017 master plan describes the results of evaluations, includes estimates of benefits on the Louisiana coast and provides estimates on damages (disbenefits) for Mississippi, St. Bernard and Plaquemines. Overall the investigation is not final because of only one uncertain future scenario was tested and project cost and environmental impact were not formally considered. The results, however, show that the HWY 90 with 2 foot gates performs best in terms of balancing damage reduction, project footprint, and induced damage effects. For these reasons, CPRA included this option in the 2017 final masterplan.

The second levee system in the State’s 2017 Coastal Master Plan providing protection to St. Tammany Parish is the Slidell Ring levee system. The project is described as construction of a levee to an elevation of 16 feet NAVD88 for storm surge risk reduction around Slidell. Project features approximately 31,000 feet of earthen levee and 14,500 feet of T-wall. The construction cost is estimated at $141 million and the total project cost is estimated to be $181.3 million.

A conceptual complete levee protection system for the St. Tammany Parish coastal zone is shown in Figure 3-9. This figure represents a levee system that encloses gaps of structural protection in St. Tammany Parish. It is not a recommended or a practical solution for gap mitigation in St. Tammany Parish. Figure 3-10 is a map showing only the levees that protect gap areas with high repetitive losses and could be considered as conceptual project alternatives. Figures 3-11, 3-12 and 3-13 are enlargements of this figure for the three coastal planning areas. Figures 3-13A – 3-13D provide alternative alignments for continuous structural protection in Slidell. Details of the existing and proposed Slidell Ring levee segments are included in the St. Tammany Parish Coastal Protection Collection and Organization of Exiting Flood Control Assets and Project Data, Chapter 5 - East Planning Zone. Table 5-1 provides a summary of the levee segments, type, length, design elevation, estimated cost and status.
d. Watershed

St. Tammany Parish is highly flood prone even in areas north of the coastal zone, and its flood risks extend to all three types of flooding – coastal (surge and tidal), pluvial (intense rain causing surface flooding) and fluvial (riverine). A review of repetitive loss data and other data searches shows St. Tammany Parish has experienced historic flooding from all three primary sources.

Flooding associated Hurricane Storm Surge: 19 Tropical Storms and Hurricanes have impacted the Parish since 1969. Recent flood events include surges associated with Hurricane Ivan in 2004, Hurricanes Katrina and Rita in 2005, and Hurricane Isaac in 2012.

Flooding associated from extreme rainfall events in St. Tammany Parish: 27 heavy rainfall events have impacted the Parish since 1979. For example, the May 8-10, 1995 storm produced flooding throughout St. Tammany Parish. As a measure of the intensity of the 1995 event, the Abita Springs gauge recorded 24.46 inches of rainfall and the Slidell gauge recorded 19.09 inches. The March 2016 storm flooded areas in the Parish, principally north of I-12. The Bogue Falaya recorded a record crest in Covington at 21’.

Flooding associated with the Pearl River waterway system in east St. Tammany Parish: The Pearl River watershed extending north into Mississippi received record rainfall in 1983. The flood moved south through St. Tammany Parish via the West Pearl River, the West Middle Pearl River, the Middle Pearl River and the East Pearl River. Over 700 St. Tammany Parish homes were flooded. The Pearl River gauge reached a record crest of 21 ft. More recent Pearl River floods have not impacted east St. Tammany Parish as extreme flooding events. Hydraulic models of the lower Pearl river waterways south of I-10 have been developed to study the recent river performance.

The St. Tammany’s Coastal Zone, Figure 3-14, is divided into three planning areas (Western, Central, and Eastern) and the three planning areas are further divided into 11 HUC-12 Units. HUC 12 is a more local sub-watershed level that captures tributary systems.

St. Tammany Parish has seven drainage districts and seven sub-drainage districts. The seven drainage districts and three of the sub-drainage districts lie either in part or entirely in the Coastal Zone. Gravity Drainage Districts Nos. 3, 4, and 5 have no active Board and/or revenue in 2019. In January of 2020, the St. Tammany Parish Council passed resolution council series No. C-6214, dissolving Gravity Drainage District No. 5 with St. Tammany Parish Government assuming any and all rights, duties and obligations previously held and/or incurred by the Gravity Drainage District No. 5. Listed in Table 3-2 are the active drainage and sub-drainage districts in the coastal zone.
### Table 3-2. St. Tammany Parish Drainage Districts in the Coastal Zone

<table>
<thead>
<tr>
<th>District</th>
<th>Area Covered</th>
<th>Assets</th>
<th>Upcoming Projects</th>
<th>Funding Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drainage District No. 2</td>
<td>Lakeshore (Slidell)</td>
<td>Levee</td>
<td>NO RESPONSE</td>
<td>Ad valorum tax</td>
</tr>
<tr>
<td>Drainage District No. 4</td>
<td>Kingspoint Subdivision</td>
<td>Levee</td>
<td>NO RESPONSE</td>
<td>Ad valorum tax</td>
</tr>
<tr>
<td>Drainage District No. 5</td>
<td>Oak Harbor / Land West of I-10</td>
<td>Levee, Pumps (3), Retention Ponds, Culverts</td>
<td>Regular maintenance of ponds/levee; Replacement of corroded culverts</td>
<td>Ad valorum tax</td>
</tr>
<tr>
<td>(Gravity) Drainage District No. 5</td>
<td>Covington/Lacombe</td>
<td>Retention Ponds, Culverts (now owned and maintained by STPG)</td>
<td>Dissolved February 2020</td>
<td>Ad valorum tax</td>
</tr>
<tr>
<td>Sub-Drainage District No. 1 of Gravity District No. 5</td>
<td>Brookstone Subdivision</td>
<td>Retention Ponds</td>
<td>Regular maintenance of ponds and drainage ditches</td>
<td>Subdivision Homeowner’s Fees</td>
</tr>
<tr>
<td>Sub-Drainage District No. 2 of Gravity District No. 5</td>
<td>Meadowbrook Subdivision</td>
<td>Retention Ponds</td>
<td>Regular maintenance of ponds and drainage ditches</td>
<td>Subdivision Homeowner’s Fees</td>
</tr>
<tr>
<td>Sub-Drainage District No. 4 of Gravity District No. 5</td>
<td>Fountains Subdivision</td>
<td>Pond, Pump, Culverts</td>
<td>Pond rehabilitation; cleaning of storm sewers</td>
<td>Subdivision Homeowner’s Fees</td>
</tr>
</tbody>
</table>

The drainage districts in the West Zone include Gravity Drainage District 4 and Gravity Drainage District 5 Special District Nos. 1, 2 and 3. The Tchefuncte River, Black River, No name Bayou and Bayou Chinchuba flow into Lake Pontchartrain within the West Zone. The drainage districts in the Central Zone include Gravity Drainage District 4 and Gravity Drainage District 5 Special District No. 4. Bayou Castine, Cane Bayou and Bayou Lacombe flow into Lake Pontchartrain within the Central Zone. The drainage districts in the East Zone include the Drainage Districts 2, 4 and 5. Salt Bayou, W-14 Canal, West Pearl River, East Pass, East Pearl and several Bayou’s flow into Lake Pontchartrain within the East Zone. Other principal waterways within the planning area include the W-15 Canal; Dubloon Bayou, Reine Canal, which hydraulically links the W-14 and W-15, Bayou Bonfouca, Bayou Vincent and, contributing local drainage laterals. These waterways, as is the case with all St. Tammany’s coastal zone waterways, are influenced by tides that affect the drainage capacity and the resulting peak water surface elevations. Figure 3-15 show the limits of the Parish’s seven coastal drainage districts.

The waterbodies surrounding the St. Tammany Parish Coastal Zone are subject to surge processes and wave actions resulting from tropical weather systems. Various computer models of flow (including surge) and wave processes in these bodies of water have been developed by different governmental and regulatory agencies. Other models including land-loss models, channelized stream models, hydrodynamics models/wave models of non-storm conditions, and salinity models have been developed in the St. Tammany Coastal Zone as well. The report titled *St. Tammany Parish Coastal Protection*
Collection and Organization of Exiting Flood Control Assets and Project Data. (Table 2-1) denotes a list of different coastal hydraulic and hydrologic models that have been developed for these bodies of water.

In 2017, the consulting firms of DDG and CE Hydro, as part of their inventorying existing models, climate and hydrologic data for the Parish, made the following general recommendations for modeling efforts in St. Tammany Parish:

- Implement a systems modeling approach where large scale, regional models provide the boundary conditions for localized drainage studies including those prepared in support of development activities.
- Develop integrated models with multiple basins where there is the potential for flow inter-basin flow exchange in extreme events. In addition, extend models to tidal boundaries so that the effects of high tide and surge conditions can be understood.
- Utilize updated climatology data for frequency based and IDF estimates.
- Utilize integrated models to evaluate floodway encroachment and subsequent increases in water surface elevations.
- Calibrate and validate models by collecting observed data (rainfall, stage, and flow data).
- Utilize spatially varying rainfall estimates.
- Use 2D modeling to represent spatially varying land use data (for spatially varying parameter selections).
- Move beyond evaluating model results in one dimension such as with a water surface profile.
- Alternatives analyses should include future conditions or future build out to determine the long-term effectiveness of the proposed improvements.
- Consider the use of physically based infiltration methods.

As a result of two historic rainfall events in 2016, both of which severely impacted St. Tammany Parish, Louisiana established the Louisiana Watershed Initiative (LWI), a statewide, watershed-based floodplain management program. This initiative is being managed by the Council on Watershed Management comprising the Office of Community Development, Coastal Protection and Restoration Authority, Governor’s Office of Homeland Security and Emergency Preparedness, Department of Transportation and Development, and the Department of Wildlife and Fisheries. The Council on Watershed Management is focused on empowering local jurisdictions and communities to implement regional, long-term solutions to flood risk reduction. This involves the delineation of programmatic, policy and coordination strategies into four areas, beginning with those initiatives that represent high benefit, low risk actions. The four areas include: 1) watershed monitoring, mapping and modeling; 2) cost share assistance and coordination; 3) watershed based programs and projects; and 4) large scale projects and programs.

Soon after the state began its investigation of this new approach, per the Bipartisan Budget Act of 2018, Congress allocated $1.2 billion in CDBG funds to the State of Louisiana for the specific purpose of mitigation activities. The rules for expenditure of these funds require the submittal of an Action Plan for approval by HUD. This Action Plan provides a concise summary of the actions, activities, and resources necessary to address the State of Louisiana’s priority mitigation needs and goals.
HUD identified the following most impacted and distressed areas: East Baton Rouge, Livingston, Ascension, Tangipahoa, Ouachita, Lafayette, Vermilion, Acadia, Washington, and St. Tammany parishes. The state will spend at least 50% or $600 million of the CDBG-MIT funds to benefit these HUD-identified MID areas or HUD MIDs.

As St. Tammany Parish works through the LWI toward regional, watershed-based coordination and as the LWI develops datasets and modeling tools to inform watershed management policy and project mitigation activities, the LWI will provide funding and assistance to implement identified projects and programs with demonstrable and quantifiable mitigation outcomes. These projects and programs may include, but are not limited to, direct physical improvements to the watershed, ecological and waterway restoration projects, code enforcement activities, floodplain/floodway easements, and strategic land acquisitions and other projects that demonstrably enhance the storage and ecosystem capacity of the land and water systems.

The program will primarily provide funding for planning, acquisition, infrastructure, code enforcement, public services, buyouts and housing activities related to resettlement, economic development and/or other public facilities projects that increase resilience to floods on a watershed level. St. Tammany Parish, working with their regional partners through the framework of watershed management entities, will be responsible for identifying and prioritizing the programs and projects to submit for funding opportunities that result in demonstrable flood mitigation. Some examples of watershed programs or projects may include, but are not limited to:

1. Watershed restoration and preservation, flood mitigation of critical facilities and infrastructure, nonstructural mitigation, stormwater management, and other innovative/replicable flood control activities;
2. Major capital projects that improve resilience to flooding, provide regional stormwater detention, or other flood protection measures;
3. Capacity building toward implementation of resilient development standards and floodplain management regulations; and
4. Any other relevant projects and programs developed through the LWI’s watershed modeling, statewide planning, and regional planning efforts.

The LWI plans for the first $100 million to be spent on “no regrets” projects, meaning projects that can move forward quickly because they have very little risk of serious downsides. Figure 3-16 shows proposed and recent drainage projects within the Coastal Zone and Figure 3-17 is a larger scale map showing the drainage projects within the eastern planning zone (Slidell area). St. Tammany Parish will need to identify projects that fit into the “no-regrets” category.
Legend

- Western Planning Zone
- Central Planning Zone
- Eastern Planning Zone
- Vegetative Tree Planting Program

St. Tammany Coastal Protection Project

GAP ANALYSIS

Shoreline Protection and Restoration Features

Contract Number 18-019
Figure Number 3-5B
St. Tammany Coastal Protection Project
GAP ANALYSIS

Legend
- Western Planning Zone
- Central Planning Zone
- Eastern Planning Zone
- Shoreline Protection
- Living Shoreline

- Proposed Marsh Creation Project
- Planned Marsh Creation Project (CPRA/STPG)
- Hydrologic Restoration

Shoreline Protection and Restoration Features
Western Planning Zone

Contract Number 18-019
Figure Number 3-6
St. Tammany Coastal Protection Project

GAP ANALYSIS

Legend
- Western Planning Zone
- Central Planning Zone
- Eastern Planning Zone
- Proposed Marsh Creation Project
- Planned Marsh Creation Project (CPRA/STPG)
- Shoreline Protection
- Living Shoreline
- Hydrologic Restoration

Shoreline Protection and Restoration Features

St. Tammany Parish
Hancock County

Contract Number: 18-019
Figure Number: 3-7
St. Tammany Coastal Protection Project

GAP ANALYSIS

Legend

- **Ring Levee with West Segment/Eden Isle Addition**
  (Allows for different levels of protection in Eden Isle)
- **Existing Ring Levees**

Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, ©OpenStreetMap contributors, and the GIS User Community

- Small or Non-Navigable Floodgate/Pump Station

**Contract Number**: 18-019
**Figure Number**: 3-13D
4.1. Conceptual Project Alternatives

Appendix B provides projects that can be considered for inclusion in the conceptual project alternatives as defined in Task III of the St. Tammany Parish Coastal Protection Project (PO-167). These projects are the result of the Gap analysis process and workshops with the St. Tammany Parish Government and the St. Tammany Parish Levee, Drainage and Conservation District. The St. Tammany Parish Government and the St. Tammany Parish Levee, Drainage and Conservation District can review these initial concepts and consider additional concepts to recommend for further study and actions. The conceptual project alternatives included in appendix B includes the following information:

- Description of Project
- Reasons for Project Selection
- Project Cost Information
- Requirements for Feasibility Analysis

To restrict the number of measures considered, the projects selected are based on the Multiple Lines of Defense Principle (MLDP). This framework includes a wide range of protective elements, namely: barrier islands (synthetic or natural), marsh restoration (to reduce wave action and surge level during a storm), flood gates and levees and pump stations, each with their own limitations, advantages and scope of action. As such, it provides a solid basis for reviewing tentative measures to be deployed in St. Tammany Parish. The acceptability of the project is also an element that was considered. Is the project sound technically, environmentally, economically and socially. For instance, some flood control measures are technically feasible (notwithstanding cost issues) yet are unpopular. Unpractical or downright unfeasible plans and measures were dropped altogether. Projects that pass these initial criteria are provided herein for consideration the St. Tammany Government and St. Tammany Levee, Drainage and Conservation District.

4.2. Restoration Projects

Based on gaps areas identified in St. Tammany’s Coastal Zone that are currently vulnerable to tidal surge and land loss the following restoration projects should be considered for inclusion in the conceptual project alternatives as defined in Task III of the St. Tammany Parish Coastal Protection Project (PO-167). The following conceptual restoration project alternatives are included in Appendix B:

- Big Branch Living Shoreline
- Fritchie Hydrologic Restoration
- Fritchie North Marsh Creation
- Guste Island Living Shoreline
- Guste Island Marsh Creation
- Mandeville Lakefront Living Shoreline and Marsh Creation
- Mandeville Lakefront Wetlands Restoration
- New Orleans East Landbridge Restoration
- Northshore/Eden Isles Breakwater
- Pearl River Island Shoreline Protection and Restoration
- St. Tammany Marsh Creation
4.3. NON-STRUCTURAL PROJECTS
Based on gaps areas identified in St. Tammany’s Coastal Zone that are currently vulnerable to flood risk, non-structural projects should be considered for inclusion in the conceptual project alternatives as defined in Task III of the St. Tammany Parish Coastal Protection Project (PO-167). The following nonstructural risk reduction projects alternatives included are in Appendix B:
- Non-Structural Risk Reduction Master Planning.

4.4. STRUCTURAL PROTECTION
Based on gaps areas identified in St. Tammany’s Coastal Zone that are currently vulnerable to storm surge, the following structural projects should be considered for inclusion in the conceptual project alternatives as defined in Task III of the St. Tammany Parish Coastal Protection Project (PO-167). The following structural protection projects alternatives are included in Appendix B:
- Eden Isles Storm Surge Protection
- Lacombe Ring Levee
- Mandeville Seawall Improvements and Shoreline Protection
- Slidell Ring Levee
- West Slidell Ring Levee

4.5. WATERSHED
The following drainage project should be considered for inclusion in the conceptual project alternatives as defined in Task III of the St. Tammany Parish Coastal Protection Project (PO-167) based on gaps identified in St. Tammany’s risk to flooding and are included in Appendix B:
- W-14 Canal Drainage Improvements

4.6. TASK III – PROJECT FEASIBILITY ANALYSIS AND ENGINEERING DESIGN
For projects selected and recommended for further study and actions, Task III of the St. Tammany Parish Coastal Protection Project (PO-167) includes the following scope of work:
- Develop conceptual project alternatives, including estimated costs for areas defined in the Task II.
- Perform benefit/cost analysis for each project approved by the St. Tammany Parish Government and St. Tammany Levee, Drainage and Conservation District. Include engineering analyses, evaluation of existing flood control assets, impact of existing flood control structures on surrounding areas, engineering design, cost estimates, and other information as necessary to provide an acceptable BCA. Project Alternatives Analyses must include, but not necessarily be limited to:
  - Reviewing all existing available data, including currently funded hurricane risk reduction and coastal restoration projects within the Coastal Zone;
- Identifying improvements needed such as repairs to existing drainage infrastructure, control structures, and pump stations;
- Determining impacts to adjacent areas, comparing before and after project water surface elevations for 10, 25, 50, 100- and 500-year storms;
- Performing benefit cost analyses for proposed structural and non-structural strategies; and,
- Identifying any other investigation and/or analyses necessary for the evaluation of proposed projects.
- With respect to planned and existing levee segments, perform a feasibility study to determine the best levee system alignment, then perform any tasks in accordance with 44CRFR65.10.

- Prepare a feasibility report of recommended project alternatives for each project identified including a prioritization of projects based on Benefit/Cost Analysis, Need and Community Input.
ST. TAMMANY PARISH
COASTAL PROTECTION PROJECT (PO-167)

Coastal Modeling Gap Analysis

Prepared by:

NEEL-SCHAFFER
Solutions you can build upon

10000 Perkins Rowe, Suite G360
Baton Rouge, LA 70810
225-924-0235

GEC

8282 Goodwood Boulevard
Baton Rouge, Louisiana 70806
225.612.3000

Prepared for:

St. Tammany Parish

October 2, 2019
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EXECUTIVE SUMMARY

St. Tammany Parish, located in southeast Louisiana, north of Lake Pontchartrain is particularly vulnerable to the impacts of coastal inundation due to its low-lying topography. Coastal hazards (storm surge, wave) and heavy rainfall cause repetitive flooding and significant losses in some areas within the Parish. The Parish will become increasingly susceptible to coastal inundation primarily due to sea level rise and subsidence. Change in coastal processes induced by climate variability will more severely impact already vulnerable areas and extend the flooding zones. Coastal processes are complex and understanding how they may impact St. Tammany Parish requires reliable and accurate data. The purpose of this data gap analysis is to review existing coastal data sets and assess their usefulness for local planning and decision-making. The data gap analysis focused mainly on the storm surge study performed as part of the 2017 Louisiana Coastal Protection and Restoration Authority (CPRA) Master Plan and the overland wave propagation study performed by the St. Tammany Parish as part of the re-analysis of their Base Flood Elevations (BFEs).

The gap analysis showed that coastal storm surge and wave modeling techniques used for the 2017 CPRA Master Plan were adequate for capturing the dynamics of hurricane driven waves and storm surge. The analysis did identify several levee segments that are missing from the grids utilized in the Master Plan storm surge models along with some levee elevations discrepancies, as these levees systems were built after the grids were developed. Although the grids were developed with fine resolutions for coastal channels and tributaries, they cover a broad domain including the entire Gulf of Mexico and the Atlantic Ocean which results in limited resolution in some areas of the Parish. The recommendations for the hydrodynamic model include updating the grids to include georeferenced data that was not available until after the grid was developed prior to 2014. The required data updates include the addition of newly completed levee segments; raised existing levee segments; some refinement of the grids to resolve critical areas within the Parish; and, added coastal features. The overland wave propagation model (WHAFIS) utilized data from the Federal Emergency Management Administration’s (FEMA) 2008 Flood Insurance Study for Southeastern Parishes in Louisiana. This data included transects, still water levels and wave conditions. Based on the gap analysis, it has been determined that WHAFIS modeling should be updated with the most recent surge, wave and topography data available for the Parish.

The recommendations drawn from the findings of this gap analysis will help fill the data gap identified and enable the application of hydrodynamic models toward restoration and flood protection efforts in St. Tammany Parish. These efforts can utilize the updated hydrodynamic models or newer, equivalent modeling methodologies to evaluate potential projects in St. Tammany Parish.
1. INTRODUCTION

Coastal flooding in the United States causes more property damage than any other natural disaster. Businesses, infrastructure, and communities are increasingly exposed to greater coastal storm and flood vulnerabilities. Hurricanes, tropical storms, and sea level rise are significant threats to the economy of coastal communities, such as St. Tammany Parish, potentially hampering the vitality of the country. St. Tammany Parish, located in southeast Louisiana, north of Lake Pontchartrain, is characterized by low elevation and flat topography making the entire parish subject to flooding from tropical storm surge, storm wave, and riverine flooding from heavy rainfall. St. Tammany Parish is among the parishes with the highest number of flood/hurricane related disaster declarations in the state of Louisiana. Loss of floodplain storage, decreased conveyance capacity, sea level rise, and subsidence are all factors leading to the repetitive flooding of some areas within the Parish.

Coastal processes are highly complex and require rigorous engineering techniques for characterizing their stochastic nature. High fidelity and high resolution modeling is necessary for coastal hazard assessment. Accurate simulations of hurricane storm surge and wave require a complete physics based numerical model; a grid that has sufficient resolution to capture the complex interaction of coastal processes; accurate bathymetric and topographic data; and, atmospheric forcing representative of the storm to be simulated.

This report is a coastal modeling data gap analysis for St. Tammany Parish. This modeling gap analysis report summarizes existing coastal modeling data sets for St. Tammany Parish and their usefulness for coastal storm surge and wave modeling at a scale that is useful for local planning and decision making. This modeling gap analysis is part of the St. Tammany Parish Coastal Reconnaissance Study (PO-0167). This analysis includes review of Advanced Circulation (ADCIRC), Simulating Waves Nearshore (SWAN) and, Wave Height Analysis for Flood Insurance Studies (WHAFIS) models provided for relevancy, completeness, and technical sufficiency in order to determine gaps in model domain and model technology. The report focuses mainly on ADCIRC and SWAN modeling performed as part of the 2017 Louisiana Coastal Protection and Restoration Authority (CPRA) Master Plan and Federal Emergency Management Agency (FEMA) Wave Height Analysis for Flood Insurance Studies modeling performed by the St. Tammany Parish as part of the re-analysis of their Base Flood Elevations (BFEs).

2. STORM SURGE STUDY

2.1. ADCIRC Modeling Description

Surge levels and wave characteristics were modeled using ADCIRC (Luettich and Westerink, 2004) tightly coupled with SWAN (Zijlema, 2010) as part of the Louisiana 2017 Coastal Master Plan. Both ADCIRC and SWAN were applied on the same unstructured grid that covers a broad domain including the entire Gulf of Mexico and the Atlantic Ocean eastward to the 60-degree west longitude line. The meshes used during the 2017 Master Plan and Master Plan Updates Project modeling (cpra2017_v11h_Y00500G00_chk.grd and cpra_2017_v01d_chk.grd) both contain over 1.3 million computational nodes and 2.7 million finite elements with the vast majority of the nodes concentrated in coastal Louisiana.

The CPRA 2017 mesh is based on the Southern Louisiana (SL) versions of the ADCIRC computational mesh which are highly accurate and robust models that have been thoroughly validated and reviewed by some of leading experts in the field of coastal engineering. The mesh was developed by retaining critical model
features from SL 18, such as waterways, levees and other hydraulic controls. The SL 18 mesh is an ultra-high-resolution grid of Southern Louisiana with over 6.8 million nodes, 13.5 million finite element with minimum element size of 10 meters in channels and rivers. The SL 18 mesh was created in 2011 (Deitrich et al., 2010, 2011a), and this mesh does not contain the hurricane protection features constructed since this date. It should be noted that some levee discrepancies have also been found in other SL grid versions, particularly the SL15-65 grid used to model the Hurricane and Storm Damage Risk Reduction System (HSDRRS) impact on unprotected areas within the Lake Pontchartrain Basin.

For this study, the levees in question are located in the southern boundaries of Lake Pontchartrain along the northern edge of New Orleans East lake shoreline. The 1965 Corps’ Hurricane Betsy Impact Report Plate 5 shows no levee in that area while the SL15-1965 grid used in the Corps’ HSDRRS evaluation of storm surge impact shows high levees along the Lake Pontchartrain shoreline that were either significantly lower or did not exist in 1965. These discrepancies have not been addressed to date, however this should not impact the surge levels in St. Tammany Parish.

Bathymetric data for the Atlantic, Caribbean, and deep Gulf of Mexico was obtained from the ETOPO1 data set (Amante and Eakins, 2009). Nearshore areas were specified using Coastal relief digital elevation models (http://www.ngdc.noaa.gov/mgg/coastal/), with data for inland water bodies including lakes, channels, and rivers coming from recent USACE and NOAA surveys. Marsh topography was specified based on marsh type with the Louisiana Gap Analysis Program (LA-GAP; http://atlas.lsu.edu/rasterdown.htm) land-cover databases with non-marsh topography based on LiDAR (http://atlas.lsu.edu/lidar/). In all cases, bathymetry/topography was applied to the mesh using a local element-scale averaging to avoid discontinuities.

The engineering consulting firm Arcadis updated the ADCIRC model for the 2017 Coastal Master Plan. As part of the update new topographic, bathymetric, and levee elevation information has been applied to the model. The improvements increased resolution to further resolve critical areas, extending the model domain into Mississippi and Alabama. The bathymetry and topography used to generate the mesh were extracted from several datasets including LiDAR. Bathymetry survey for the nearshore and inland waterways was provided by regional bathymetric surveys and dredging surveys, typically from the United States Army Corps of Engineers, New Orleans District, Mississippi Valley Network (USACE, MVN) and the National Ocean Service (NOS) (Attachment C3-25.1: Storm Surge, CPRA2017)

While features such as barrier islands, rivers, and dredged channels are generally well resolved in meshes, features such as levees, floodwalls, and raised highways require different attention. In general, these features must be incorporated into the model as sub-mesh scale features or a line of computational nodes along the crown of the feature. Both approaches require strategic positioning both horizontally and vertically. For the 2017 Master Plan, federal, state, and local roads, levees, and railroads were positioned in the horizontal using the USACE GIS database, Atlas Light Detection and Ranging (LiDAR - Louisiana State University, 2004), and satellite imagery. The crown elevation for each feature was obtained from federal, state or parish surveys where available. Elsewhere, LiDAR elevations were extracted automatically by searching a defined region around each node along the pronounced feature. The pronounced features found near Slidell in the 2017 Master Plan meshes are shown in Figure 1. The right panel shows features within the 2017 Master Plan Updates Project include levee segments from the South Slidell Levee that are not in the 2017 Master Plan base conditions grid depicted in the left panel.
The meshes were used to predict storm responses for 446 synthetic storms. The synthetic storm suite modeled were developed as part of the Joint Probability Method-Optimum Sampling approach (JMP-OS) developed by the USACE and FEMA in 2008 (USACE 2008a, USACE 2008b, USACE 2008c). The storm covers the probable range of hurricane parameters of central pressure, heading, forward speed, radius of maximum winds, and landfall location expected to impact Louisiana. A total of 152 high-intensity storms were developed for eastern Louisiana including 50 in Category 3, 52 in Category 4, and 50 in Category 5 by the Saffir-Simpson intensity scale. Radii of the maximum wind speed for each hurricane category are distributed as follows: 11-35 nautical miles in Category 3, 8-25 nautical miles in Category 4, and 6-21 nautical miles in Category 5. The recurrence interval of the 152 high-intensity storms ranges between one in 50 years and one in 3500 years. In addition, 71 low-intensity storms were also generated yielding a total of 223 storms characterizing the storm hazard for eastern Louisiana. Storm tracks for Louisiana are provided in Figure 2.
The meteorological forcing files (wind and pressure fields) were developed by OWI (Ocean Weather Inc.). Wind and atmospheric pressure time series were calculated by the planetary boundary layer (PBL) model (Thompson and Cardone, 1996). These wind and pressure fields were also created as part of FEMA Flood Insurance Rate Map studies in Louisiana (USACE 2008a, USACE 2008b, USACE 2008c) and are required inputs used to drive the storm surge and wave models.

In all of the synthetic storms, the initial water levels were raised to account for the seasonal thermal expansion of sea surface in the Gulf of Mexico (steric) and the average offset between local mean sea level (LMSL) and the North American Vertical Datum of 1988 (NAVD88). The approximation for thermal expansion is computed using long-term National Oceanic and Atmospheric Administration (NOAA) stations at Grand Isle, Eugene Island, and Dauphin Island.

### 2.2 Key Findings

The following levee features exist in the ADCIRC grid within St. Tammany Parish: Lakeshore Estates Levee, Kings Point Levee, and Oak Harbor Levee. Some discrepancies in the levee elevations were found while comparing the grids with the levee elevations provided by the Parish. Some levee segments, either newly constructed or raised, are also missing within the 2017 Master Plan ADCIRC grids based on two documents: the St. Tammany Coastal Protection Project, Collection and Organization of Existing Flood Control Assets and Project Data and the St. Tammany Parish South Slidell Segments Summary. Below are the specific discrepancies identified:
(1) **Cypress Bayou Levee and Salmen Tract Levee**: These levees exist in St. Tammany Parish and are not represented in the 2017 Master Plan grids (Figure 3)

(2) **Lakeshore Estates Ring Levee (Segment 03b)**: (DD#2) from I-10 to the Lakeshore Ring Levee is missing in both 2017 Master Plan grid and 2017 Master Plan Updates Project. (Figure 4)

(3) **Lakeshore Estates Ring Levee (Segment 03a)**: Oak Harbor Ring Levee (DD#5) to I-10 is complete and does not exist in both 2017 Master Plan ADCIRC grids. (Figure 4)

(4) **Lakeshore Estates Ring Levee (Segment 03c)**: East Howse Beach Road Raising is complete. (Figure 4)

(5) **Oak Harbor Ring Levee (Segment 01)**: Levee segment 01 of the Oak Harbor Levee is missing in the 2017 Master Plan grid. The Oak Harbor Levee elevations are well represented in the 2017 Master Plan grid, however the elevations of levee segment 01 and the northern segment of the Oak Harbor Levee are not well represented in the 2017 Master Plan updates project grid (Figure 5).

(6) **Oak Harbor Ring Levee (Segment 02a)**: from highway 11 to Schneider Canal Pump Station is complete and does not exist in both 2017 Master Plan ADCIRC grids. (Figure 5)

(7) **Kings Point Levee**: The kings Point levee (Voter Road Levee West) and the Voters Road Levee (Voter Road Levee East) are collectively known as the kings Point Levee. They are two separate ring levee systems. The kings Point levee is portrayed as a single ring levee system in the 2017 Master Plan Updates Project grid as shown in Figure 6.
Figure 3: Levees in St. Tammany Parish
Top Left Panel – Lakeshore Estates Levee elevations.
Bottom Left Panel – Lakeshore Estates Levee from 2017 Master Plan grid (cpra2017_v11h_Y00500G00_chk.grd).

Figure 4: Lakeshore Estates Levee Segments/Elevations
Top Left Panel – Oak Harbor Levee elevation elevations.

**Figure 5: Oak Harbor Levee Elevation Levee Segments/Elevations**
Top Left Panel – Kings Point Levee elevation elevations.
Bottom Left Panel – Kings Point levee elevation from 2017 Master Plan grid (cpra2017_v11h_Y00500G00_chk.grd).

**Figure 6: Kings Point Levee Elevation Levee Segments/Elevations**
2.3 Recommendations

The ADCIRC and SWAN models themselves are not in need of any known fundamental improvements for capturing the dynamics of hurricane driven waves and storm surge. ADCIRC has been used in numerous regional studies such as the North Atlantic Comprehensive Coast Study (NACCS) and FEMA RiskMAP studies. These high fidelity models have demonstrated that they can provide the desired level of accuracy for storm responses. Below are recommendations based on the ADCIRC modeling review:

(1) The unstructured mesh used as part of the 2017 Coastal Master Plan is well suited for resolving and representing complex and irregular shoreline features of St. Tammany Parish. However, the grid needs to be updated to include newly complete levee segments and raised existing levee segments. Further refinement of the grid might be necessary to add coastal features depending on the proposed projects and increase resolution within the Parish to resolve critical areas.

(2) ADCIRC and SWAN models produce large volume of data for all the grid points. Model results are usually sampled at some discrete points. Figure 7 shows the save point locations in the region of St. Tammany Parish for the Louisiana Coastal Protection and Restoration (LACPR) 2009 study as an example. There are not many save point locations within St. Tammany Parish. Additional save point locations should be identified for the study area to archive model results and facilitate future analyses.

(3) The ADCIRC data collected to date does not include the statistical analysis of the storm responses. Return period analyses should be performed at the selected save point locations with a quantitative measure of the uncertainty of the results. The storm recurrence rates along with the results of the ADCIRC/SWAN models should be used to compute the response joint probabilities as per Nadal et al. (2015).

(4) The ADCIRC data collected to date does not include the wind and pressure fields, which are required inputs to ADCIRC.
Figure 7: Save Point Locations for LACPR 2009 Study in St. Tammany Parish
3. OVERLAND WAVE PROPAGATION STUDY

3.1. WHAFIS Modeling Description

Overland wave propagation for the BFEs is modeled using FEMA’s WHAFIS model. WHAFIS is a model used to estimate waves in the flood inundated areas. WHAFIS computes heights and wave crest elevations along representative transects using a 1D-wave action equation, which are then used to establish the flooding zones (VE, AE, X…). Areas susceptible of flooding are identified as coastal AE zones, which means that a base flood elevation has been determined, and the area is affected by waves less than 3 feet high. The USACE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard zones. The 3-foot wave has been established as the minimum size wave capable of causing major damage to conventional wood frame and brick veneer structures. Figure 8 shows a profile for a typical transect illustrating the effects of energy dissipation and regeneration on a wave as it moves inland.

![Figure 8: Transect Schematic](image)

Effective Flood Insurance Rate Maps (FIRMs) for St. Tammany Parish are dated April 21, 1999. The revised preliminary FIS for St. Tammany Parish is dated April 30, 2008. The Parish is currently appealing the revised preliminary FIRMs. The maps have been under review since that time and have not become effective. Pursuant of the publication of preliminary FIRMs, WHAFIS modeling was performed by St. Tammany Parish to re-determine the BFEs for a portion of the City of Madisonville and Slidell. The FEMA starting still water elevations and wave heights used to produce the preliminary Standard Digital Flood Insurance Rate Map (DFIRM) for St. Tammany Parish were based on the surge study performed as part of the Flood Insurance Study for Southeastern Parishes in Louisiana dated 2008. SL15 mesh was used to simulate a set of 152 storms with ADCIRC and the numerical model STWAVE to develop still water elevation and near shore wave for coastal Louisiana. Some discrepancies were found between the still water elevation used by FEMA and the data of the Parish. Table 1 documents the starting still water elevations and wave heights used in the FEMA set up and the St. Tammany Parish reanalysis set up.
Table 1: WHAFIS Starting Water Levels and Waves FEMA vs St. Tammany Parish Reanalysis

<table>
<thead>
<tr>
<th>Transect ID</th>
<th>FEMA</th>
<th></th>
<th>STP</th>
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<tbody>
<tr>
<td></td>
<td>Wave Height*</td>
<td>Wave Period</td>
<td>Still Water Level</td>
<td>Wave Height*</td>
</tr>
<tr>
<td>73</td>
<td>1.65</td>
<td>1.50</td>
<td>10.5</td>
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</tr>
<tr>
<td>74</td>
<td>1.62</td>
<td>1.49</td>
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<td>1.30</td>
</tr>
<tr>
<td>75</td>
<td>0.78</td>
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<td>76</td>
<td>0.96</td>
<td>2.22</td>
<td>10.8</td>
<td>0.37</td>
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<tr>
<td>78</td>
<td>2.76</td>
<td>1.95</td>
<td>11.4</td>
<td>1.75</td>
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<tr>
<td>79</td>
<td>0.66</td>
<td>2.17</td>
<td>11.9</td>
<td>0.53</td>
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<tr>
<td>80</td>
<td>5.95</td>
<td>6.62</td>
<td>12.4</td>
<td>0.92</td>
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<tr>
<td>81</td>
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<td>12.6</td>
<td>4.35</td>
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<tr>
<td>82</td>
<td>7.56</td>
<td>6.82</td>
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<td>1.30</td>
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</table>

*Controlling wave height taken as 1.6 times the significant wave height for NFIP purposes.

The controlling wave height approximately represents the average height of the highest 1 percent of waves during a storm event and significant wave height is the average height of the highest one-third of all waves. Transects for this study were located considering the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced closely together originating along the Tangipahoa Parish line and into St. Tammany Parish. In areas having more uniform characteristics, transects were spaced at larger intervals. Transects were also located in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects.

The topographic information applied in transect profiles was obtained from LiDAR data collected by the State of Louisiana and FEMA between 2003 and 2005. The bathymetric data for Lake Pontchartrain was obtained from the STWAVE grid elevations applied by the USACE in the wave setup computation. The Louisiana GAP Analysis, developed by the United States Geologic Survey (USGS), served as the primary source for the spatial distribution of vegetative cover. Aerial imagery and field reconnaissance were applied to verify the Louisiana GAP Analysis data. The imagery, collected from late October 2005 through November 2005, was applied to verify features such as buildings, forested vegetation, and marsh grass for input to the wave height models. Detailed information about the features, such as building types and density and vegetation types was gathered during a ground field reconnaissance.

3.2 Key Findings

(1) The input still water levels and wave heights are based on the surge study performed as part of the Flood Insurance Study for Southeastern Parishes in Louisiana dated 2008.

(2) The still water level and wave inputs to WHAFIS are decoupled.

(3) The transect orientation and spacing are adequate. Most transects are representative of the major topographic, vegetative and cultural features. Transects crossing newly raised or built levee segments may be outdated.
3.3 Recommendations

(1) The input still water elevations and wave heights should be updated with the most up to date ADCIRC modeling available for the area.

(2) Statistical wave and water level conditions should be used as input to WHAFIS. The recommended approach for evaluating overland wave propagation is a joint probability method to compute the combination of wave and water level conditions near the shore. The decoupling of surge and wave is a source of uncertainty. Pairing the 1% water level with the 1% wave height is not always appropriate and may lead to either an overestimation or underestimation of inland flood elevations. The use of coupled water level and wave conditions would result in a more rigorous probabilistic solution.

(3) Transects crossing newly complete or raised levee segments need to be updated with new levee heights.

(4) The WHAFIS modeling obtained to date is not georeferenced. FEMA WHAFIS output files typically contain the start and end locations of transects; however, this information does not exist in the WHAFIS output files acquired to date. A GIS database of the WHAFIS modeling may exist and will be needed to facilitate updates to the transects.

4. CONCLUSION

A coastal data gap analysis was conducted for St. Tammany Parish within the framework of the St. Tammany Parish Coastal Reconnaissance Study. The storm surge study performed as part of the 2017 Louisiana Coastal Protection and Restoration Authority (CPRA) Master Plan and the overland wave propagation study performed by St. Tammany Parish as part of the re-analysis of their Base Flood Elevations (BFEs) were reviewed to assess their accuracy and usefulness. The storm surge model ADCIRC was used in CPRA 2017 Coastal Master Plan Modeling. A number of levee segments built after the grids were developed do not exist in the grids. Discrepancies in some existing levee elevation were also found as some levee segments were also raised after the grid was developed. Increased resolution to resolve critical areas within the Parish and added coastal features may be required depending on the proposed projects. The flood elevation (wave crest elevation) for the low-lying coastal areas were computed in FEMA’s (2008) Flood Insurance Study using the overland wave propagation model WHAFIS. The transect orientation and spacing are considered adequate but the terrain for some transects (newly raised or built levee segments) may need to be updated due to local topography change. The input still water elevations and wave heights of the WHAFIS model are outdated and should be updated with the most up to date surge and wave data.

As the need for protection against flooding and storm surge remains a top priority throughout coastal Louisiana, the use of hydrodynamic modeling will continue to be the primary means by which coastal protection projects are developed. By implementing the recommendations provided in this gap analysis, St. Tammany Parish would ensure that proposed projects, such as ring levees, breakwaters, or marsh creation projects, could be evaluated by utilizing updated hydrodynamic models or through future modeling efforts such as those authorized under the Louisiana Watershed Initiative.
5. REFERENCES


maxele.63 (maximum elevation at all nodes) swan_HS.63 (wave height time series at all nodes) swan_HS_max.63 (maximum wave height at all nodes) swan_TPS.63 (relative peak period at all nodes) swan_TPS_max.63 (maximum relative peak period at all nodes) swaninit file (swan initialization file).
Appendix A: DATA INVENTORY

**Source:** St. Tammany Parish (4TB drive from Katelyn Costanza, CE Hydro, LLC, 633 Asbury Drive, Suite A, Mandeville, LA 70471, 985-778-2552, 504-756-9376)

**Acquired on:** 06/04/2019

**Recipient:** Fatimata Diop

Data copied to GEC-Noble 8TB drive on 06/05/2019

**ADCIRC/SWAN**

\ADCIRC_CPRA_2017_MP\Simulations.2017MasterPlan_CurrentConditions.50_99

Simulations conducted during the 2017 Master Plan. Note that a different datum, flow rate, and underlying geometry is used from the Master Plan Updates simulation set. Powell wind drag and reduced bottom friction per FEMA Texas are used.

Mesh folder contains the fort.13 file (nodal attributes) and grid file. cpra2017_v11h_Y00S00G00_chk.grd

The folder also contains 92 folders representing each a storm simulation (folder name format: Run.XXX where XXX is the storm ID). Each folder contains:

- fort.15 (model parameter and periodic boundary condition file)
- fort.26 (SWAN runtime parameters and ADCIRC/SWAN coupling details file)
- fort.63 (elevation time series at all nodes)
- maxele.63 (maximum elevation at all nodes)
- swan_HS.63 (wave height time series at all nodes)
- swan_HS_max.63 (maximum wave height at all nodes)
- swan_TPS.63 (relative peak period at all nodes)
- swan_TPS_max.63 (maximum relative peak period at all nodes)
- swaninit file (swan initialization file).

\ADCIRC_CPRA_2017_MP\Simulations.2017MasterPlanUpdates_CurrentConditions.50_99

Full suite of 446 storms run during the Master Plan Updates project. Note that these storms use the Powell wind drag and reduced bottom friction per FEMA Texas, and differ from the FEMA Louisiana formulation.

Mesh folder contains the fort.13 file (nodal attributes) and grid file. cpra_2017_v01d_chk.grd

The folder also contains 446 folders representing each a storm simulation (folder name format: Run.XXX where XXX is the storm ID). Each folder contains:

- fort.15 (model parameter and periodic boundary condition file)
- fort.26 (SWAN runtime parameters and ADCIRC/SWAN coupling details file)
- fort.63 (elevation time series at all nodes)
**WHAFIS**

0 Madisonville WHAFIS Analysis Report.docx: WHAFIS Report for Madisonville containing revision made to existing transect 13 and modeling results

0 STP Slidell Area WHAFIS Reanalysis March 15 2015.docx: WHAFIS results for LAMP transects 73, 74, 75, 76, 79 & 80

0 STP WHAFIS March 2015 Summary.docx: Summary of initial wave and water level for transects 73, 74, 75, 76, 78, 79, 80, 81 from FEMA and STP

Folder contains WHAFIS input and output files for Transects 13A, 13R, STF67, STF68, STF69, STF70, STF71, STF72, STF73AS, STF74, STF74AS, STF75, STF75AS, STF76, STF76AS, STF78, STF78AS, STF79, STF79AS, STF80, STF80AS, STF81, STF82, STF83, STF84, STF85, STF86, STF87

STF73 output file exists, however STF73 input file is missing.
Appendix B: STP EXISTING LEVEES

Kings Point Levee Elevations

Oak Harbor Levee Elevations
## St. Tammany Parish Coastal Reconnaissance Study

### Coastal Data Gap

<table>
<thead>
<tr>
<th>Segment Number</th>
<th>Segment Description</th>
<th>Segment Type</th>
<th>Length (Linear feet)</th>
<th>Current or Design Elevation (feet)</th>
<th>Status [J]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Raising Highway 15 to N8 to Tracks - Phase 1 (55') - LP</td>
<td>Earthen</td>
<td>1916.70</td>
<td>15.0</td>
<td>Complete, April 2018</td>
</tr>
<tr>
<td>02a</td>
<td>Hwy 11 to Schneider Canal Pump Station</td>
<td>Earthen</td>
<td>894.10</td>
<td>15.0</td>
<td>Complete. Constructed to 100 year design height. Will need small pump station over levee to replace current to meet USACE guidelines</td>
</tr>
<tr>
<td>02b</td>
<td>Schneider Canal Pump Station to Oak Harbor Ring Level (OHL)</td>
<td>T-Wall across Canal &amp; Pump station</td>
<td>331.60 [3]</td>
<td>15.0</td>
<td>Design complete, waiting on construction funding.</td>
</tr>
<tr>
<td>03a</td>
<td>Oak Harbor Ring Level (OHL) to T-10</td>
<td>Earthen</td>
<td>441.20</td>
<td>15.3</td>
<td>Complete. Constructed to 100 year design height. Will need small pump station over levee to replace current to meet USACE Guidelines</td>
</tr>
<tr>
<td>03b</td>
<td>1-10 to Lakeshore Estates Ring Level (DEK)</td>
<td>Earthen</td>
<td>1462.20</td>
<td>15.3</td>
<td>Complete. Constructed to 100 year design height.</td>
</tr>
<tr>
<td>03c</td>
<td>East Houze Beach Road Raising</td>
<td>Earthen</td>
<td>16.75</td>
<td>15.3</td>
<td>Complete. Constructed to 100 year design height.</td>
</tr>
<tr>
<td>03d</td>
<td>T-10 Raising</td>
<td>T-B</td>
<td>TBD</td>
<td>TBD</td>
<td>No work yet.</td>
</tr>
<tr>
<td>4</td>
<td>Segment 01 to Baptist Church</td>
<td>Earthen</td>
<td>1298.70</td>
<td>15.25</td>
<td>Designed but must be permitted with segments 5, 6, 9, 10, 11, and 14.</td>
</tr>
<tr>
<td>5</td>
<td>Baptist Church to Sun Valley Pump Station</td>
<td>T-Wall</td>
<td>1736.80</td>
<td>15.25</td>
<td>Complete. Constructed to 100 year design height. Will need small pump station over levee to replace current to meet USACE Guidelines</td>
</tr>
<tr>
<td>6</td>
<td>Lakeshore Estates Ring Level (DEK) to Hwy 435 (Note: Alignment may change)</td>
<td>Earthen</td>
<td>1758.00</td>
<td>TBD</td>
<td>No work yet.</td>
</tr>
<tr>
<td>7</td>
<td>Hwy 435 to Kingspoint Ring Level (DEK) (Note: Alignment may change)</td>
<td>Earthen</td>
<td>4626.50</td>
<td>TBD</td>
<td>No work yet.</td>
</tr>
<tr>
<td>8</td>
<td>Sun Valley Pump Station to Lousiana Street</td>
<td>T-Wall</td>
<td>4626.50</td>
<td>15.25</td>
<td>Complete. Constructed to 100 year design height. Will need small pump station over levee to replace current to meet USACE Guidelines</td>
</tr>
<tr>
<td>9</td>
<td>Lousiana Street to Bayou Liberty Road</td>
<td>T-Wall</td>
<td>2728.80</td>
<td>15.25</td>
<td>Complete. Constructed to 100 year design height. Will need small pump station over levee to replace current to meet USACE Guidelines</td>
</tr>
<tr>
<td>10</td>
<td>Bayou Liberty Road to south of Bayou Patterson</td>
<td>T-Wall</td>
<td>1555.40</td>
<td>15.25</td>
<td>Complete. Constructed to 100 year design height. Will need small pump station over levee to replace current to meet USACE Guidelines</td>
</tr>
<tr>
<td>11</td>
<td>Bayou Patterson to Bayou Labre</td>
<td>T-Wall</td>
<td>1229.92</td>
<td>15.25</td>
<td>Complete. Constructed to 100 year design height. Will need small pump station over levee to replace current to meet USACE Guidelines</td>
</tr>
<tr>
<td>12</td>
<td>Raise portion of Kingspoint Ring Level (DEK) &amp; Install Pump Station in W-14 Canal</td>
<td>Earthen</td>
<td>4109.40</td>
<td>17.25</td>
<td>No work yet. A portion of this levee, about 4,000 ft, will need to be raised about 4 ft. PLUS the City of Slidell’s City Farm drainage pump station will need to be relocated.</td>
</tr>
<tr>
<td>13a</td>
<td>Raise portion of Existing Kingspoint Ring Level (DEK) and extend to Hwy 190</td>
<td>Earthen</td>
<td>3575.30</td>
<td>17.25</td>
<td>No work yet. Approx 7500 ft. height varies from Kingspoint levee to high ground just north of Hwy 250 - includes pump in Hwy 190.</td>
</tr>
<tr>
<td>13b</td>
<td>Connect new segment to Kingspoint Ring Level (DEK) and extend to Hwy 190</td>
<td>Earthen</td>
<td>3980.50</td>
<td>15.25</td>
<td>Complete. Constructed to 100 year design height. Will need small pump station over levee to replace current to meet USACE Guidelines</td>
</tr>
<tr>
<td>14</td>
<td>Bayou Lane to W. Pass Avenue</td>
<td>T-Wall</td>
<td>2814.50</td>
<td>15.25</td>
<td>Complete. Constructed to 100 year design height. Will need small pump station over levee to replace current to meet USACE Guidelines</td>
</tr>
<tr>
<td>15</td>
<td>Raising Oak Harbor Boulevard (same road over levee)</td>
<td>Earthen</td>
<td>17.1</td>
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<td>Complete. Use estimated cost with contingency to be $1.1M.</td>
</tr>
<tr>
<td>16</td>
<td>W-14 Canal Pump Station</td>
<td>Earthen</td>
<td>18.0</td>
<td></td>
<td>Complete. Use estimated cost with contingency to be $1.1M.</td>
</tr>
</tbody>
</table>

[Footnotes:

1. SEC for OPA (August 2018)
2. Constructed but will need site visited to 35 year protection elevation
3. Data from St. Tammany Parish - October 2019]
Appendix C: 2017 MASTER PLAN GRIDS FEATURES

2017 Master Plan grid (cpra2017_v11h_Y00S00G00_chk.grd)
2017 Master Plan Updates Project grid (cpra_2017_v01d_chk.grd)
APPENDIX A2

APPENDIX A2 – LEVEE SURVEY
NOTES:
1) SURVEY WORK PERFORMED USING LEICA GPS EQUIPMENT WITH
   RTK USING LEICA SMARTNET AT APPROXIMATE CENTER LINE OF
   LEVEE/CONNECTION/RAIL.
2) WORK PERFORMED UNDER SUPERVISION OF SEAN M. BURKES,
   PE. (BS: FL PE #1785) – J.W. BURKES & ASSOCIATES, INC. IN
   FEBRUARY 2020.
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<th>Start</th>
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</table>

*Note: Times are approximate.*
APPENDIX B – PROJECTS FOR INCLUSION IN CONCEPTUAL PROJECT ALTERNATIVES
## Alternative Project Summary

<table>
<thead>
<tr>
<th>Planning Zone</th>
<th>Planning Area</th>
<th>Project Type</th>
<th>Project Title</th>
<th>Cost Estimate(^2)</th>
<th>Jurisdictional Authority</th>
<th>Project Phase</th>
<th>Current Project Activity (Y/N)</th>
<th>Priority (STLDCD High Priorities (= ) H) (^1)</th>
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<tbody>
<tr>
<td>Eastern</td>
<td>E-08</td>
<td>Structural</td>
<td>Eden Isles Storm Surge Protection</td>
<td>$35,000,000 - $128,000,000</td>
<td>TBD - New Project</td>
<td>Conceptual Design</td>
<td>N</td>
<td>H</td>
</tr>
<tr>
<td>Central</td>
<td>C-06</td>
<td>Structural</td>
<td>Lacombe Ring Levee</td>
<td>$234,000,000</td>
<td>TBD - New Project</td>
<td>Planning</td>
<td>N</td>
<td>H</td>
</tr>
<tr>
<td>Central</td>
<td>C-05</td>
<td>Structural</td>
<td>Mandeville Seawall Improvements and Shoreline Protection</td>
<td>$240,000 - $37,700,000</td>
<td>City of Mandeville</td>
<td>Planning</td>
<td>Y</td>
<td>H</td>
</tr>
<tr>
<td>Eastern</td>
<td>E-08 &amp; E-09</td>
<td>Structural</td>
<td>Slidell Ring Levee</td>
<td>$181,000,000</td>
<td>CPRA/STPG/City of Slidell</td>
<td>Design and Construction</td>
<td>Y</td>
<td>H</td>
</tr>
<tr>
<td>Eastern &amp; Central</td>
<td>E-08 &amp; C-07</td>
<td>Structural</td>
<td>West Slidell Ring Levee</td>
<td>$144,000,000.00</td>
<td>TBD - New Project</td>
<td>Planning</td>
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<td>H</td>
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<tr>
<td>All</td>
<td>All</td>
<td>Nonstructural</td>
<td>St. Tammany Parish Nonstructural Risk Reduction</td>
<td>$1,611,300,000</td>
<td>Varies</td>
<td>Planning</td>
<td>Y</td>
<td>H</td>
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<td>Central</td>
<td>C-06</td>
<td>Restoration</td>
<td>Big Branch Living Shoreline</td>
<td>$103,500,000</td>
<td>STPG</td>
<td>Conceptual Design</td>
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<tr>
<td>All</td>
<td>All</td>
<td>Restoration</td>
<td>Coastal Vegetative Tree Planting Program</td>
<td>TBD</td>
<td>Varies</td>
<td>Planning</td>
<td>Y</td>
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<td>E-09 &amp; E-11</td>
<td>Restoration</td>
<td>Fritchie Hydrologic Restoration</td>
<td>$4,820,000</td>
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<td>W-03</td>
<td>Restoration</td>
<td>Guste Island Living Shoreline</td>
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<td>W-03</td>
<td>Restoration</td>
<td>Guste Island Marsh Creation</td>
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<td>CPRA/STPG</td>
<td>Conceptual Design</td>
<td>N</td>
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<td>C-05</td>
<td>Restoration</td>
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<td>E-11</td>
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<td>Restoration</td>
<td>Tchefuncte River Area, Wooded Island Protection, Peninsula Replacement and Marsh Creation</td>
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<td>Design Phase</td>
<td>N</td>
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<td>Western</td>
<td>W-03</td>
<td>Restoration</td>
<td>West Shoreline Protection</td>
<td>$12,000,000 - $19,500,000</td>
<td>CPRA/STPG</td>
<td>Planning</td>
<td>N</td>
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| Eastern       | E-08          | Coastal Watershed | W-14 Drainage Canal Improvements | TBD | City of Slidell | Design Phase | N |                                |

**Note:**  
1. Priority H projects are projects the St. Tammany Levee Drainage and Conservation District considers critical projects for consideration in flood damage reduction.  
2. A construction cost range is shown for projects with multiple cost estimates from both the 2017 CPRA Master Plan and the 2016-2020 St. Tammany Parish Government Coastal Master Plan.  
3. This is the total cost estimate and is inclusive of all restoration areas in Orleans Parish. St. Tammany restoration specific cost estimates are ‘To Be Determined’.
R ESTORATION PROJECTS

B IG BRANCH LIVING SHORELINE

DESCRIPTION: This proposed project is an 11-mile shoreline protection located south of Lacombe and potentially protecting the proposed St. Tammany Marsh Creation, shown in figures 1 and 2 below. The shoreline in this area has begun to deteriorate rapidly and several breaches exist today. These breaches provide direct connection between the fresher interior marshes and higher salinity waters of Lake Pontchartrain. This project would provide protection from the continued wave erosion along this 11-mile shoreline. The project would also provide a natural infrastructure solution, wildlife and fisheries habitat, as well as natural coastal resilience to communities near south Lacombe.

Conceptual planning has been done on this living shoreline project. The living shoreline feature has a conceptual design elevation of approximately 2 FT. NAVD 88.

REASONS FOR PROJECT SELECTION: This living shoreline project offers the following potential benefits:

- Restore deteriorating shoreline
- Future protection for the proposed CPRA Master Plan Project, St. Tammany Marsh Creation
- Provide wildlife and fisheries habitat
- Provide coastal resilience for the south Lacombe communities

PROJECT COST INFORMATION: The 11-mile living shoreline project has a total estimated construction cost of approximately $103.5M. This includes the wave attenuation structures, breach repairs (where necessary) and contingency.

This project is relatively large and could be further reduced or segmented during the feasibility analysis to achieve cost effectiveness.

A detailed engineering analysis including survey, geotechnical studies, H&H modeling and coastal modeling needs to be performed to support continued planning and document costs and project benefits.

REQUIREMENTS FOR FEASIBILITY ANALYSIS:

1. Hydraulic/Wave Modeling
2. Refine living shoreline concepts and features
3. Develop conceptual data collection requirements and collect preliminary geotechnical and survey information
4. Refine conceptual cost estimates
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

PROJECT LOCATION:

Figure 1: Big Branch Living Shoreline

Figure 2: Vicinity Map

REFERENCES: None

ATTACHMENTS: None
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

RESTORATION PROJECTS

FRITCHIE HYDROLOGIC RESTORATION

DESCRIPTION: The 2016-2020 St. Tammany Parish Coastal Master Plan included several marsh creation projects, including the Fritchie Hydrologic Restoration. This proposed project is a 4,395-acre hydrologic restoration project located near Salt Bayou within the Fritchie Marsh area, shown in figure 1 below. Over the last 20 years has lost significant amount of marsh, including 14.6% from Hurricane Katrina. Additionally, Fritchie Marsh has sustained significant changes in flow patterns since the construction of Highway 90 which has aided in the degradation of the marsh. This project would look to improve the way water discharges from the W-14 Canal, which enters the Fritchie Marsh. Several projects are being undertaken by St. Tammany Parish, CWPPRA and the USACE in this area to restore marsh. This project would benefit and support the sustainability of these projects.

The project includes the following features and components:

- Deepening an existing meandering distributary channel connecting W-14 canal to the center of the marsh
- Dredging a channel from the W-14 connection and the northeast lake to an existing tributary of Salt Bayou
- Add Two (2) RCP flap gate culverts in Salt Bayou under Hwy 90
- Increase connectivity between Salt Bayou and marsh center
- Deepening main stem of Salt Bayou to remove shallow portions surrounding flow divide
- Add Four (4) flap gate culverts of Geoghegan Canal
- Dredging a channel through the southeast lake connecting the new canal to Salt Bayou
- Maintaining W-14 Canal weir to promote flow through marsh

REASONS FOR PROJECT SELECTION: Conceptual preliminary engineering has been done on this hydrologic restoration. The hydrologic restoration offers the following potential benefits:

- Improve the hydraulics of the Fritchie Marsh in order to improve flow thought the marsh and decrease salinity levels.
- Included as one of several marsh creation/restoration projects along Lake Pontchartrain.

PROJECT COST INFORMATION: The 2016-2020 St. Tammany Parish Coastal Master Plan has developed a conceptual construction cost estimate of $4.82M for this hydrologic restoration project.

As stated in the description section, the construction cost estimate was developed using the following project components and attributes:

- Total Area of Approximately 8,000 acres
- Deepening of W-14 Canal
- Additional flap gate culverts for new and increased hydrologic connectivity
- Improve existing hydrologic connectivity within the project

The details of this estimate and project components are provided in the attachment.
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

**Requirements for Feasibility Analysis:**

1. Hydraulic Modeling for benefits and culvert sizing
2. Develop conceptual geotechnical requirements
3. Develop preliminary cost estimates of individual features
4. Develop a prioritized list of features and a funding plan

**Project Location:**

*Figure 1: Fritchie Hydrologic Restoration*  
*Figure 2: Vicinity Map*

**References:**

St. Tammany Parish Government Coastal Master Plan

**Attachments**

CWPPRA Region 1 and 2 Planning Document
RESTORATION PROJECTS

FRITCHIE HYDROLOGIC RESTORATION

DESCRIPTION: The 2016-2020 St. Tammany Parish Coastal Master Plan included several marsh creation projects, including the Fritchie Hydrologic Restoration. This proposed project is a 4,395-acre hydrologic restoration project located near Salt Bayou within the Fritchie Marsh area, shown in figure 1 below. Over the last 20 years has lost significant amount of marsh, including 14.6% from Hurricane Katrina. Additionally, Fritchie Marsh has sustained significant changes in flow patterns since the construction of Highway 90 which has aided in the degradation of the marsh. This project would look to improve the way water discharges from the W-14 Canal, which enters the Fritchie Marsh. Several projects are being undertaken by St. Tammany Parish, CWPPRA and the USACE in this area to restore marsh. This project would benefit and support the sustainability of these projects.

The project includes the following features and components:

- Deepening an existing meandering distributary channel connecting W-14 canal to the center of the marsh
- Dredging a channel from the W-14 connection and the northeast lake to an existing tributary of Salt Bayou
- Add Two (2) RCP flap gate culverts in Salt Bayou under Hwy 90
- Increase connectivity between Salt Bayou and marsh center
- Deepening main stem of Salt Bayou to remove shallow portions surrounding flow divide
- Add Four (4) flap gate culverts of Geoghegan Canal
- Dredging a channel through the southeast lake connecting the new canal to Salt Bayou
- Maintaining W-14 Canal weir to promote flow through marsh

REASONS FOR PROJECT SELECTION: Conceptual preliminary engineering has been done on this hydrologic restoration. The hydrologic restoration offers the following potential benefits:

- Improve the hydraulics of the Fritchie Marsh in order to improve flow thought the marsh and decrease salinity levels.
- Included as one of several marsh creation/restoration projects along Lake Pontchartrain.

PROJECT COST INFORMATION: The 2016-2020 St. Tammany Parish Coastal Master Plan has developed a conceptual construction cost estimate of $4.82M for this hydrologic restoration project.

As stated in the description section, the construction cost estimate was developed using the following project components and attributes:

- Total Area of Approximately 8,000 acres
- Deepening of W-14 Canal
- Additional flap gate culverts for new and increased hydrologic connectivity
- Improve existing hydrologic connectivity within the project

The details of this estimate and project components are provided in the attachment.
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

REQUIREMENTS FOR FEASIBILITY ANALYSIS:

1. Hydraulic Modeling for benefits and culvert sizing
2. Develop conceptual geotechnical requirements
3. Develop preliminary cost estimates of individual features
4. Develop a prioritized list of features and a funding plan

PROJECT LOCATION:

Figure 1: Fritchie Hydrologic Restoration

Figure 2: Vicinity Map

REFERENCES:

St. Tammany Parish Government Coastal Master Plan

ATTACHMENTS

CWPPRA Region 1 and 2 Planning Document
FRITCHIE MARSH HYDROLOGIC RESTORATION PROJECT
Presented by Duplantis Design Group, PC

PROJECT COMPONENTS

1. Deepening an existing meandering distributary channel connecting the W-14 canal to the center of the marsh
2. Dredging a channel from the W-14 connection and the northeast lake to an existing tributary of Salt Bayou
3. Two additional RCP flap gate culverts in Salt Bayou under Highway 90
4. Increase connectivity between Salt Bayou and marsh center
5. Deepening main stem of Salt Bayou to remove shallow portions surrounding flow divide
6. Four RCP flap gate culverts at Gogehagan Canal
7. Dredging a channel through the southeast lake connecting the new Gogehagan Canal culverts to Salt Bayou
8. Maintaining W-14 Canal weir to promote flow through marsh

LEGEND

Weir structure  BLT-WET Creation
One-way culverts  Marsh Creation
Improvements  Terrace Fields

ACRONYMS

CWPFRA  Coastal Wetlands Planning, Protection and Restoration Act
USACE  United States Army Corps of Engineers

ST. TAMMANY PARISH

DDG
RESTORATION PROJECTS

FRITCHIE NORTH MARSH CREATION

DESCRIPTION: The 2016-2020 St. Tammany Parish Coastal Master Plan included several marsh creation projects, including the Fritchie North Marsh Creation. This proposed project is a 4,395 acre marsh creation located near Salt Bayou within the Fritch Marsh area, shown in figure 1 below. Over the last decade this area has seen an increase in open water by nearly double, greatly exceeding previous rates of deterioration. This project would restore approx. 2,417 acres of low salinity marsh as well as increase the nourishment of approx. 1,997 acres of stressed marsh by using hydraulically dredged sediment from Lake Pontchartrain. Sediment would be placed at +1.2 EL. NAV88 throughout the site. Existing tidal creeks would be maintained in the project to continue to facilitate hydrologic exchange and fisheries access.

It should be noted that several CPRA, CWPPRA, and USACE marsh creation projects have been planned and constructed within this larger marsh creation project.

It should also be noted that a similar project, Fritchie North Marsh Creation 001.MC.103, was evaluated for the 2017 CPRA Master Plan, but ultimately it was not selected for inclusion in the final plan. This project included the creation of 4,000 acres in a similar vicinity.

Conceptual planning has been done on this shoreline protection project for both the 2016-2020 St. Tammany Parish Government Coastal Master Plan as well as the CPRA Master Plan. The details of these project are included as attachments.

REASONS FOR PROJECT SELECTION: Conceptual Planning has been done on this marsh creation project. The marsh creation project offers the following potential benefits:

- Restore deteriorating marsh and increase nourishment of threatened marsh land
- Maintaining and upgrading tidal creeks to more effectively convey open water and offer fisheries access
- Included as one of several marsh creation/restoration projects along Lake Pontchartrain.

PROJECT COST INFORMATION: The 2016-2020 St. Tammany Parish Coastal Master Plan has developed a conceptual construction cost estimate of $104.11M (including contingency) for this marsh creation project.

As stated in the description section, the construction cost estimate was developed using the following project components and attributes:

- Total Area of 4,395 acres
- Confined Marsh Creation Cell with Containment Dike El. Of +1.2 FT. NAVD88
- Borrow Source Lake Pontchartrain
- Fill Volume = Approximately 13.17M Cubic Yards

CPRA’s estimated construction cost was slightly higher at $175.8M for the entire project. This is likely because the marsh fill elevation was higher than 1.2 FT., which led to additional marsh fill volume required for the project.
The details of both estimates and project attributes are provided in the attachment.

**REQUIREMENTS FOR FEASIBILITY ANALYSIS:**

1. Develop and understand any applicable environmental restrictions (such as dredging permit requirements with borrow from Lake Pontchartrain)
2. Develop conceptual geotechnical requirements
3. Develop more detailed engineering documents and cost estimates

**PROJECT LOCATION:**

*Figure 1: Fritchie North Marsh Creation*

*Figure 2: Vicinity Map*

**REFERENCES**

CPRA 2017 Master Plan

St. Tammany Parish Government Coastal Master Plan

**ATTACHMENTS**

CPRA Master Plan 001.MC.103 Fact Sheet

St. Tammany Parish Government Coastal Master Plan (Fact Sheet)
**Description**

Creation of approximately 4,000 acres of marsh in St. Tammany Parish along the eastern Lake Pontchartrain shoreline to create new wetland habitat and restore degraded marsh.

**Project Cost Estimate**

<table>
<thead>
<tr>
<th>Description</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning/Engineering &amp; Design</td>
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<tr>
<td>Construction</td>
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<td>Operations &amp; Maintenance</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$196,400,000</strong></td>
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</table>

**Land Area Built or Maintained***

- **Near Term (Year 20)**: 2,392 acres
- **Long Term (Year 50)**: 233 acres

*Based on the high environmental scenario.

---

**Scale of Influence**

- **Local**
- **Sub-basin**
- **Basin**
- **Regional**

**Project Location**

St. Tammany Parish

**Project Duration**

Planning, Engineering, and Design is estimated to take 2 years.

Construction is estimated to take 2 years.

---

**Other Nearby Projects in the Master Plan**

---
Fritchie North **Marsh Creation.**

The goal of this project is the restoration of 2,417 acres of marsh as well as the nourishment of 1,997 acres of stressed marsh using sediment that is hydraulically dredged from Lake Pontchartrain.

The Fritchie North Marsh Creation project is a 4,395 acre marsh creation project located in St. Tammany Parish along the Lake Pontchartrain Shoreline. This project is located near Salt Bayou with most of the site being located on the Big Branch Marsh National Wildlife Refuge. The low salinity brackish marsh in this area was reasonably stable until Hurricane Katrina. Over the following decade this area has seen an increase in open water by nearly double, far exceeding the previous rate of deterioration. With an increase in tidal exchange due increased land loss and increased wind driven fetch, the rate of marsh loss is expected to continue. Sediment would be placed throughout the site to a height of +1.2 NAVD 88. Tidal creeks exist and would be maintained in order facilitate water exchange and fisheries access.

**Project Attributes**

Area: 4,395 Acres  
Latitude 30.213152, Longitude -89.708031  
Dike Elevation: 1.2’ NAVD  
Borrow Source: Lake Pontchartrain  
Fill Volume: 13,169,017 yd³

**Project Specification**

- Estimated Construction Cost: $83,284,979
- Estimated Construction + Contingency: $104,106,224
RESTORATION PROJECTS

GUSTE ISLAND LIVING SHORELINE

DESCRIPTION: This proposed project is a 1.5-mile living shoreline located west of Madisonville, on Lake Pontchartrain, and potentially protecting the proposed Guste Island Marsh Creation (shown in figures 1 and 2 below). The shoreline in this area has begun to deteriorate rapidly and several breaches exist today. These breaches provide direct connection between the fresher interior marshes and higher salinity waters of Lake Pontchartrain. This project would provide protection from the continued wave erosion along this 1.5-mile shoreline. The project would also provide a natural infrastructure solution, wildlife and fisheries habitat, as well as natural coastal resilience to communities near Guste Island.

Conceptual planning has been done on this living shoreline project. The living shoreline feature has a conceptual design elevation of approximately 2 FT. NAVD 88.

REASONS FOR PROJECT SELECTION: This living shoreline project offers the following potential benefits:

- Restore deteriorating shoreline
- Future protection for the proposed CPRA Master Plan Project, Guste Island Marsh Creation
- Provide wildlife and fisheries habitat
- Provide coastal resilience for the Guste Island communities

PROJECT COST INFORMATION: This 1.5-mile living shoreline project has a total estimated construction cost of approximately $11.25M. This includes the living shoreline or wave attenuation structures, breach repairs or shoreline restoration (where necessary) and contingency.

A detailed engineering analysis including survey, geotechnical studies, and coastal modeling needs to be performed to support continued planning and document costs and project benefits.

REQUIREMENTS FOR FEASIBILITY ANALYSIS:

1. Hydraulic/Wave Modeling
2. Refine living shoreline concepts and features
3. Develop conceptual data collection requirements and collect preliminary geotechnical and survey information
4. Refine conceptual cost estimates
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

PROJECT LOCATION:

Figure 1: Guste Island Living Shoreline

Figure 2: Vicinity Map

REFERENCES: None

ATTACHMENTS: None
RESTORATION PROJECTS

GUSTE ISLAND MARSH CREATION (CPRA MASTER PLAN 2017)

DESCRIPTION: This project includes the creation of approximately 700 acres of marsh in St. Tammany Parish along the northwest shoreline of Lake Pontchartrain within and adjacent to the area of Guste Island. This project will create new wetland and marsh habitat as well as restoring degraded areas of wetland and marsh habitat. This project was included in the 2017 CPRA Master Plan as one of the Marsh Creation Projects within St. Tammany Parish. The project is titled, Guste Island Marsh Creation, and has the Project ID 001.MC.108. The CPRA Project Fact Sheet is included as an attachment to this document.

St. Tammany Parish Government has developed a Coastal Master Plan and a very similar project, titled Guste Island Marsh Creation has been included as a priority Marsh Creation project. This project is slightly smaller and is listed at 685 acres. This St. Tammany Parish Government Project Fact Sheet has been included as an attachment.

REASONS FOR PROJECT SELECTION: The project was evaluated and approved by CPRA as part of the 2017 Coastal Master Plan. The project will provide for the creation and restoration of approximately 700 acres of marsh and wetland habitat along the northwest shoreline of Lake Pontchartrain. The project will also provide and help to maintain the coastal resilience of areas within St. Tammany Parish coastal zone, including the area of West Madisonville.

PROJECT COST INFORMATION: The 2017 CPRA Master Plan includes the following cost information for the full project:

```
| Planning/Engineering & Design | $4,600,000 |
| Construction                   | $57,600,000 |
| Operations & Maintenance       | $2,200,000  |
| **Total**                      | **$64,400,000** |
```

*Figure 1: Project Cost Estimate developed by CPRA as part of the CPRA Master Plan 2017*

The project included in the St. Tammany Coastal Master Plan is slightly smaller in area and less expensive, with a construction cost estimate of $27.81M. The project area is smaller and the marsh fill elevation is lower than CPRA’s project. This leads to a smaller required quantity of marsh fill volume. The construction cost information for the St. Tammany Coastal Master Plan Project have been included attachments.

REQUIREMENTS FOR FEASIBILITY ANALYSIS:
Project has already been evaluated and approved by CPRA as part of the 2017 Master Plan. The next steps of the feasibility will focus on funding and prioritizing the segments of the project. The next steps are as follows:
1. Develop a Priority for each Marsh Creation Cell
2. Developing a Funding Source for the Project and each Marsh Creation Cell
3. Initiate Data Collection in the areas of highest priority to begin developing preliminary engineering and design

**PROJECT LOCATION:**

*Figure 2: Project Plan View and Location developed by CPRA as part of the CPRA Master Plan 2017*
REFERENCES

CPRA 2017 Master Plan

St. Tammany Parish Government Coastal Master Plan

ATTACHMENTS

CPRA Master Plan 001.MC.108 Fact Sheet

Guste Island (St. Tammany Coastal Master Plan Fact Sheet)
Guste Island Marsh Creation
Marsh Creation
Project ID: 001.MC.108

Description
Creation of approximately 700 acres of marsh in St. Tammany Parish along the northwest Lake Pontchartrain shoreline to create new wetland habitat and restore degraded marsh.

Project Cost Estimate

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<th>Description</th>
<th>Estimated Cost</th>
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</tr>
<tr>
<td>Total</td>
<td>$64,400,000</td>
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</table>

Other Nearby Projects in the Master Plan

Scale of Influence
- Local
- Sub-basin
- Basin
- Regional

Project Location
St. Tammany Parish

Project Duration
Planning, Engineering, and Design is estimated to take 2 years. Construction is estimated to take 1 year.

Land Area Built or Maintained*
- Near Term (Year 20): 533 acres
- Long Term (Year 50): 1,912 acres

*Based on the high environmental scenario.
Guste Island Marsh Creation.

The goal of this project is the restoration of 651 acres of marsh as well as the nourishment of 34 acres of stressed marsh using hydraulically dredged sediment from Lake Pontchartrain.

**Project Summary**

The Guste Island Marsh Creation project is a 685 acre marsh creation project located in St. Tammany Parish along the Lake Pontchartrain Shoreline. This project is located near Guste Island. The low salinity brackish marsh became impounded over 20 years ago and marsh loss was severe. During that time this area become almost all open water. With an increase in tidal exchange due increased land loss and increased wind driven fetch, land located north of this site is deteriorating quickly. Sediment would be placed throughout the site to a height of +1.2 NAVD 88.

Tidal creeks would be constructed in order facilitate water exchange and fisheries access. Containment dikes would be gapped and/or degraded when practical.

**Project Attributes**

Area: 685 Acres  
Latitude 30.386698, Longitude -90.220022  
Dike Elevation: 1.2’ NAVD  
Borrow Source: Lake Pontchartrain  
Fill Volume: 2,713,378 yd³

**Project Specification**

Estimated Construction Cost $27,804,634
Description: This proposed project is a 1.75-mile living shoreline and approximately 125-acre marsh creation located to protect Mandeville Lakefront, shown in figures 1 and 2 below. Over the last decade this Mandeville Lakefront area has been subjected to severe wave energy from tropical and subtropical storms. This project would protect the Mandeville Seawall and provide natural coastal resilience to the community of Old Mandeville.

The project will also facilitate the creation of approximately 125 acres of marsh and wetland habitat while maintaining the natural hydrologic connectivity to Lake Pontchartrain. This will provide a natural infrastructure solution, wildlife and fisheries habitat, as well as improving water quality and promoting recreation.

Conceptual planning has been done on this living shoreline project. The living shoreline features has a conceptual design elevation of approximately 2 FT. NAVD 88. The marsh and wetland creation areas have a design elevation of approximately 2.5 FT. NAVD88.

Reasons for Project Selection: This living shoreline project offers the following potential benefits:

- Restore wetland and marsh habitat along the Mandeville Seawall
- Provide protection and coastal resilience for the Mandeville Seawall
- Provide wildlife and fisheries habitat
- Provide water quality benefits for surface flow runoff
- Provide coastal resilience for the Mandeville Lakefront community
- Promote recreation for the Mandeville Lakefront community

Project Cost Information: This 1.75-mile living shoreline project has a total estimated construction cost of approximately $8.0M (including contingency).

The 125-acre marsh creation project has a total estimated construction cost of approximately $10.0M (including contingency). This includes construction of any necessary hydrologic connections or tidal creeks.

The total estimated construction cost of the project is approximately $18.0M (including contingency).

Requirements for Feasibility Analysis:
1. Hydraulic/Wave Modeling
2. Borrow area identification
3. Refine living shoreline concepts and features
4. Develop conceptual data collection requirements and collect preliminary geotechnical and survey information
5. Refine conceptual cost estimates
**APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES**

**PROJECT LOCATION:**

Figure 1: Mandeville Lakefront Living Shoreline and Marsh Creation

Figure 2: Vicinity Map

**REFERENCES**

None

**ATTACHMENTS**

None
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

RESTORATION PROJECTS

MANDEVILLE LAKEFRONT WETLANDS RESTORATION

DESCRIPTION: The City of Mandeville contracted Neel-Schaffer to design a wetlands restoration project on the Mandeville lakefront in 2011. This project included providing hydraulic analysis using HEC-RAS and HEC-HMS to aid in the design of the Galvez Channel outfall (with weir structure), Galvez diversion channel, and Masena channel outfall. The project includes a proposed berm for shoreline protection, two pedestrian bridges, fill sediment for wetlands creation, and ready conditions for a future wetlands planting project.

REASONS FOR PROJECT SELECTION: This project has previously been designed by Neel-Schaffer, Inc. for the City of Mandeville. This design included geotechnical investigation, hydraulic analysis, and producing signed and sealed plans and specifications. The wetlands restoration offers the following potential benefits:

- Provide shoreline protection of existing wetlands with a berm and two outfalls.
- Restore deteriorating wetlands and increase nourishment of threatened wetlands.
- Increases lakefront recreational use by providing connection from Lakeshore Dr. to Masena St. with two pedestrian bridges.
- Reduces storm surge.

PROJECT COST INFORMATION: The estimated cost for construction was $2.52 Million when the design was completed in 2016.

REQUIREMENTS FOR FEASIBILITY ANALYSIS:

1. Update Hydraulic Modeling, as necessary.
2. Review status of permits.
3. Update cost estimate.
4. Revisit inclusion of planting into this project, rather than a separate project.
5. Evaluate potential impacts to project if Mandeville seawall is raised.
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

PROJECT LOCATION:

Figure 1: Mandeville Lakefront Wetland Restoration

Figure 2: Vicinity Map

ATTACHMENTS:

Proposed Site Plan.pdf
RESTORATION PROJECTS

NEW ORLEANS EAST LANDBRIDGE RESTORATION (CPRA MASTER PLAN 2017)

DESCRIPTION: This project includes the creation of approximately 33,400 acres of marsh in St. Tammany and Orleans Parish along the historic New Orleans East Landbridge. This project will create new wetland and marsh habitat as well as restoring degraded areas of wetland and marsh habitat. This project was included in the 2017 CPRA Master Plan as one of the Marsh Creation Projects within St. Tammany Parish. The project is titled, New Orleans Landbridge Marsh Creation, and has the Project ID 001.MC.05. The CPRA Project Fact Sheet is included as an attachment to this document.

The New Orleans East Landbridge Restoration project is very large and includes cells in multiple parishes. The marsh creation or restoration cells in St. Tammany Parish are as follows:

- Weems Island Marsh Creation/Restoration Cell
- Hog Island Marsh Creation/Restoration Cell
- Johnson Island Marsh Creation/Restoration Cell

These areas are shown in Figures 1 and 2. Individual Fact Sheets with detailed information for each of these marsh creation cells in St. Tammany Parish should be developed as this project moves forward.

REASONS FOR PROJECT SELECTION: The project was evaluated and approved by CPRA as part of the 2017 Coastal Master Plan. The project will provide for the creation and restoration of approximately 33,400 acres of marsh and wetland habitat along the New Orleans East Landbridge. The project will also provide and help to maintain the coastal resilience of areas within the St. Tammany Parish coastal zone, including the area of East Slidell.

PROJECT COST INFORMATION: The 2017 CPRA Master Plan includes the following cost information for the full project:

![Project Cost Estimate](image)

*Figure 1: Project Cost Estimate developed by CPRA as part of the CPRA Master Plan 2017*

The project included in the CPRA Coastal Master Plan 2017 is inclusive of the entire Orleans Landbridge. A specific construction cost estimate for the Marsh Creation cells only within St. Tammany Parish has not been developed yet.
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

REQUIREMENTS FOR FEASIBILITY ANALYSIS:
Project has already been evaluated and approved by CPRA as part of the 2017 Master Plan. The next steps of the feasibility will focus on funding and prioritizing the segments of the project. The next steps are as follows:

1. Develop a construction cost estimate for the 3 Marsh Creation Cells in St. Tammany
2. Develop a Priority for each Marsh Creation Cell
3. Developing a Funding Source for the Project and each Marsh Creation Cell
4. Initiate Data Collection in the areas of highest priority to begin developing preliminary engineering and design documents

PROJECT LOCATION:

Figure 2: Project Plan View and Location developed by CPRA as part of the CPRA Master Plan 2017
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

Figure 3: CPRA MP 2017 Project Plan View for the Marsh Creation Cells within St. Tammany Parish

REFERENCES
CPRA 2017 Master Plan

ATTACHMENTS
CPRA Master Plan 001.MC.05 Fact Sheet
New Orleans East Landbridge Restoration
Marsh Creation
Project ID: 001.MC.05

Description
Creation of approximately 33,400 acres of marsh in the New Orleans East Landbridge to create new wetland habitat and restore degraded marsh.

Project Cost Estimate

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<th>Description</th>
<th>Estimated Cost</th>
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Other Nearby Projects in the Master Plan

Scale of Influence

- Local
- Sub-basin
- Basin
- Regional

Project Location
Orleans Parish; St. Tammany Parish

Project Duration
Planning, Engineering, and Design is estimated to take 3 years. Construction is estimated to take 18 years.

Land Area Built or Maintained*
- Near Term (Year 20): N/A
- Long Term (Year 50): 25,858 acres

*Based on the high environmental scenario.

Note
The first increment of the project, consisting of 11,600 acres with a cost of $396 M, will be constructed in Implementation Period I. The remaining 3 increments, consisting of 21,800 acres with a cost of $1,107 M, will be constructed in Implementation Period II.
RESTORATION PROJECTS

NORTHSHORE / EDEN ISLES BREAKWATER

DESCRIPTION: This proposed project is a segmented offshore rock breakwater from east of the I-10 Twinspan Bridge to the mouth of Bayou Liberty. The breakwater would be approx. 5.5 miles long and provide shoreline protection for the community of Eden Isle. The project would also provide future protection from wave erosion for the St. Tammany Marsh Creation project. The project would also provide additional fisheries habitat as well as coastal resilience for greater Slidell community.

Conceptual planning has been done on this rock breakwater project. The segmented offshore rock breakwater feature has a conceptual design elevation of approximately 3.5 FT. NAVD 88.

REASONS FOR PROJECT SELECTION: This living shoreline project offers the following potential benefits:

- Provide shoreline protection and coastal resilience for the communities in Eden Isles, Oak Harbor, Carr Drive and Palm Lake
- Provide protection to the coastal areas of Slidell from erosive effects of storm enhanced wave action
- Future protection for the proposed CPRA Master Plan Project, St. Tammany Marsh Creation
- Provide fisheries habitat and restore habitat for native flora and fauna

PROJECT COST INFORMATION: This 5.5-mile segmented offshore breakwater project has a total estimated construction cost of approximately $29.25M (including contingency).

REQUIREMENTS FOR FEASIBILITY ANALYSIS:

1. Hydraulic/Wave Modeling
2. Develop conceptual sizing and layout for the segmented rock breakwaters
3. Develop conceptual data collection requirements and collect preliminary geotechnical and survey information
4. Refine conceptual cost estimates
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

PROJECT LOCATION:

Figure 1: Northshore / Eden Isles Breakwater

Figure 2: Vicinity Map

REFERENCES: None

ATTACHMENTS: None
DESCRIPTION: This proposed project includes shoreline protection, restoration and marsh creation projects located on Pearl River Island, shown in figures 1 and 2 below. Over the last decade this area has seen an increase in open water, greatly exceeding previous rates of deterioration. This project would protect approx. 5.5-miles of shoreline and facilitate approximately 2,400 acres of the restoration and marsh creation on Pearl River Island.

Conceptual planning has been done on this project. The shoreline protection features would consist or either a rock dike or segmented breakwater and have a conceptual design elevation of approximately 3 FT. NAVD 88. The marsh and wetland creation areas have a design elevation of approximately 2.5 FT. NAVD88.

REASONS FOR PROJECT SELECTION: The project will provide for the protection, creation and restoration of marsh and wetland habitat within Pearl River Island. The project will also provide additional coastal resilience to areas within St. Tammany Parish coastal zone, including the area of East Slidell and Eden Isle.

This shoreline protection and restoration project also offers the following potential benefits:

- Restore deteriorating shoreline and increase nourishment of threatened marsh land
- Create and maintain wildlife and fisheries habitat

PROJECT COST INFORMATION: This 5.5-mile shoreline protection project has a total estimated construction cost of approximately $22M (including contingency).

The 2,400-acre marsh creation project has a total estimated construction cost of approximately $72M (including contingency). This includes construction of new marsh creation areas as well as restoration of existing deteriorating marsh.

The total estimated construction cost of the project is approximately $94M (including contingency).

It should be noted that this is a very large project and during feasibility the project can be divided into smaller phases. These smaller phases can allow the parish to prioritize and fund individual pieces of the overall Pearl River Island project.

REQUIREMENTS FOR FEASIBILITY ANALYSIS:

1. Hydraulic/Wave Modeling
2. Borrow area identification
3. Refine shoreline protection concepts and features
4. Develop conceptual data collection requirements and collect preliminary geotechnical and survey information
5. Refine conceptual cost estimates
6. Prioritize features and funding plan
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

PROJECT LOCATION:

- Figure 1: Pearl River Island Shoreline Protection & Restoration
- Figure 2: Vicinity Map

REFERENCES
None

ATTACHMENTS
None
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

RESTORATION PROJECTS

ST. TAMMANY MARSH CREATION (CPRA MASTER PLAN 2017)

DESCRIPTION: This project includes the creation of approximately 6,700 acres of marsh in St. Tammany Parish along the northern shore of Lake Pontchartrain within and adjacent to the Big Branch National Wildlife Refuge and west of Eden Isle. This project will create new wetland and marsh habitat as well as restoring degraded areas of wetland and marsh habitat. This project was included in the 2017 CPRA Master Plan as one of the Marsh Creation Projects within St. Tammany Parish. The project is titled, St. Tammany Marsh Creation, and has the Project ID 001.MC.106. The CPRA Project Fact Sheet is included as an attachment to this document.

The St. Tammany Marsh Creation project is relatively large and difficult to fund and construct at one time. For this reason, St. Tammany Parish Government developed a Coastal Master Plan that identified smaller segments or Marsh Creation cells within the overall St. Tammany Marsh Creation Project. These cells or segments are as follows:

- Cane Bayou Marsh Creation
- Bayou Lacombe Marsh Creation
- Faciane Canal Marsh Creation

These smaller projects allow the parish to prioritize and fund individual pieces of the overall St. Tammany Marsh Creation project. Individual Fact Sheets with detailed information for each of these projects have been included as attachments.

REASONS FOR PROJECT SELECTION: The project was evaluated and approved by CPRA as part of the 2017 Coastal Master Plan. The project will provide for the creation and restoration of approximately 6,700 acres of marsh and wetland habitat along the north shore of Lake Pontchartrain. The project will also provide and help to maintain the coastal resilience of areas within St. Tammany Parish coastal zone, including Lacombe and West Slidell.

PROJECT COST INFORMATION: The 2017 CPRA Master Plan includes the following cost information for the full project:

![Project Cost Estimate](image)

Figure 1: Project Cost Estimate developed by CPRA as part of the CPRA Master Plan 2017

The smaller segments or Marsh Creation cells of the overall St. Tammany Marsh Creation project have individual cost estimates that are included as part of the fact sheets for each project (attached).
**REQUIREMENTS FOR FEASIBILITY ANALYSIS:**
Project has already been evaluated and approved by CPRA as part of the 2017 Master Plan. The next steps of the feasibility will focus on funding and prioritizing the segments of the project. The next steps are as follows:

1. Develop a Priority for each Marsh Creation Cell
2. Developing a Funding Source for each Marsh Creation Cell
3. Initiate Data Collection in the areas of highest priority to begin developing preliminary engineering and design

**PROJECT LOCATION:**

![Project Plan View and Location](image)

*Figure 2: Project Plan View and Location developed by CPRA as part of the CPRA Master Plan 2017*

**REFERENCES**

CPRA 2017 Master Plan
St. Tammany Parish Government Coastal Master Plan

**ATTACHMENTS**

CPRA Master Plan 001.MC.106 Fact Sheet
Cane Bayou Marsh Creation
Bayou Lacombe Marsh Creation
Faciane Canal Marsh Creation
St. Tammany Marsh Creation
Marsh Creation
Project ID: 001.MC.106

Description
Creation of approximately 6,700 acres of marsh in St. Tammany Parish along the northern shore of Lake Pontchartrain to create new wetland habitat and restore degraded marsh.

Project Cost Estimate

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Other Nearby Projects in the Master Plan

Scale of Influence

Local | Sub-basin | Basin | Regional

Project Location
St. Tammany Parish

Project Duration
Planning, Engineering, and Design is estimated to take 3 years. Construction is estimated to take 4 years.

Land Area Built or Maintained*
Near Term (Year 20) | 3,138 acres
Long Term (Year 50) | 4,013 acres

*Based on the high environmental scenario.

Other Nearby Projects in the Master Plan
Cane Bayou **Marsh Creation.**

The goal of this project is the restoration of 850 acres of low salinity marsh as well as the nourishment of 3,293 acres of stressed marsh using sediment that is hydraulically dredged from Lake Pontchartrain.

---

**Project Summary**

The Bayou Cane Marsh Creation project is a 4,117 acre marsh creation project located in St. Tammany Parish along the Lake Pontchartrain Shoreline. This project is located near Bayou Cane with most of the site being located on the Big Branch Marsh National Wildlife Refuge. The low salinity brackish marsh in this area was reasonably stable until Hurricane Katrina. Over the following decade this area has seen an increase in open water by nearly double, far exceeding the previous rate of deterioration. With an increase in tidal exchange due to small breaches in the shoreline and increased wind driven fetch, the rate of marsh loss is expected to continue. Sediment would be placed throughout the site to a height of +1.2 NAVD 88. Tidal creeks exist and would be maintained in order facilitate water exchange and fisheries access.

**Project Attributes**

- **Area:** 4,117 Acres
- **Latitude:** 30.292398, **Longitude:** -89.981120
- **Marsh Elevation:** 1.2' NAVD
- **Borrow Source:** Lake Pontchartrain
- **Fill Volume:** 8,193,032 yd$^3$

**Project Specification**

- **Estimated Construction Cost:** $53,526,175
- **Estimated Construction + Contingency:** $66,907,719
Bayou Lacombe Marsh Creation.

The goal of this project is the restoration of 623 acres of low salinity marsh as well as the nourishment of 2,336 acres of stressed marsh using sediment that is hydraulically dredged from Lake Pontchartrain.

The Bayou Lacombe Marsh Creation project is a 3,114 acre marsh creation project located in St. Tammany Parish along the Lake Pontchartrain Shoreline. This project is located near Bayou Lacombe with much of the site being located on the Big Branch Marsh National Wildlife Refuge. The low salinity brackish marsh in this area was reasonably stable until Hurricane Katrina. Over the following decade this area has seen an increase in open water by nearly double, far exceeding the previous rate of deterioration. With an increase in tidal exchange due increased land loss and increased wind driven fetch, the rate of marsh loss is expected to continue. Sediment would be placed throughout the site to a height of +1.2 NAVD 88. Tidal creeks exist and would be maintained in order facilitate water exchange and fisheries access.

**Project Attributes**

Area: 3,114 Acres  
Latitude 30.261683, Longitude -89.938037  
Dike Elevation: 2.5' NAVD  
Borrow Source: Lake Pontchartrain  
Fill Volume: 6,441,922 yd$^3$

**Project Specification**

| Estimated Construction Cost | $41,257,058 |
| Estimated Construction + Contingency | $51,571,323 |
Faciane Canal Marsh Creation.

The goal of this project is the restoration of 1,997 acres of low salinity marsh as well as the nourishment of 630 acres of stressed marsh using sediment that is hydraulically dredged from Lake Pontchartrain.

The Faciane Canal Marsh Creation project is a 2,853 acre marsh creation project located in St. Tammany Parish along the Lake Pontchartrain Shoreline. This project is located near Bayou Bonfouca with most of the site being located on the Big Branch Marsh National Wildlife Refuge. The low salinity brackish marsh in this area was reasonably stable until Hurricane Katrina. Over the following decade this area has seen an increase in open water by nearly double, far exceeding the previous rate of deterioration. With an increase in tidal exchange due to small breaches in the shoreline and increased wind driven fetch, the rate of marsh loss is expected to continue. Sediment would be placed throughout the site to a height of +1.2 NAVD 88. Tidal creeks exist and would be maintained in order facilitate water exchange and fisheries access.

**Project Attributes**

Area: 2853 Acres  
Latitude 30.2424, Longitude -89.825230  
Dike Elevation: 1.2' NAVD  
Borrow Source: Lake Pontchartrain  
Fill Volume: 9,199,670 yd³

**Project Specification**

- Estimated Construction Cost $59,377,743  
- Estimated Construction + Contingency $74,222,179
RESTORATION PROJECTS

Tchefuncte River Area, Wooded Island Protection, Peninsula Replacement and Marsh Restoration

DESCRIPTION: Project identified in conjunction with local non-profits and landholders. The analysis to date on project concepts suggests the following project phasing:

- **Phase 1 - Wooded Island Protection** (purple, located between pink and blue) – designed and permitted - Provides shoreline protection to 7 acres of wooded land, marsh and structure as well as protection to an additional 50 acres north of the shoreline. This breakwater structure is anticipated to stimulate 37 acres of land accretion.

- **Phase 2a - Emergency Breakwater** (yellow) - first step of peninsula replacement - Phase 2a will install the north facing portion of the peninsula paralleling the river channel a first step protection measure. The alignment, shape and elevation will be designed so water will flow over the edge in high water conditions thereby providing land/marsh accretion conditions.

- **Phase 2b - Living Shoreline Protection** (yellow) - second step on peninsula replacement - The south and southeast facing peninsula shorelines will be shaped both in profile and direction to provide wave dampening during prevailing winds. The western facing shoreline will also be shaped to prevent wave action from further battering the mainland shoreline.

- **Phase 3 - Marsh Restoration Spray** (green) - Spray dredged techniques will support further construction of the restored Peninsula. Additionally, river channel sediment of sand will be deposited on the shoreline and beach area to restore the peninsula topography.
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

- Phase 4 - Marsh Restoration West Shoreline (Pink and Blue) - Terracing structures will be considered.

A detailed engineering analysis including survey, geotechnical studies, river H&H modeling and coastal modeling needs to be performed to support continued planning and document costs and project benefits.

REASONS FOR PROJECT SELECTION: To restore the mouth of the Tchefuncte River at Lake Pontchartrain to its historic hydrologic condition, which included a peninsula extension from the east shoreline westward across the current river channel opening to the Lake. The former peninsula influenced storm tidal surge into the Tchefuncte River channel.

PROJECT COST INFORMATION: Total estimated construction cost for all Phases - $11,750,000 (including contingency). The cost breakdown is as follows:

- Phase 1 - Wooded Island Protection (purple, located between pink and blue) – designed and permitted - $1,500,000 estimated construction cost.
- Phase 2a - Emergency Breakwater (yellow) - first step of peninsula replacement - $3,000,000 estimated construction cost.
- Phase 2b - Living Shoreline Protection (yellow) - second step on peninsula replacement - $5,000,000 estimated construction cost.
- Phase 3 - Marsh Restoration Spray (green) - $1,250,000 estimated construction cost.
- Phase 4 - Marsh Restoration West Shoreline (Pink and Blue) - $1,000,000 estimated construction cost.

REQUIREMENTS FOR FEASIBILITY ANALYSIS:

1. Engineering analysis to determine feasibility
2. Hydraulic and Coastal Modeling
3. Borrow area identification
4. Initiate Detailed Data Collection (Survey and Geotechnical)
5. Refine cost estimates
6. Develop cost verses benefits analysis to prioritize features
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

PROJECT LOCATION:

**Figure 1: Tchefuncte River Area**

**Figure 2: Vicinity Map**

REFERENCES

None

ATTACHMENTS

TRA Shoreline Protection Presentation 9 2018 (summary slides)
Tchefuncte River Area,
Wooded Island Protection,
Peninsula Replacement, and
Marsh Restoration
and
Wooded Island Protection,
Tchefuncte River Area
Developed by a coalition of concerned citizens associated with the LPBMM and TRF
Organized to support the Town of Madisonville
Project Facts

- Marsh Creation on Peninsula – 188 Acres
- Marsh Restored/Nourished on east side of river – 35 Acres
- Land Protected in Wooded Area – 7 Acres
- Marsh/Land Accretion on west side of river (on north shoreline) – 37 Acres
- Land Protected in Wooded Area – 7 Acres
- Marsh Restored/Nourished on east side of river – 35 Acres
- Marsh Creation on Peninsula – 188 Acres

Restores Peninsula Destroyed by Logging Era Activity

- Marsh Protected – 4,000 Acres
- Affected Area - the entire watershed of the Tchefuncte
- Project Facts Continued

Town of Madisonville
(501C3), TRF (501C3), one individual land owner, and the

A cooperative group of land owners including LPBM

upper watershed

Reduces the risk of flooding from the lake and from the

"surge" and "hurricane surge"

Protects 2 municipality from both "prevailing wind" and Lake

River

Corrects the natural hydraulic flow of the Tchefuncte

River

Affected Area - the entire watershed of the Tchefuncte
Site with respect to Town of Madisonville
Tchefuncte River Area, Wooded Island Protection, Peninsula Replacement, and Marsh Restoration

- **Phase 1 – Wooded Island Protection**
  - Perimeter Bulkhead and Access
  - Land Accretion and Breakwater Structure
  - Protects existing marsh, woodlands, and structures from further destruction

- **Phase 2 – Peninsula Replacement**
  - Emergency Breakwater Rock Installation
  - Peninsula Vegetation Installation
  - Construction of Spring-fed Estuary
  - Placement of channel area river sediment on existing lake bottom
  - Peninsula Vegetation installation
  - Further destruction
  - Placement of channel area river sediment on existing lake bottom
  - Peninsula Vegetation installation
  - Emergency Breakwater Rock Installation
  - Peninsula Vegetation installation
  - Further destruction
  - Placement of channel area river sediment on existing lake bottom
  - Peninsula Vegetation installation

- **Phase 3 – Marsh Restoration – East River Bank Shoreline and Beach**
  - Placement of channel area river sediment on existing lake bottom
  - Peninsula Vegetation installation
  - Emergency Breakwater Rock Installation
  - Peninsula Vegetation installation
  - Further destruction
  - Placement of channel area river sediment on existing lake bottom
  - Peninsula Vegetation installation
  - Emergency Breakwater Rock Installation
  - Peninsula Vegetation installation

- **Phase 4 – Marsh Restoration West River Bank, North Lake Shoreline**
  - Placement of channel area river sediment on existing lake bottom
  - Peninsula Vegetation installation
  - Emergency Breakwater Rock Installation
  - Peninsula Vegetation installation
  - Further destruction
  - Placement of channel area river sediment on existing lake bottom
  - Peninsula Vegetation installation
  - Emergency Breakwater Rock Installation
  - Peninsula Vegetation installation

**Peninsula Replacement, and Marsh Restoration**

Tchefuncte River Area, Wooded Island Protection,
Tchefuncte River Area, Wooded Island Protection, Peninsula Replacement, and Marsh Restoration

- Phase 1 – Wooded Island Protection – (permitted and ready for bidding) $1,500,000
- Phase 2a – Emergency Breakwater (first step on peninsula replacement) $3,000,000
- Phase 2b – Living Shoreline Protection (second step on peninsula replacement) $5,000,000
- Phase 3 – Marsh Restoration Spray $1,250,000
- Phase 4 – Marsh Restoration Terracing $1,000,000

Total all phases $11,750,000
RESTORATION PROJECTS

VEGETATIVE TREE PLANTING PROGRAM

DESCRIPTION: St. Tammany Parish has begun tree planting and currently plants ~2300 trees per year in dry stormwater detention ponds, Parishwide, using student volunteers. The goal of this planting program on the St. Tammany coastline would be to contribute to long-term restoration of the coastline. Reforestation restores the habitat for animals and provides water quality and storm surge benefits for the surrounding communities.

The Lake Pontchartrain Basin Foundation (LPBF) has conducted various swamp tree plantings on the Maurepas Landbridge since 2013 in partnership with the Restore the Earth Foundation (REF) and with the help of community volunteers. In addition to volunteer plantings, there have also been commercial plantings, supported by REF.

REASONS FOR PROJECT SELECTION: Tree plantings are part of the Multiple Lines of Defense Principle (MLDP) framework that includes a wide range of protective elements, namely: barrier islands (synthetic or natural), marsh restoration (to reduce wave action and surge level during a storm), flood gates and levees and pump stations, each with their own limitations, advantages and scope of action.

PROJECT COST INFORMATION: The scale and cost of a vegetative tree planting program would be determined as part of the analysis.

REQUIREMENTS FOR FEASIBILITY ANALYSIS: Meet with St. Tammany Parish staff responsible for existing tree plantings to discuss existing program and goals

1. Establish criteria for areas to be considered for tree planting (elevation, soils, etc.)
2. Locate areas meeting criteria
3. Develop a conceptual planting plan (representative plan view)
4. Develop unit concept costs
5. Establish benefit methodology
6. Review permit requirements
7. Identify potential funding sources to implement St. Tammany Parish’s plan
8. For each proposed planting site, conduct WHAFIS modeling to determine surge benefits and submit a CLOMR to FEMA for review.
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

PROJECT LOCATION:

Figure 1: Coast Wide Vegetative Planting

ATTACHMENTS: None
**Restoration Projects**

**West Shoreline Protection**

**Description:** The 2016-2020 St. Tammany Parish Coastal Master Plan included the West Shoreline Protection. This proposed project is a 4.7-mile shoreline protection (rock dike) located near west of Mandeville and south of Madisonville, shown in figures 1 and 2 below. The shoreline in this area has begun to deteriorate rapidly and several breaches exist today. These breaches provide direct connection between the fresher interior marshes and higher salinity waters of Lake Pontchartrain. This project would protect 4.7 miles of shoreline and potentially fill the existing breaches.

The project attributes in the 2016-2020 St. Tammany Parish Coastal Master Plan are as follows:

- Project Length = 24,773 ft.
- Rock Dike Elev. = 2.5 FT. NAVD 88
- Rock Dike Top Width = 4 FT.
- Estimated Rock Quantity = 94,988 tons

It should be noted that a similar project, North Lake Pontchartrain Shoreline Protection 001.SP.102, was evaluated for the 2017 CPRA Master Plan, but ultimately it was not selected for inclusion in the final plan. This project included shoreline protection in a similar vicinity as rock breakwaters.

Conceptual planning has been done on this shoreline protection project for both the 2016-2020 St. Tammany Parish Government Coastal Master Plan as well as the CPRA Master Plan. The details of these project are included as an attachment.

**Reasons for Project Selection:** The shoreline protection offers the following potential benefits:

- Restore deteriorating shoreline and fill the existing breaches
- Reduce wetland degradation from wave erosion
- Preventing existing breaches from growing helps to prevent salt water intrusion in the fresh interior marsh

**Project Cost Information:** The 2016-2020 St. Tammany Parish Coastal Master Plan has developed an estimated construction cost of $12M (including contingency) for this shoreline protection project.

CPRA’s estimated construction cost was slightly higher at $19.5M for the entire project. This is generally because the rock dike elevation was selected at 3.5 FT. NAVD 88, which led to additional rock required for the project.

The cost estimates for this project are included as an attachment in the fact sheets.

**Requirements for Feasibility Analysis:**

1. Hydraulic/Wave Modeling
2. Refine shoreline concepts (breakwaters, rock dike, rock revetment, etc.)
3. Develop conceptual geotechnical and survey requirements and collect preliminary data
4. Refine conceptual cost estimates
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

PROJECT LOCATION:

![Figure 1: West Shoreline Protection](image1)

![Figure 2: Vicinity Map](image2)

REFERENCES

CPRA 2017 Master Plan

St. Tammany Parish Government Coastal Master Plan

ATTACHMENTS

CPRA Master Plan 001.SP.102 Fact Sheet

West Shoreline Protection (St. Tammany Coastal Master Plan Fact Sheet)

Tchefuncte Marsh Shoreline Protection
North Lake Pontchartrain Shoreline Protection
Shoreline Protection
Project ID: 001.SP.102

Description
Shoreline protection through rock breakwaters designed to an elevation of 3.5 feet NAVD88 along approximately 23,300 feet of the north side of the Lake Pontchartrain shoreline to preserve shoreline integrity and reduce wetland degradation from wave erosion.

Project Cost Estimate

| Planning/Engineering & Design | $1,600,000 |
| Construction                  | $19,500,000 |
| Operations & Maintenance      | $25,900,000 |
| **Total**                     | $47,000,000 |

Land Area Built or Maintained*
Near Term (Year 20) 0 acres
Long Term (Year 50) 113 acres
*Based on the high environmental scenario.

Other Nearby Projects in the Master Plan

Scale of Influence

Project Location
St. Tammany Parish

Project Duration
Planning, Engineering, and Design is estimated to take 2 years.
Construction is estimated to take 2 years.

*2017 Coastal Master Plan | Project Factsheet*
West Shoreline Protection.

The West St. Tammany Shoreline Protection project is a 24,773 linear foot project located in St. Tammany Parish along the Lake Pontchartrain Shoreline.

This project is located west of Mandeville and south of Madisonville. The marsh loss in this area has been relatively minimal, partly due to wetland assimilation project on the east side of the project location. However, the shoreline in this area has begun to deteriorate rapidly and several breaches exist today. These breaches provide direct connection between the fresher interior marshes and higher salinity waters of Lake Pontchartrain. These shoreline breaches should be filled and the remaining shoreline protected before accelerated marsh loss rate begin.

Project Attributes

Area: 24,773 feet
Latitude 30.374163, Longitude -90.144885
Dike Elevation: 2.5' NAVD
Dike Top Width: 4'
Rock: 94,988 Tons

Project Specification

Estimated Construction Cost $9,549,792
Estimated Construction + Contingency $11,937,240
NON-STRUCTURAL PROJECTS

NON-STRUCTURAL RISK REDUCTION MASTER PLANNING

DESCRIPTION: Nonstructural Risk Reduction projects include non-residential floodproofing, residential elevation, and residential voluntary acquisition. The 2017 CPRA Masterplan includes a project to mitigate flood risk in St. Tammany Parish applying nonstructural solutions. These include floodproofing non-residential properties where 100-year flood depths are projected 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet. For St. Tammany Parish, the 2017 Masterplan includes:

- 375 Floodproofing non-residential structures
- 4,605 Elevation of residential structures
- 889 Voluntary acquisitions

Total of 5,869 properties totaling $1,611.3 million. The cost estimate does not represent specific residential or commercial structures to be mitigated.

As part of the Louisiana Watershed Initiative (LWI), the state will conduct large-area buyouts (on the block or neighborhood scale) for families within repetitive loss areas, areas subject to moderate or high flood risk and/or within FEMA designated floodways. Such buyout programs will include provisions for community-oriented assistance to homeowners in order to facilitate a successful transition to a location of lower flood risk outside of SFHAs. Property acquired through program buyouts will be restored to natural floodplain conditions and may be further enhanced through the use of blue and green infrastructure. In order to preserve communities that, for reasons of geography or natural resource dependence, cannot relocate to <0.2% AEP flood event areas and maintain important social and cultural standards, the state may also administer residential elevations or other traditional nonstructural flood risk mitigation activities. The state will administer residential elevations justified by cost-benefit and cost reasonable analyses relative to other mitigation measures and the results of watershed modeling. This program will prioritize project funding that benefits low- to moderate-income residents and uses predictive watershed modeling to produce measurable reductions in residents’ exposure to flood risk.

Since 2005, St. Tammany Parish has completed mitigation on residential properties either through elevation or acquisition in both the Hazard Mitigation Grant Program and Flood Mitigation Assistance (FMA) programs. The Parish has approximately $38 million in active grant funding to mitigate properties in unincorporated St. Tammany and submit a competitive application annually for an additional FMA funding. To date St. Tammany has mitigated approximately 450 homes.

REASONS FOR PROJECT SELECTION: Non-Structural Risk Reduction is a major component of the 2017 CPRA Masterplan and LWI. Although St. Tammany Parish has mitigated 450 homes since 2005 this is a small portion of what the State is proposing. Also, the State has not identified specific residential or commercial structures to be mitigated. The targeted buyout areas need to be identified in order to plan flood reduction projects as part of St. Tammany’s flood reduction planning. It is also information that home owners and businesses need as well.

PROJECT COST INFORMATION: The 2017 CPRA Master Plan includes $1.6 billion for non-structural risk reduction.
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

REQUIREMENTS FOR FEASIBILITY ANALYSIS:
1. Workshop with St. Tammany Parish Grants and Public Works Departments to discuss a Non-Structural Risk Reduction Masterplan
2. Developing a Public Information program
3. Research funding programs
4. Master planning for buy-out and mitigation areas

PROJECT LOCATION:
Parish wide

ATTACHMENTS:
None
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

STRUCTURAL PROJECTS

EDEN ISLES STORM SURGE PROTECTION

DESCRIPTION: In August 2015 the East St. Tammany Storm Protection Committee (members appointed by homeowners associations in affected area) submitted the East Tammany Storm Surge Project Request asking CPRA to conduct a feasibility study to determine the most cost effective method of providing a storm surge reduction system for their community. In June 2019 CPRA did a conceptual evaluation for Eden Isles. The request and conceptual evaluation are attachments to this document providing details of the request and evaluated protection.

REASONS FOR PROJECT SELECTION: Eden Isles has approximately 7,000 residents and small businesses. It is currently outside the proposed Slidell Ring Levee.

PROJECT COST INFORMATION: The CPRA conceptual evaluation estimated $128M for the construction cost of this project while the Protection Committee Request estimated costs at $35M.

A detailed engineering analysis including survey and geotechnical studies needs to be performed to support continued planning and document costs and project benefits. These costs will continue to be refined in Task III.

REQUIREMENTS FOR FEASIBILITY ANALYSIS:

1. Develop a basis for levels of protection to be considered.
2. Develop preliminary concepts for further evaluation.
3. Develop a data base of the properties protected at various levels of protection and value of same.
4. Determine benefits for various levels of protection.
5. Select alternative(s) for further consideration –
   a. Modeling
   b. Construction Costs
   c. Benefit / Costs analysis

PROJECT LOCATION:
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

Figure 1: Vicinity Map

Figure 2: Eden Isles Storm Surge Protection

ATTACHMENTS:


East Tammany Storm Surge Project Request
committed to our coast

Coastal Protection and Restoration Authority of Louisiana

Russ J. Joffrin, P.E.

June 2019

Engineering Division

St. Tammany Parish

Conceptual Evaluation

Proposed Flood Protection:

Slidell, LA Region
Coastal Protection and Restoration Authority of Louisiana

Outline

- Questions
- Summary

Proposed Storm Protection Plan

Conceptual Evaluation of East St. Tammany Parish

- Slidell Ring Levee Alignment
- Numerical Modeling

CPRA 2017 Master Plan

CPRA Sponsored Projects
Planning, Design, and Operations Support

- Neel Shaffer: Prime engineering design consultant
- St. Tammany Parish Study Underway

Regional Studies
- GOMESA
- St. Tammany Ring Levee (St. Tammany Parish) E&G
- Schneider Canal Pump Station: E&G
- Shellell Levees

Flood Protection Projects
- (PO-181) Bayou Cain Marsh Creation Project
- (PO-104) Bayou Bonfouca Marsh Creation Project
- (PO-33) Goose Point/Pointe Plate Marsh Creation Project

Restoration Projects

ST. TAMMANY PARISH - CPAA SPONSORED PROJECTS
Coastal Protection and Restoration Authority of Louisiana

2017 Coastal Master Plan

Coastal Protection and Restoration Authority Hyperlink: coastal.louisiana.gov/ourplan

Map Creation Date: May 16, 2019

About Restoration

Restoration Projects

2017 Coastal Master Plan

2017 MASTER PLAN DATA VIEWER Coastal Protection and Restoration Authority

Gulf of Mexico Restoration Projects Near Sediment
2017 MASTER PLAN-APENDIX A- PROJECT ID: 001. HP.13

SLEEPER RING LEVEES- STRUCTURAL PROTECTION

Coastal Protection and Restoration Authority of Louisiana
Using the existing landscape at Year 0, modeled output at Year 0, Year 25, and Year 50 for whom the project, medium scenario sea level rise: 1.5m (4.9') by 2100
- Low, medium, high, and high scenarios for relative sea level rise
- 92 storms evaluated

ADICIRC + SWAN storm and wave modeling

CPRA-2017 MASTER PLAN NUMERICAL MODELING
Coastal Protection and Restoration Authority of Louisiana

100-year event: The flood of more complex to the natural condition. Increased risk is applied by nearly all areas of the coast, including areas not currently inundated by a 100-year event.

About Flood Risk:

- Floods and other extreme events can cause significant damage to coastal properties.
- Understanding flood risk can help in planning and mitigating potential damages.

2011 Coastal Master Plan:

- Environmental Scenarios:
  - Initial Conditions
  - Near-Term Master Plan
  - Historical (1990-2011)

Food Risk:

- Food Depths (FDP):
  - 0 to 12 cm
  - 12.1 to 40 cm
  - 40.1 to 120 cm
  - 120.1+ cm

Coastal Louisiana faces one of the biggest land loss issues in the world, which impacts our homes, businesses, communities, and our natural environment. Understanding and mitigating flood risk is crucial for sustainable development and community resilience.
Coastal Protection and Restoration Authority of Louisiana

Future Without Master Plan - Medium Scenario - Year 50
Coastal Protection and Restoration Authority of Louisiana

Proposed 50' Wide Gate at Martina Entrance

Proposed Surge Barrier Along Lakeview Dr. (1 mile long)

Existing S. Shidell Levee

Existing Hwy. 11 Barrier

Existing 1-10 Barrier

EAST ST. TAMMANY PARISH PROPOSED STORM PROTECTION PLAN
East Boundary - I-10

East St. Tammany Parish Proposed Storm Protection Plan
- Existing utilities.
- Property boundaries not evaluated.
- Width ranges from 350' to 430' (imager).

**Estimated Existing Right of Way**

- Existing average roadway elevation @ +10.
- Interchange at Oak Harbor Blvd.
- Edge of shoulder to edge of shoulder @ 156'
- Roadway width @ 56'

**Existing Roadway**

- Contraction
- TYPically requires continual service of travel lanes.

**Existing Hurricane Evacuation Route (LADOTD)**

- Is the primary Hurricane Evacuation route for East Orleans.

- Federal Interstate I-10

East Boundary: I-10

East 5th, Tammany Parish Proposed SP Plan: Conceptual Evaluation
- Existing utilities.
- Property boundaries not evaluated.
- Width: average @ 60' (power pole to power pole)

Estimated Existing Right of Way
- Existing property access driveways on both sides of the road.
- Existing average roadway elevation @ +5.
- 2-1/2' asphalt travel lanes: Total Width = 24'.

Existing Roadway
- Navigation channel width approximately 275' to 300'.
- Offers unrestricted access to Lake Pontchartrain.

Estimated Iles

Southern Boundary: Lakeview Drive. General Information
East St. Tammany Parish Proposed SP Plan: Conceptual Evaluation
Coastal Protection and Restoration Authority of Louisiana

WEST BOUNDARY - US HWY 11

EAST ST. TAMMANY PARISH PROPOSED STORM PROTECTION PLAN

Existing 150' Wide

Right-of-Way

HWY II

EL 6.5

20'

20'

190 RW

0.5

2

0.5

2
- Existing utilities.
- Property boundaries not evaluated.
- Circle to Oak Harbor Blvd.
- Width ranges from 120' to 150' (power pole to power pole) from North shore.

Estimated Existing Right of Way:
- Existing driveways on both sides, more on the eastern side.
- Existing average roadway elevation @+6.
- 2-1.2' asphalt travel lanes with 2-10' shoulders. Total Width = 44'.

Existing Roadway:
- Typically requires continual service of travel lanes.

Existing Hurricane Evacuation Route (LADOTD):

Hurricane Katrina:
- Hurricane Katrina and was the only evacuation route out of East New Orleans after shore, and was the only evacuation route out of East New Orleans after.
- Prior to the Interstate, US 11 was the major roadway system for the north.

U.S. Highway

US HWY 11: GENERAL INFORMATION
EAST ST. TAMMANY PARISH PROPOSED SP PLAN: CONCEPTUAL EVALUATION
Coastal Protection and Restoration Authority of Louisiana

An estimated construction cost of $35M was submitted in the East St. Tammany Proposed FP Plan, reflecting damage, and wetland impacts.

The 2017 CPRA Master Plan, and includes a 25% cost contingency. These costs do not include the costs for levees, utility from flood protection projects constructed by local levee districts within the Louisiana coastal zone, includes information from East St. Tammany Proposed FP Plan: HWY 1, Raised Roadway +10’ Lakefront -"Wall" +10’ Bare Gate, 8’-10’ levee.

** Estimated Construction Cost (2019)**

| Proposed Flood Protection | $128,000,000 |

**Estimated Construction Costs**

East St. Tammany Parish Proposed SP Plan: Conceptual Evaluation
Coastal Protection and Restoration Authority of Louisiana

Phased construction may be needed.

- Relocations, for internal drainage requirements, and for wetland impacts.
- Constructed storm protection features.
- The estimated construction costs do not include costs for LAERD, for utility
- The estimated construction cost of $128 M for the proposed storm protection features.
- The estimated construction cost of $35 M is below the revised estimated

Proposed Estimated Construction Cost

- Proposed disposal sites, and staging areas.
- Requirements, and costs for LAERD (lands, easements, rights-of-ways).
- US HWY 11 permitting requirements could impact project footprint. R.O.W.
- US HWY 11 permitting requirements could impact property.
- Could produce significant overtopping volumes, impact internal drainage.
- Provides a minimum level of protection from storm surge.
- Along lakefront drive, the FEMA DFRM Zone VE elevation @ +1.7.
- All FEMA DFRM (4/30/2008) Zone VE & AE elevations are above +1.0.

Comments

- Proposed Flood Protection Design Criteria @+1.0

East St. Tammany Parish Proposed SP Plan: Conceptual Evaluation
The estimated design elevations for the proposed flood protection features are conceptual and are based on existing data from **The 2017 Master Plan**.

<table>
<thead>
<tr>
<th>Proposed Elevation</th>
<th>Proposed Flood Protection Cases &amp; Alignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>+16 to +18</td>
<td>Case 1: HWY 11 Raised Roadway, Lakefront T-Wall</td>
</tr>
<tr>
<td>+18 (TOW)'</td>
<td>Case 2: HWY 11-T-Wall, Lakefront T-Wall &amp; Gate, 8-10 Levee/T-Wall</td>
</tr>
<tr>
<td>+16 to +18</td>
<td>Case 3: HWY 11 Raised Roadway, 1-10 Levee/T-Wall, Lakefront T-Wall &amp; Gate, 8-10 Levee/T-Wall</td>
</tr>
</tbody>
</table>

Coastal Protection and Restoration Authority of Louisiana
I-10 ALIGNMENT: I-10/OAK HARBOR BLVD. INTERCHANGE
CONCEPTUAL EVALUATION - CASES 1, 2, 3
Coastal Protection and Restoration Authority of Louisiana

**Lateral Front Alignment: T-Wall Conceptual Design**

**Conceptual Evaluation - Cases 1, 2, 3**
Coastal Protection and Resettlement Authority of Louisiana

LAKESIDE ALIGNMENT - T-WALL: LAKEVIEW DRIVE VIEW LOOKING WEST

CONCEPTUAL EVALUATION - CASES 2, 3, 4, & 5

STLD - Proposed Sidewall FP System
Conceptual Evaluation - Case 1

Hwy 11 Realignment - Alternative #1: Elevated Roadway Embankment: Reach 2

STLP - Proposed Elevation & System

Legend:
- HWY 11 Realignment - Proposed Realignment
- HWY 11 Realignment - Existing Realignment
- HWY 11 Realignment - Proposed Roadway Width
- HWY 11 Realignment - Existing Roadway Width
- HWY 11 Realignment - Proposed Roadway Cross Section
- HWY 11 Realignment - Existing Roadway Cross Section

Note:
- Proposed Roadway Cross Section
- Existing Roadway Cross Section
- HWY 11 Realignment - Proposed Realignment
- HWY 11 Realignment - Existing Realignment
VIEW: LOOKING NORTH

HWY 21 ALIGNMENT - ALTERNATIVE #2: T-WALL

CONCEPTUAL EVALUATION - CASE 2
VIEW: LOOKING SOUTH
HWY 11 ALTERNATIVE
ALTERNATIVE #2: T-WALL
CONCEPTUAL EVALUATION - CASE 2
Coastal Protection and Restoration Authority of Louisiana

* An estimated construction cost of $359M was submitted in the East St. Tammany Proposed FP Plan.

** Recaptions, drainage, and wetland impacts.

The 2017 CRAP Master Plan, and includes a 25% cost contingency. These costs do not include the costs for Levees' utility from flood protection projects constructed by local levee districts within the Louisiana Coastal Zone, includes information from the estimated construction costs for the proposed flood protection features are conceptual and are based on unit cost data.

<table>
<thead>
<tr>
<th>Levee/Wall</th>
<th>Case 1: HWY 11 Raised Roadway, Lakefront T-Wall, Bare Gate, R-1</th>
<th>**</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ 284,000,000</td>
<td>Case 3: HWY 11 Raised Roadway, I-Wall, Bare Gate, R-1-10</td>
<td>$</td>
</tr>
<tr>
<td>$ 305,000,000</td>
<td>Case 2: HWY 11 T-Wall, Lakefront T-Wall, Bare Gate, R-1</td>
<td>$</td>
</tr>
<tr>
<td>$ 265,000,000</td>
<td>Case 1: HWY 11 Raised Roadway, Bare Gate, R-1-10</td>
<td>$</td>
</tr>
<tr>
<td><strong>$ 128,000,000</strong></td>
<td>Wall @ +10 R, Bare Gate, R-1-10 Levee</td>
<td>$</td>
</tr>
</tbody>
</table>

Proposed Flood Protection

*Estimated Construction Cost (2019)

**Conceptual Evaluation**
Coastal Protection and Restoration Authority of Louisiana

- Coordination and cooperation of local entities is required for successful development of an effective regional flood protection plan and system.

- Utilized for construction.

- The conceptual design of the proposed Eden Isles Flood Protection System provides examples of proposed systems.

- For the Slidel area.

- For the development of a comprehensive flood protection plan features should coordinate with the current Neel Shaffer study.

- New proposed flood protection system alignments and protection projects in the Slidel, LA region.

- CPRA continues to sponsor both restoration and flood protection plan.

SUMMARY
East St. Tammany
Storm Surge Protection Project Request

Submitted to

Coastal Protection & Restoration Authority of Louisiana (CPRA)

Study Location

August 2015

Contact Information:
Thomas Nolan Thompson
The East St. Tammany Storm Protection Committee
thomasthompson@yahoo.com
985-285-1768
Latest Revision August 2015
Project Request - The East St. Tammany Storm Protection Committee respectfully requests the CPRA to conduct a feasibility study to determine the most cost effective method of providing a storm surge reduction system for this community.

Situational Assessment - Until a comprehensive plan to restrict storm surge from entering the Lake Pontchartrain Basin is implemented, localized structural protection solutions are needed for the most populated and most vulnerable communities located within the Lake Pontchartrain basin, particularly along its northeastern shoreline of Lake Pontchartrain.

Once storm surge enters Lake Pontchartrain it is trapped and can not dissipate into the southern flood plains that once existed in Orleans and Jefferson parishes prior to the Corps’ barrier projects. As the hurricane travels north the winds shift causing the lake’s built-up surge to tilt to the east forcing a tsunami type surge to the east end of Lake Pontchartrain. Corps’ barriers constructed along the south shore of Lake Pontchartrain have eliminated all surge escape routes except for the narrow Chef Menteur and Rigolets passes eliminating all other avenues of escape the built-up storm surge is funneled directly into the densely populated unincorporated community south of Slidell.

While the CPRA recognizes the extreme storm surge risk within this area of the lake basin it has only provided assistance to the city of Slidell by participating in the construction of a ring levee around the city of Slidell. The ring levee protection provided to the city of Slidell has only increased the flood risk to the community of 7,000 residents located south of the city by creating a box consisting of the Schneider Canal Levee, Highway 11 and I-10 resulting in a surge back flow raising the flood elevations within the community located in this box.

This project will help mitigate the damage caused by the south shore structures and the south Slidell levee.
**Project Description**

**Location/Map** - The community’s area is small (4.2 square miles), with only a mile of lake frontage, but it is the most venerable, densely populated community within St. Tammany Parish and possibly within the entire Lake Pontchartrain Basin not currently included in a storms surge protection plan.

St. Tammany Parish’s Department of Homeland Security & Emergency Preparedness recognizes the vulnerability of this vital community and placed its need for protection into the St. Tammany’s 2015 Parish Hazard Mitigation Plan Update.

![Map of the community](image)

**Goal** – Develop a feasible, noninvasive, logical, cost effective storm surge mitigation and reduction plan using existing boundaries, barriers and topographic features in order to reduce cost, increase feasibility and reduce environmental impact to surrounding areas.

This community, south of the City of Slidell, is vital to St. Tammany’s social and economic wellbeing and consists of several well maintained gated subdivisions that contribute significantly to the parish’s tax base, while utilizing few parish services such as streets, drainage and green area maintenance.

In addition to the 7,000 residents living in these single-family subdivisions, the proposed protection area also encompasses extensive commercial small business constituencies, essential to the commercial vitality of the entire region.
Cost Benefit – If this extremely valuable, venerable, densely populated community does not receive storm surge protection it will no longer be able to sustain itself and survive due to fear of the next flood combined with never ending flood insurance premium increases. Signs of this downward spiral have already begun; new home construction and business development has stopped; families have left and converted their homes into rental property contributing to a decline in property values.

Such an event could cause the loss of:

- 7,000 residents (2010 Census), which could double within 10 years if protection is provided and vacant property is developed
- Approximately 3,000 homes with a mean value of $278,666 as of 2012 for a total value of over $800 million (http://www.city-data.com/city/Eden-Isle-Louisiana.html)
- Average median household income of $76,334 as of 2012 (http://www.city-data.com/city/Eden-Isle-Louisiana.html)
- $67.4 million in assessed property values (St. Tammany Parish Assessor’s Office, 2015)
- More than $8.2 million in yearly parish property tax revenue (St. Tammany Parish Assessor’s Office, 2015), which will increase as vacant property is developed
- St. Tammany Parish Fire District 1’s Station 16 fire house valued at $1.2 million
- The communities’ water and sewerage treatment facilities
- 300 condo apartment units (Anchorage apartment complex)
- Dozens of multimillion dollar businesses
- Millions in sales tax revenue
- Millions in future property and sales tax revenue when prime undeveloped residential and commercial sights are left undeveloped due to storm surge risk
- The Parish’s oldest, safest and more exclusive cost effective communities

The estimated cost of storm surge protection for this community is approximately $35 million. Based upon the economic and social losses noted above, this localized storm surge protection project is extremely cost effective.
**Historical Storm Surge Data**

A one-hundred-year event has a 1% probability of occurring in any given year.

The theoretical 100 year surge elevation at the Lakeview Dr. shoreline has yet to be determined by modeling, but According to USGS, State records, NOAA and private reports, in the past 164 years the Slidell region has only experienced 4 storm surges to exceed 10 feet: The 1915 storm - The 1947 storm - Hurricane Betsy in 1965 - Hurricane Katrina in 2005. All other storm surge reports from USGS, State records, NOAA and private reports state surges to be less than 10 feet.

Using actual Lake Pontchartrain surge history readings taken along Slidell area shoreline, shows that a ten foot high ring system will provide significant storm surge reduction for the vast majority of storm surges. This is especially true when factoring in the reservoir capacity of the waterways located inside the levee system that will act as retention ponds absorbing large quantities of overtopping surge.

A low 10 foot high levee would be affordable, unobtrusive and reduce the FEMA Base Flood Elevation, reduce flood insurance rates to an affordable level and save this vital community from extinction even if it does not meet the definition of a theoretical 100 year surge system. This minimum surge reduction plan positions this community for greater protection once the CPRA’s “Land Bridge” project is implemented.

The East St. Tammany Storm Protection Committee requests the CPRA to perform a feasibility study based upon this low level moderate surge reduction concept.
Storm Surge Reduction Concepts for Study

**Project Features** – The proposed project seeks to make very modest enhancements to existing barriers that already surround the project on three sides. The proposed project area is densely populated, but only encompasses a small area of 2,688 acres (4.2 square miles), with only a mile of lake frontage; therefore, removing this small area from the flood plain should not adversely impact flooding in surrounding areas.

**Storm Surge Reduction Options The CPRA May Consider In Their Feasibility Plan:**
- A breakwater in the lake as proposed by Senator Crowe in 2010
- An overtopping gate located at the mouth of the marina alone may provide 100 year protection when the reservoir capacities of the existing canals are added into the equation
- Use the multiple lines of defense principle by incorporating both a breakwater and overtopping gate
- Elevate the 1.2 mile long Lakeview Dr. to provide both surge protection and evacuation capability
- Construct a retaining wall within the Lakeview Dr. right-of-way
- With both Highway 11 and I-10 alignment in parallel with the storm surge’s direction, their existing elevations may be adequate without modifications. But if not, there is adequate right-of-way available to accommodate modifications if needed

There are many options available to provide storm surge reduction and the CPRA has the expertise and resources to perform a feasibility study to evaluate all the options and develop the most cost effective storm surge reduction plan for this vital community in addition to providing a second layer of protection for the City of Slidell.

2011 – Garrett Graves and A. G. Crowe provided surge prevention concepts to Storm Committee
Elements of One Proposed Mitigation Ring Levee Plan

The East St. Tammany Storm Protection Committee has developed one possible plan that could be built for approximately $35 million. This plan is simply a preliminary concept to show feasibility and cost effectiveness. The CPRA is free to use any or all of the concept or recommend a totally different concept.

North Boundary

Location: Schneider Canal Levee south of Slidell

Enhancements: Needs no additional construction, study or funding and does not require any additional modifications. The existing levee provides limited surge protection for the city of Slidell. This proposed project south of Slidell would improve the current level of protection significantly.

Cost: No additional improvements or cost to the existing Schneider Canal Levee needed.
**West Boundary**

**Location:** State Highway 11

**Enhancements:** Highway 11 is currently in the preliminary design process of constructing major widening improvements by the Regional Planning Commission (RPC) in conjunction with the Louisiana Department of Transportation and Development (DOTD). Improvements include removal and replacement of the existing roadway with a revised profile to enhance development along this major St. Tammany artery. Incorporating storm surge enhancements into the design at this preliminary stage is both feasible and cost neutral. The neutral ground area between the two travel lanes can easily serve as the western levee boundary without any adverse traffic issues.

**Cost:** With an existing 150-foot wide highway right-of-way, the RPC and DOTD can incorporate additional surge protection, if needed, at little or no additional cost.
East Boundary

Location: Interstate 10 (I-10)

Enhancements: Interstate 10 meets proposed elevation requirements and may need only a small levee section to protect the study community as well as the Federal Highway hurricane evacuation route. Although the I-10 travel lanes did not flood during Hurricane Isaac in 2012, the off ramps did flood as a result of back flow through drainage culverts servicing the interstate’s ramps. The interstate interchange flooding directly lead to the death of an individual attempting to flee the rising surge waters of Hurricane Isaac.

Blocking storm surge from entering the proposed project area would not only protect the residents and business located within the area, but also prevent back flow flooding of the interstate’s access ramps and save the lives of those attempting to evacuate hurricane storm surges. A small levee section, parallel to Lake Pontchartrain’s shoreline under the I-10 Bridge and along the eastern interchange right-of-way boundary would complete the eastern section of the levee protection system.

Cost: Federal funding can and should be made available to provide this cost effective solution to interstate travel of a major hurricane evacuation route.
South Boundary- 2 Components

1st South Boundary Component Location: Lakeview Drive (only a mile long).

Enhancements: The short mile long southern boundary is the only boundary not currently providing existing surge protection. The existing 60’ wide Lakeview Drive right-of-way allows for a variety of design concepts to block surge by elevating the roadway within this right-of-way or installing permanent or removable walls or by combining two or more surge protection techniques. Each method provides its own unique benefits and can be finalized during the preliminary design process. Elevating the roadway will not only restrict storm surge, but also provide Lakeview Dr. residents hurricane evacuation access and relieve the parish of repetitive repair and maintenance cost associated with clearing the roadway of storm related debris.

Cost: To raise/modify existing 1.2 mile roadway to an elevation of 10 feet would cost approximately $3,000,000. The cost should be shared between parish road funds and levee district funds.
**2nd South Boundary Component Location:** Entrance to the Oak Harbor Marina at the end of Lakeview Drive.

**Enhancements:** Construction of a Gate System at the entrance to Oak Harbor Marina is the most costly component of the proposed storm surge protection system. A 50 foot opening would be more than adequate to allow safe recreational boat traffic and the occasional waterway maintenance boat access. There are various proven gate systems that may be used to effectively block storm surge.

**Cost:** 25 million based on existing Corp of Engineer gate design. This cost could be potentially reduced by incorporating a less complicated manually-driven gate design.
### Estimated Cost of Project

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>$2,750,000</td>
</tr>
<tr>
<td>Raise/modify Lakeview Dr. 10-12 feet</td>
<td>$3,000,000</td>
</tr>
<tr>
<td>Gate System at Oak Harbor entrance</td>
<td>$25,000,000</td>
</tr>
<tr>
<td>Miscellaneous contingencies</td>
<td>$4,250,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$35,000,000</strong></td>
</tr>
</tbody>
</table>

### Community Involvement and Support

The East St. Tammany Storm Protection Committee has presented this proposed localized storm surge protection plan to:

- St. Tammany Parish President Pat Brister
- St. Tammany Parish State Senator A. G. Crowe
- St. Tammany Parish State Representative Gregory Cromer
- East St. Tammany Chamber of Commerce
- The Homeowners Associations located within the project’s boundaries

The plan has been well received by all the above-mentioned governmental agencies and community groups.

### Conclusion

**This community is most venerable, densely populated, community within St. Tammany Parish** and possibly within the entire Lake Pontchartrain Basin not currently included in a storms surge protection plan.

This structural protection project proposed would mitigate the additional storm surge risk created by the south shore barriers of Lake Pontchartrain and the south Slidell levee. This project could also significantly enhance storm surge protection for the city of Slidell.

A low 10 foot high levee would be affordable, unobtrusive and reduce the FEMA Base Flood Elevation, reduce flood insurance rates to an affordable levee and save this vital community from extinction even if it does not meet the definition of a theoretical 100 year surge system. This minimum surge reduction plan will position this community for greater protection once the CPRA’s “Land Bridge” project is implemented.

It is critical that the CPRA recognize the critical need to study surge reduction options for this most venerable, densely populated, community and develop a feasible, noninvasive, logical, cost effective storm surge mitigation and reduction plan.

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¹ Members of the East St. Tammany Storm Protection Committee have been appointed by the board of directors of the various homeowners associations located within the study area bounded by Highway 11, Schneider Canal Levee, Lakeshore Drive and Interstate 10 representing all 7,000 residents living within the study area.
DESCRIPTION: This proposed project was determined by the “Gap Analysis Data” to provide protection to Lacombe. This project would include the construction of 12.8 miles of earthen ring levee that would include flood gates from roadways and a Bayou Lacombe Floodgate with a pumping station. The preliminary ring levee alignment begins at HWY 190 west of Lacombe, follows the St. Tammany Trace to Lacombe, runs south and encapsulates Lacombe, and ties back into HWY 190 east of Lacombe. See location in figure 1 below.

REASONS FOR PROJECT SELECTION: No preliminary engineering has been done on this ring levee. The ring levee offers the following potential benefits:

- Lacombe is protected from storm surges.
- Provides protection for a concentrated area of repetitive losses

PROJECT COST INFORMATION: A preliminary planning estimate of the engineering, construction and maintenance cost is $234 Million.

A detailed engineering analysis including survey and geotechnical studies needs to be performed to support continued planning and document costs and project benefits. These costs will continue to be refined in Task III.

REQUIREMENTS FOR FEASIBILITY ANALYSIS:

1. Develop alignments
3. Estimate property acquisition for alignments.
4. Develop conceptual levee sections for alignments.
5. Preliminary engineering for floodgates and pumping station
6. Discuss potential permitting with USACE
7. Develop conceptual cost estimates

PROJECT LOCATION:
ATTACHMENTS: None
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

STRUCTURAL PROJECTS

MANDEVILLE SEAWALL IMPROVEMENTS AND SHORELINE PROTECTION

DESCRIPTION: The City of Mandeville is considering raising and/or replacing approximately 1.7 miles of seawall located at the Old Mandeville Lakefront, shown in figure 1 below. Over the last 25 years the existing seawall has visible deterioration that includes corroding sheet pile and reinforcing steel, concrete cap cracks and backfill loss.

In addition, the 2014 Old Mandeville Shoreline Protection Study provided several options and alternatives for improving shoreline protection. These recommendations included improvements to existing drainage structures, addition of two swing gates at Little Bayou Castine and Ravine aux Coquille and raising the seawall, among others.

REASONS FOR PROJECT SELECTION: The Mandeville seawall improvements and shoreline protection offers the following potential benefits:

- Replace deteriorating seawall and improve protection from Lake Pontchartrain.
- Raise seawall to a higher elevation to increase protection against storm surge and obtain a map revision from FEMA reducing the flood risk for the area.
- Reduce yearly storm surge and backwater flooding in the Old Mandeville area.
- Protect against storm surges of various stages.

PROJECT COST INFORMATION: The estimated cost to replace the seawall is $15 Million.

The 2014 study included the following estimates based on flood stage levels:
- 3.0 foot protection level - $240,000.00 (drainage structure improvements only)
- 4.2 foot protection level - $33.1 Million (flood gates, pumping stations)
- 5.3 feet protection level - $35.1 Million (flood gates, pumping stations)
- 7.3 feet protection level - $37.7 Million (flood gates, pumping stations, raising seawall)

REQUIREMENTS FOR FEASIBILITY ANALYSIS:

The St. Tammany Levee Drainage and Conservation District can coordinate and work with the City of Mandeville and its consultant(s) to determine the best option(s) for this project(s).
APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES

PROJECT LOCATION:

ATTACHMENTS:

Mandeville Seawall Replacement Summary.pdf
Mandeville Tidal Protection Summary.pdf
4. Seawall Replacement
Summary

Scope: Replace 1.7 mile Concrete-capped Steel Sheetpile Seawall
Status: Future Requirement (10-15 yrs)
Est. Const. Cost: $15M

Right: Deterioration visible at 24 yrs of age includes corrosion at wet/dry line, reinforcing steel corrosion causing concrete cracks, and backfill loss from corner joint
Tidal Protection Summary

Scope: Prevent Tidal Inundation of Old Mandeville
Status: Alternative Development
Est. Const. Cost: $11M to $40M

Note: Any alternative may prove environmentally difficult.

City Strategy: Develop strong engineering & environmental feasibility document, to make the project attractive & competitive for funding.

View of Existing Seawall, El. 5.3

Rendering of Seawall at El. 7.3
DESCRIPTION: The 2017 Coastal Master Plan includes a levee to an elevation of +/-16 feet for storm surge risk reduction around Slidell. Figure 3 below shows the current alignment of this levee system and Table 2-5, attached, shows the status for the various segments of this system. This project would address the following gaps identified in this project and further the planning and preliminary engineering:

- Consider the feasibility of alternative alignments for segments 6 and 7 as shown if figure 1 below.
- Preliminary planning and engineering for the W-14 pumping station that was not included in the Master Plan project.
- Evaluate the northern termination points of the ring levee system.
- Evaluation of the existing levee segments.
- Planning for land acquisition and the sequence of design and construction.

REASONS FOR PROJECT SELECTION: Project is part of the 2017 CPRA master plan and the gaps and alignments need to be addressed prior of moving this project into design. Also, some funding is available for this project and sequencing plan is needed to advance the planning and design. The alternative alignments offer the following potential benefits:

- Property Acquisition / Easements easier and less costly to obtain.
- Potential access through the W-14 canal.
- Project could be potentially combined with W-14 dredging with spoils being used for levee construction.
- Inclusion of approximately 630 Acres of additionally protected land.

PROJECT COST INFORMATION: The 2017 Coastal Master plan total project cost for the Slidell Ring Levee project is $181,300,000. The master plan includes $11.0 million for the construction cost of segments 6 and 7.

A detailed engineering analysis including survey and geotechnical studies needs to be performed to support continued planning and document costs and project benefits. These costs will continue to be refined in Task III.

REQUIREMENTS FOR FEASIBILITY ANALYSIS:

1. Model alternate alignments and modeling to determine levee termination points.
2. Estimate property acquisition for existing and alternate alignments.
3. Develop conceptual levee sections for existing and alternate alignments.
4. Discuss potential access and dredging possibilities with USACE.
5. Feasibility and preliminary engineering for the W-14 pumping station.
6. Master planning for a sequence of design and construction of the levee system.
7. Develop conceptual cost estimates.
8. Determine additional benefits of revised alignments and compare with the delta in construction costs.
9. Survey and geotechnical evaluation of exiting levee segments that are lacking information.

**PROJECT LOCATION:**

![Figure 1: Alternative Alignments 6 & 7](image1)

![Figure 2: Vicinity Map](image2)
CURRENT LEVEE STATUS:

![Figure 3: Current Proposed/Existing Levee Alignments](image)

**Table 1: St. Tammany Parish South Slidell Levee Segments Status**

<table>
<thead>
<tr>
<th>Coastal Zone Levee Segment</th>
<th>Levee Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2A, 3A, 3B, 15</td>
<td>Complete / Existing</td>
</tr>
<tr>
<td>12, 13A</td>
<td>Raise</td>
</tr>
<tr>
<td>2B, 4</td>
<td>Design / Engineering</td>
</tr>
<tr>
<td>5, 6, 7, 8, 9, 10, 11, 13B, 14</td>
<td>Planning</td>
</tr>
</tbody>
</table>

Note: See Figure 3 for Segment Locations

ATTACHMENTS:

Table 2-5 – St. Tammany Parish South Slidell Levee Segments Summary

001. HP.13 Fact Sheet.pdf
<table>
<thead>
<tr>
<th>Segment Number</th>
<th>Segment Description</th>
<th>Segment Type</th>
<th>Length (Linear feet)</th>
<th>Current or Design Elevation (feet)</th>
<th>Estimated Costs from STPG</th>
<th>Status [3]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Raising Highway 11 to NS RR Tracks - Phase 2 (15') - Lift</td>
<td>Earthen</td>
<td>1916.70</td>
<td>15.0</td>
<td>Complete, April 2018</td>
<td></td>
</tr>
<tr>
<td>02a</td>
<td>Hwy 11 to Schneider Canal Pump Station</td>
<td>Earthen</td>
<td>894.10</td>
<td>15.0</td>
<td>Complete, Constructed to 100 year design height. Will need small pump station over levee to replace culvert to meet USACE Guidelines.</td>
<td></td>
</tr>
<tr>
<td>02b</td>
<td>Schneider Canal Pump Station to Oak Harbor Ring Levee</td>
<td>t-Wall</td>
<td>131.60</td>
<td>15.0 [1]</td>
<td>$ 5,000,000</td>
<td>Design complete, waiting on construction funding.</td>
</tr>
<tr>
<td>03a</td>
<td>Oak Harbor Ring Levee (DD#5) to I-10</td>
<td>Earthen</td>
<td>181.10</td>
<td>12.5</td>
<td>Complete</td>
<td></td>
</tr>
<tr>
<td>03b</td>
<td>I-10 to Lakeshore Estates Ring Levee (DD#2)</td>
<td>Earthen</td>
<td>1462.20</td>
<td>15.5</td>
<td>Complete, Constructed to 100 year design height. Will need small pump station over levee to replace culvert to meet USACE Guidelines.</td>
<td></td>
</tr>
<tr>
<td>03c</td>
<td>East Howse Beach Road Raising</td>
<td></td>
<td></td>
<td></td>
<td>16.25</td>
<td>Complete, Constructed to 100 year design height.</td>
</tr>
<tr>
<td>03d</td>
<td>I-10 Raising</td>
<td>TBD</td>
<td></td>
<td></td>
<td></td>
<td>Have existing centerline elevations. Cost may increase due to possible concrete barrier project LADOTD is proposing.</td>
</tr>
<tr>
<td>4</td>
<td>Segment 01 to Baptist Church</td>
<td>Earthen</td>
<td>1298.70</td>
<td>15.25</td>
<td></td>
<td>Designed but must be permitted with segments 5, 8, 9, 10, 11, and 14.</td>
</tr>
<tr>
<td>5</td>
<td>Baptist Church to Sun Valley Pump Station</td>
<td>t-Wall</td>
<td>1758.60</td>
<td>15.25</td>
<td>$ 11,250,000</td>
<td>Some preliminary engineering work done. This is to be T-Wall levee.</td>
</tr>
<tr>
<td>6</td>
<td>Lakeshore Estates Ring Levee (DD#2) to Hwy 433 (Note: Alignment may change)</td>
<td>Earthen</td>
<td>1758.60</td>
<td>TBD</td>
<td>$ 3,125,000</td>
<td>No work yet.</td>
</tr>
<tr>
<td>7</td>
<td>Hwy 433 to Kingspoint Ring Levee (DD#4) (Note: Alignment may change)</td>
<td>Earthen</td>
<td>462.50</td>
<td>TBD</td>
<td>$ 7,500,000</td>
<td>No work yet.</td>
</tr>
<tr>
<td>8</td>
<td>Sun Valley Pump Station to Lizana Street</td>
<td>t-Wall</td>
<td>462.50</td>
<td>15.25</td>
<td>$ 20,000,000</td>
<td>Some preliminary engineering work done. Approximately 2990 ft long x 10 ft high wall.</td>
</tr>
<tr>
<td>9</td>
<td>Lizana Street to Bayou Liberty Road</td>
<td>t-Wall</td>
<td>2728.40</td>
<td>15.25</td>
<td>$ 10,250,000</td>
<td>Some preliminary engineering work done. Approx 2750 ft long wall x 10 ft high wall. CLECO conflicts.</td>
</tr>
<tr>
<td>10</td>
<td>Bayou Liberty Road to south of Bayou Pattisat</td>
<td>t-Wall</td>
<td>1553.40</td>
<td>15.25</td>
<td>$ 6,625,000</td>
<td>Some preliminary engineering work done. Approx 1500 ft long x 10 ft high wall.</td>
</tr>
<tr>
<td>11</td>
<td>Bayou Pattisat to Bayou Lane</td>
<td>t-Wall</td>
<td>2209.40</td>
<td>15.25</td>
<td>$ 15,000,000</td>
<td>Some preliminary engineering work done. Approx 2250 ft long x 9 ft high wall. CLECO conflicts.</td>
</tr>
<tr>
<td>12</td>
<td>Raise portion of Kingspoint Ring Levee (DD#4) &amp; Install Pump Station in W-14 Canal</td>
<td>Earthen</td>
<td>4109.40</td>
<td>17.25</td>
<td>$ 45,000,000</td>
<td>No work yet. A portion of this levee, about 4,000-ft, will need to be raised about 4-ft, PLUS the City of Slidell’s City Barn drainage pump station will need to be relocated.</td>
</tr>
<tr>
<td>13a</td>
<td>Raise Portion of Existing Kingspoint Ring Levee (DD#4)</td>
<td>Earthen</td>
<td>2575.20</td>
<td>17.25</td>
<td>$ 8,750,000</td>
<td>No work yet. Approx 7500 ft, height varies from Kingspoint levee to high ground just nort of Hwy 190 - includes hump in Hwy 190.</td>
</tr>
<tr>
<td>13b</td>
<td>Connect new segment to Kingspoint Ring Levee (DD#4) and extend to Hwy 190</td>
<td>Earthen</td>
<td>3980.50</td>
<td>15.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Bayou Lane to W. Hall Avenue</td>
<td>t-Wall</td>
<td>2814.50</td>
<td>15.25</td>
<td>$ 8,750,000</td>
<td>Some preliminary engineering work done. Earthen &amp; levee wall, approx 2800 long from Bayou Land/Freemont to East Hall. Utility relocations and work within railroad r/w are complications.</td>
</tr>
<tr>
<td>15</td>
<td>Raising Oak Harbor Boulevard (raise road over levee)</td>
<td></td>
<td></td>
<td></td>
<td>17.1</td>
<td>Complete</td>
</tr>
<tr>
<td>16</td>
<td>W-14 Canal Pump Station</td>
<td>Earthen</td>
<td></td>
<td></td>
<td>$ 31,000,000</td>
<td>USACE estimated cost with contingency to be $31M.</td>
</tr>
<tr>
<td>17</td>
<td>Lakeshore levee</td>
<td></td>
<td></td>
<td>18.0</td>
<td></td>
<td>Complete</td>
</tr>
</tbody>
</table>

[1] GEC for CPRA (August 2013)
[2] Constructed but will need to be raised to 100-year protection elevation
Description
Construction of a levee to an elevation of 16 feet NAVD88 for storm surge risk reduction around Slidell. Project features approximately 31,000 feet of earthen levee and 14,500 feet wall.

Project Cost Estimate

<table>
<thead>
<tr>
<th>Description</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning/Engineering &amp; Design</td>
<td>$20,400,000</td>
</tr>
<tr>
<td>Construction</td>
<td>$141,000,000</td>
</tr>
<tr>
<td>Operations &amp; Maintenance</td>
<td>$19,900,000</td>
</tr>
<tr>
<td>Total</td>
<td>$181,300,000</td>
</tr>
</tbody>
</table>

Scale of Influence

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>Sub-basin</td>
</tr>
<tr>
<td>Basin</td>
<td>Regional</td>
</tr>
</tbody>
</table>

Project Location
St. Tammany Parish

Project Duration
Planning, Engineering, and Design is estimated to take 2 years. Construction is estimated to take 1 year.

Other Project Area Statistics

<table>
<thead>
<tr>
<th>Description</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Current Population</td>
<td>20,000</td>
</tr>
<tr>
<td>Percent of Population who are Low-to-Moderate Income</td>
<td>41%</td>
</tr>
<tr>
<td>Number of Severe Repetitive Loss Properties</td>
<td>440</td>
</tr>
</tbody>
</table>

Implementation Period
2017 Coastal Master Plan
Economic Damage

Structural protection projects are evaluated by how they reduce Expected Annual Damage (EAD) for a particular area. EAD represents the average direct economic damage projected to result from storm surge flooding events, from Category 1 or greater storms, in any given year, taking into account both the expected damage and the overall frequency of such storms occurring. EAD is a summary measure of the potential damage averaged over the entire distribution of possible flood events. Damage is also summarized at various return periods (DRP), e.g., 100-year damage being the damage with a 1% chance of occurring or being exceeded in a given year. The following are the economic damage summaries for the Future Without Action (FWOA) and Future With Project (FWP) conditions, for the project as a whole (Table 2), and for each Risk Region (Table 3). EAD and DRP values are reported in millions of dollars.

Table 2: Expected Annual Damage

<table>
<thead>
<tr>
<th>Year</th>
<th>FWOA</th>
<th>WNP</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>517M</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>25</td>
<td>1,255M</td>
<td>823 M</td>
<td>432 M</td>
</tr>
<tr>
<td>50</td>
<td>2,688 M</td>
<td>1,904 M</td>
<td>784 M</td>
</tr>
</tbody>
</table>

Critical Infrastructure

The data in Table 1 was provided by GOHSEP and the Homeland Security Infrastructure Program (HSIP). "Protected" assets are those that otherwise flood in FWOA conditions but are protected by the project.

Table 1: Critical Infrastructure Counts

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>Protected</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airport Facility</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gas Processing</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Government/Military</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Electric Power Substation</td>
<td>-</td>
<td>11</td>
</tr>
<tr>
<td>Liquefied Natural Gas Terminal</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Louisiana Offshore Oil Port</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Manufacturing/Chemical</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Electric Power Plant</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Port</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Petroleum Pump Station</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Refinery</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Water and Sewer</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Strategic Petroleum Reserve</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>22</td>
</tr>
</tbody>
</table>

Table 3: Economic Damage by Return Period at Year 50

<table>
<thead>
<tr>
<th>Risk Region</th>
<th>50 Year FWOA</th>
<th>50 Year WNP</th>
<th>100 Year FWOA</th>
<th>100 Year WNP</th>
<th>500 Year FWOA</th>
<th>500 Year WNP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orleans - Lake Catherine</td>
<td>$340M</td>
<td>$340 M</td>
<td>$342 M</td>
<td>$342 M</td>
<td>$351 M</td>
<td>$351 M</td>
</tr>
<tr>
<td>Orleans - New Orleans</td>
<td>$9,351 M</td>
<td>$9,753 M</td>
<td>$22,629 M</td>
<td>$22,675 M</td>
<td>$47,244 M</td>
<td>$46,173 M</td>
</tr>
<tr>
<td>Orleans - Rigolets</td>
<td>$129 M</td>
<td>$130 M</td>
<td>$130 M</td>
<td>$130 M</td>
<td>$130 M</td>
<td>$130 M</td>
</tr>
<tr>
<td>St. Tammany</td>
<td>$14,001 M</td>
<td>$14,059 M</td>
<td>$24,531 M</td>
<td>$23,533 M</td>
<td>$34,024 M</td>
<td>$33,931 M</td>
</tr>
<tr>
<td>St. Tammany - Slidell</td>
<td>$18,532 M</td>
<td>$4,762 M</td>
<td>$21,568 M</td>
<td>$6,888 M</td>
<td>$25,013 M</td>
<td>$28,982 M</td>
</tr>
<tr>
<td>Total</td>
<td>$42,353 M</td>
<td>$29,043 M</td>
<td>$69,199 M</td>
<td>$53,567 M</td>
<td>$106,762 M</td>
<td>$109,566 M</td>
</tr>
</tbody>
</table>

2017 Coastal Master Plan | Project Factsheet
STRUCTURAL PROJECTS

WEST SLIDELL RING LEVEE

DESCRIPTION: This proposed project was determined by the “Gap Analysis Data” to provide protection to west Slidell beyond the CPRA Slidell Ring Levee project. This project would include the construction of 7.7 miles of ring levee that would include flood gates for roadways and three Bayou Floodgates with pumping stations. The ring levee project begins at HWY 190 west of Slidell, runs south and encapsulates the west Slidell area, and ties into the Slidell Ring Levee. See location in figure 1 below.

REASONS FOR PROJECT SELECTION: No preliminary engineering has been done on this ring levee. The ring levee offers the following potential benefits:

- West Slidell is protected from storm surges.
- Provides protection for a concentrated area of repetitive losses

PROJECT COST INFORMATION: A preliminary planning estimate of the engineering, construction and maintenance cost is $144 Million.

A detailed engineering analysis including survey and geotechnical studies needs to be performed to support continued planning and document costs and project benefits. These costs will continue to be refined in Task III.

REQUIREMENTS FOR FEASIBILITY ANALYSIS:

1. Develop alignments
3. Estimate property acquisition for alignments.
4. Develop conceptual levee sections for alignments.
5. Preliminary engineering for floodgates and pumping station
6. Discuss potential permitting with USACE.
7. Develop conceptual cost estimates.

PROJECT LOCATION:
**APPENDIX B – CONCEPTUAL PROJECT ALTERNATIVES**

*Figure 1: West Slidell Ring Levee*

*Figure 2: Vicinity Map*

**ATTACHMENTS:** None