Mississippi Valley Division,
Regional Planning and Environment Division South

St. Tammany Parish, Louisiana Feasibility Study

Appendix B – Plan Formulation

June 2021

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Section 1
Introduction

This appendix provides supplemental plan formulation information for the St. Tammany Parish, Louisiana Feasibility Study (study). It supplements the material in Section 1 Introduction, Section 2 Problems and Opportunities and Section 4 Formulation of Alternative Plans of the Draft Integrated Feasibility Report and Draft Environmental Impact Statement (DIFR and DEIS) (report) and includes tables and maps used in the development, screening, evaluation and comparison of management measures, alternative plans and borrow sites.

During the study, the Project Delivery Team (PDT) followed the United States Army Corps of Engineers (USACE) planning process. This process is a structured systematic and repeatable planning approach to problem solving for water resource studies. The process (Figure B:1-1) is defined in the Planning Guidance Notebook (ER 1105-2-100) and the Principles and Guidelines for Federal Water Resource projects. The six planning steps, though presented and discussed in a sequential manner for ease of understanding, usually occur iteratively and sometimes concurrently. Iterations of steps are conducted as necessary to formulate and evaluate efficient, effective, and reasonable array of alternative plans. As more information is acquired and developed, it may be necessary to reiterate some of the previous steps.

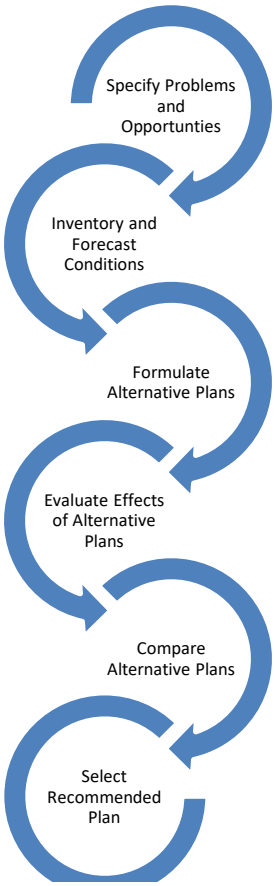

Figure B:1-1. USACE's Planning Process

Step 1 focuses on identifying the problems and opportunities in the study area. The PDT needed to understand the issues within the study area and what was driving the issues. The PDT was then able to define the objectives of the study, or what the PDT hopes to achieve with a project and identify any constraints that limit potential solutions. In Step 2, the PDT documents and understands the existing conditions in the study area that are relevant to the problem. This was done by looking at historic trends and potential changes to the

existing conditions and forecasting would likely happen in the future if no Federal actions are taken. That defined the future without-project (FWOP) condition, or the “No Action” alternative. The FWOP condition is the default baseline to which all other alternatives are compared. The without-project condition is the same as the National Environmental Policy Act (NEPA) “no action” condition, and it assumes that the USACE would take no action to solve the problem. Step 3 involves developing a wide range of potential actions the PDT could take to solve the problems and meet the planning objectives. Individual actions, or measures, are combined to create different alternatives to meet the study objectives. Input from the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB) who is the Non-Federal Sponsor (NFS), St. Tammany Parish, key stakeholders, and the public was very important during this planning step. In Step 4, the PDT looked at each potential measure and grouping of measures to form alternatives to see what its effects, benefits, costs, and potential impacts would be. This step usually involved using existing and developing new data to model the physical, economic, and environmental conditions along with measuring how well each alternative performs at meeting the objectives and avoiding the constraints. In Step 5, the PDT compared each alternative plan to the other alternative plans, including the “No Action” alternative. Based on the comparisons, the PDT was able to determine which alternatives perform the best and warrant further investigation. Step 6 was an additional screening step, where the PDT selected which alternatives to keep and which to discard. In early iterations of this process, the PDT narrowed the focus from a large number of alternatives to a smaller array of alternatives. In the final iteration, the PDT selected a single alternative to recommend for implementation as the Tentatively Selected Plan (TSP).

Information developed during one of the later steps may require an additional look at an earlier step. For example, there may be a new aspect of the problem that needs attention. That could lead to reconsideration of the problems and opportunities and also the need to conduct additional inventory and forecasting. Feedback from the public or the vertical team may also result in revisiting previously completed steps.

1.1 OVERVIEW OF STUDY AREA, PROBLEMS, OPPORTUNTIES, OBJECTIVES AND CONTRAINTS

An overview of the study area and the problems, opportunities, objectives, and constraints are described in Sections 1 and 2 of the Report and summarized here as a point of reference.

Per the study authority, as identified in Section 1. 2 of the report, the study area encompasses all of St. Tammany Parish Louisiana. The State of Mississippi, with the Pearl River creates the eastern boundary. Lake Pontchartrain serves as the southern boundary while Tangipahoa Parish is located along the western boundary and Washington Parish is located to the north (Figure B:1-2). The highlighted subbasins in Figure B:1-2 illustrates the project area where documented flooding has occurred, whether from coastal or riverine, and repetitive flood loss. The project area, a subset of the larger study area, defines the area where measures and alternatives could be developed to address the problems, opportunities

and objectives. The subbasins used were the U.S. Geological Survey Hydrologic Unit Code 12 denoted on Figure B:1-2 as WBDHUC12.

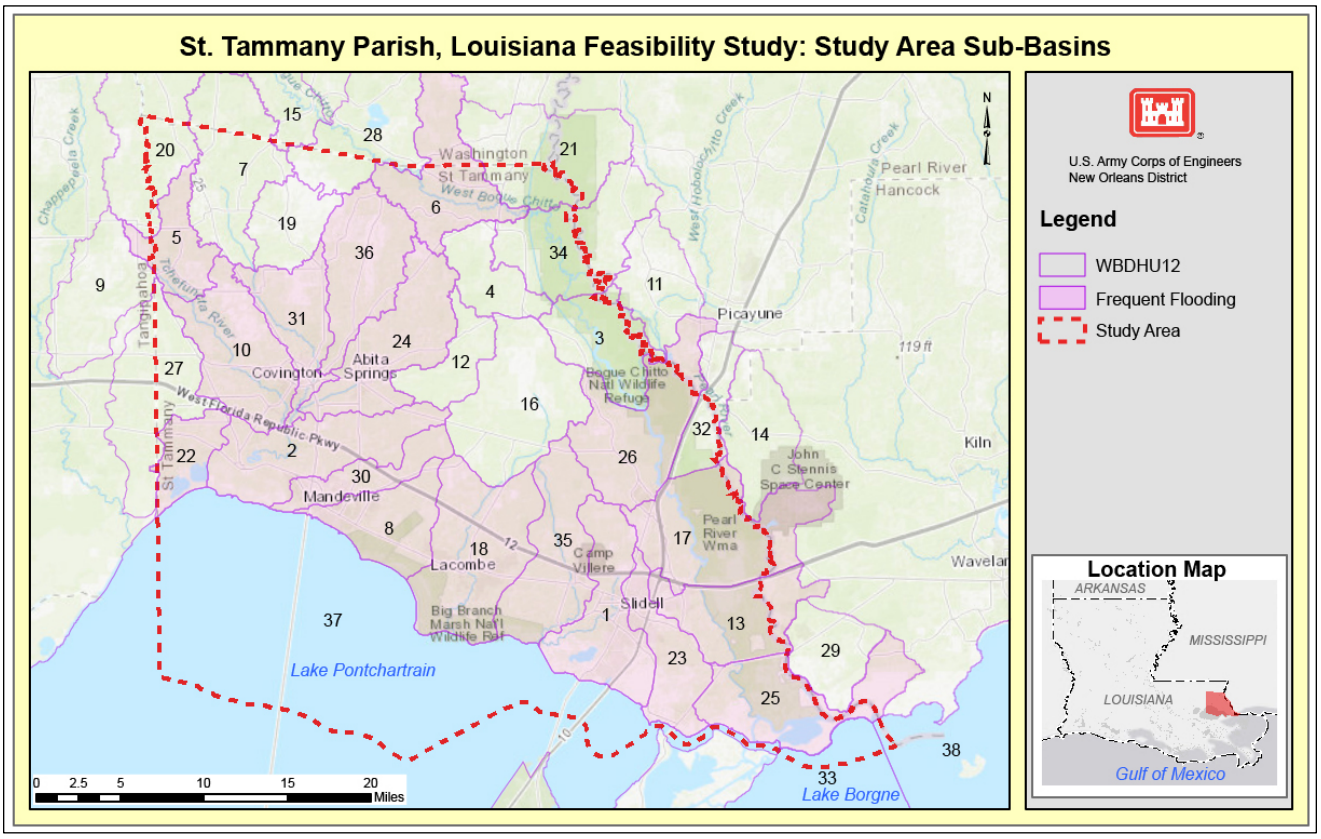

Figure B: 1-2. St. Tammany Parish, Louisiana Feasibility Study Area

The study area problems, opportunities, and objectives are identified in Section 2 of the Report. Table B:1-1 shows the relationship between the defined problems, opportunities, and objectives. The table categorizes the problems in the study area and then documents the opportunities for addressing a given problem and ultimately the project objective developed to address the linked problem and opportunity.

Table B: 1-1. St. Tammany Parish, Louisiana Feasibility Study, Problems, Opportunities, and Objectives Crosswalk

PROBLEMS	OPPORTUNITIES	OBJECTIVES
St. Tammany Parish has experienced repeated, widespread flooding from rainfall and coastal storms that has caused riverine bank overtopping, high tides, waves, drainage, and storm surge • Study area prone to flood damages from rainfall, riverine bank overtopping, high tides, waves, drainage, and storm surge. • 3,500 residential structures are on the Federal Emergency Management Agency (FEMA) repetitive and severe repetitive loss list. • Sea level rise and subsidence are expected to increase in the future, causing more frequent storm surge inundation and flood events.	Reduce Flood Damages • Provide Flood Risk Management (FRM) and Coastal Storm Risk Management (CSRM) alternatives to convey and redirect water to reduce the flood risks to public, commercial, and residential property, real estate, and infrastructure. • Reduce susceptibility of residential, commercial, and public structures and infrastructure to hurricane and rainfall induced storm damages. • Reduce storm surge heights and durations in protected areas. • Optimize water storage and conveyance needs.	Reduce flood damage to structures (i.e. businesses, residential, commercial, and public structures) from flooding in St. Tammany Parish.
Increasing risk to people from catastrophic flooding events. • Hurricanes, tropical storms, and locally heavy rainfall pose a significant flood risk to the 258,110 people residing in the study area.	Reduce Risk to Public Safety • Reduce the risk to human life during flooding.	Reduce the risk to public health and safety by reducing flood impacts to structures, evacuation routes, and critical infrastructure in St. Tammany Parish.
Increasing risk of damage to residential and commercial property. • Hurricane Katrina damaged over 48,000 residential structures. • National and regional economic losses from flooding to industrial and commercial infrastructure/assets.	Reduce Flood Damages • Provide FRM and CSRM alternatives to convey and redirect water to reduce the flood risks to public, commercial, and residential property, real estate, and infrastructure. • Reduce the susceptibility of residential, commercial, and public structures and infrastructure to hurricane-induced and rainfall induced storm damages.	Reduce flood damage to structures (i.e. businesses, residential, commercial, and public structures) from flooding in St. Tammany Parish.
Critical infrastructure throughout the region including the I-10, I-12 and I-59 transportation system and evacuation routes, Government facilities, hospitals, and schools is expected to become more at risk of damage from potential floods. • The August 2016 flood impacted the Nation's critical infrastructure by shutting both the I-10 and I-12 transportation system. • Local roads that frequently flood have been identified.	Increase the reliability of the Nation's transportation corridor (I-10, I-12 and I-59) by providing alternatives that would potentially lessen damages from induced flooding.	Reduce interruption to the maximum extent practicable to the Nation's transportation corridor e.g. the I-10 and I-12 and the I-10 interchange in St. Tammany Parish.
Economic losses from flooding to industrial and commercial infrastructure/assets. • The August 2016 flood impacted over 900 businesses and 8,000 employees.	Reduce Flood Damages Reduce economic damages and improve economic resiliency of the local economy and communities. Reduce the susceptibility of residential, commercial, and public structures and infrastructure to hurricane-induced and	Reduce flood damage to structures (i.e. businesses, residential, commercial and public structures) from flooding in St. Tammany Parish. Reduce the risk to public health and

	rainfall induced storm damages.	safety by reducing flood impacts to structures, evacuation routes and critical infrastructure in St. Tammany Parish.
Increased risk to historically significant structures in the study area	Reduce Flood Damages • Provide FRM and CSRM alternatives to convey and redirect water to reduce the flood risks to public, commercial, and residential property, real estate, and infrastructure. • Reduce the susceptibility of residential, commercial, and public structures and infrastructure to hurricane-induced and rainfall induced storm damages. • Reduction in storm surge heights and durations.	Reduce flood damage to structures (i.e. businesses, residential, commercial and public structures) from flooding in St. Tammany Parish.
Degrading of local channels and banks stability contribute to upstream and downstream flooding. • Diverse ecologically and important habitat within the study area is being lost and degraded due to saltwater intrusion, waves, subsidence, storm surge, and development. • Sea level rise and subsidence are expected to increase in the future, causing more frequent storm surge inundation and flood events.	Natural Resources: Protect the function and increase the resiliency of the ecosystem to reduce flood damages. • Reduce loss of coastal habitat. • Increase resiliency of coastal and riparian habitats to act as a natural resource to reduce flood damages.	Increase resiliency of coastal and riparian habitats as natural resources to reduce flood damages.
Limited warning systems for flood events.	Enhance public education and awareness to FRM and CSRM risk. Encourage public competency and understanding of how the flood warning systems function and response they should take when alarmed.	Increase community resiliency, the sustained ability of a community to use available resources, before, during, and after significant rainfall and or coastal events.
Sea level rise and subsidence are expected to increase in the future, causing more frequent storm surge inundation and flood events.	Develop robust alternatives that account for predicted RSLR and climate change.	Reduce flood damage to structures (i.e. businesses, residential, commercial, and public structures) from flooding in St. Tammany Parish. Increase resiliency of coastal and riparian habitats as natural resources to reduce flood damages. Increase community resiliency, the sustained ability of a community to use available resources, before, during, and after significant rainfall and or coastal events.

Development has led to increased flooding.	Enhance public education and awareness to FRM and CSRM risk. Optimize water storage and conveyance within the study area.	Reduce flood damage to structures (i.e. businesses, residential, commercial and public structures) from flooding in St. Tammany Parish. Increase resiliency of coastal and riparian habitats as natural resources to reduce flood damages. Increase community resiliency, the sustained ability of a community to use available resources, before, during, and after significant rainfall and or coastal events.

The constraints for the study that were used in the plan formulation are:

- Proposed projects must meet minimum flow (800 cubic feet per second for a 10 percent chance flood) and drainage area (1.5 square. miles) requirements (ER 1165-2-21).
- Avoid promoting development within the floodplain (in accordance with EO 11988), to the maximum extent practicable, which contributes to increased life safety risk.
- Avoid locating project features on lands known to have hazardous, toxic, and radioactive waste (HTRW) and/or related concerns.

Additionally, several planning considerations were identified for plan formulation that would not require the removal of an alternative plan, but were assessed as part of the plan formulation process:

- Avoid and or minimize impacts to threatened and endangered (T&E) species and their critical habitats.
- Avoid and or minimize impacts to managed habitats i.e. essential fish habitat (EFH).
- Avoid and or minimize impacts to established recreational areas.
- Avoid and or minimize impacts to viewshed.
- Avoid or minimize impacts to cultural resources.

1.2 MANAGEMENT MEASURES

Management measures are the building blocks of alternative plans. Sometimes an alternative plan is one measure. More often it is a set of measures. The categories of measures considered to reduce flood risk from the multiple sources of flooding included structural, nonstructural and nature-based measures. The team identified 30 types of measures under the structural, nonstructural, and engineering with nature/nature-based categories to address flood risk reduction. The types are measures were:

- Structural (S): Structural measures are physical modifications designed to reduce the frequency of damaging levels of flood inundation.

    1. Detention Ponds
    2. Diversion Channels
    3. Bridge Improvements
    4. Channels Improvements
    5. Dredging
    6. Elevate Roadways
    7. Flood Gates
    8. Levee Setback
    9. Levees and Floodwalls
    10. Pumping Stations

11. Breakwaters
12. Reservoir
13. Revetments (shoreline)
14. Ring Berms
15. Seawall, Bulkhead
16. Snagging and Clearing
17. Weirs

- Nonstructural (NS): Nonstructural measures are permanent or contingent measures applied to a structure and/or its contents that prevent or provide resistance to damage from flooding. NS measures differ from structural measures in that they focus on reducing consequences of flooding instead of focusing on reducing the probability of flooding. NS measures reduce flood damages without significantly altering the nature or extent of flooding. Damage reduction from nonstructural measures is accomplished by changing the use made of the floodplains, or by accommodating existing uses to the flood hazard.

18. Elevations of Homes
19. Evacuation Plans
20. Flood Proofing Critical Infrastructure Dry
21. Flood Proofing Critical Infrastructure Wet
22. Flood Proofing Residential Dry
23. Flood Proofing Residential Wet
24. Flood Warning System
25. Optimize Operation of Existing Structures or Projects
26. Property Acquisition (Buyouts)
27. Relocations

- Nature Based (NB): Nature-based measures work with or restore natural processes with the aim of wave attenuation, storm surge reduction, slow and store floodwaters, wetlands or coastal habitat to store inland water.

28. Habitat Creation to attenuate wave energy, reduce erosion (marsh, ridge or coastal forest)
29. Habitat to Store and Slow Water
30. Shoreline Protection including Living Shorelines

The categories of potential types of management measures were evaluated to assist the team in identifying a broad range of potential site-specific solutions during the plan formulation process; the general evaluation provided information regarding they types of actions that could be used to address study objectives, timescale, and acceptability. The categories were referred to during the development of site-specific management measures to make sure a comprehensive and robust list of measures was considered.

Table B:1-2 provides a summary of the general evaluation of these potential types of actions by evaluating three categories—"Study Objectives", "Timescale" and "Acceptability" to

evaluate measures. For example, the “Timescale” evaluation category assigns one of these five tiers to each study alternative: “Maximum”, “Long”, “Midrange”, “Short”, or “Minimum” timescales. These tiers are represented in Table B:1-2 by the abbreviations “MAX”, “LONG”, “MID”, “SHORT”, or” MIN”, respectively. A key defining each evaluation category scale and scoring system is found below Table B:1-2.

Following the identification and evaluation of the types of management actions that could reduce flood risk to the area, specific site management measures within the categories and types were then identified and compiled from previous reports, NFS, stakeholders, the public and recommendations from the PDT. A full list of all the identified site-specific management measures is presented in Table B:1-3. Initially a total of 195 measures were identified. Through subsequent iterations of the plan formulation process and at the request of the NFS and the St. Tammany Parish Government for additional measures at Eden Isle, an additional 13 management measures were added for a total of 208. The management measures were evaluated based on category type (Table B:1-3), planning objectives, existing data, professional judgment, avoiding study constraints and addressing the opportunities and problems of the area (See Table B: 1-3). The management measures were also screened on effectiveness and efficiency, which are two of the four P&G evaluation criteria as defined in P&G Section VI.1.6.2(c). Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities (P&G Section VI.1.6.2(c)(2)). Alternative plans that clearly make little or no contribution to the planning objectives should be dropped from consideration. Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation’s environment (P&G Section VI.1.6.2(c)(3)). Benefits can be both monetary and non-monetary. Alternative plans that provided little benefit relative to cost should be dropped from consideration.

Following this screening process, the remaining 61 initial measures, which are shown in bold in the Table B:1-3, were combined to form the Initial Array of Alternatives plans for flood prone areas based on the hydrologic subunits.

Table B: 1-2. Types of Measures Evaluated Under the St. Tammany Feasibility Study

			Does Action Meet Project Objectives?								Timescale	Acceptability	
Measures	**USACE Category**	**FRM or CSRM**	**Reduces economic damage**	**Reduces flood impacts to structures, evacuation routes, critical infrastructure**	**Reduces interruption to nation's transportation corridor including the I-10/I-12 interchange**	**Improves regional scale conditions**	**Provides benefits beyond mitigating flood risk**	**Minimizes recreational user impacts**	**Minimizes view shed impacts**	**Minimizes environmental consequences**	**Time to implement**	**Included in CPRA Master Plan**	**Included in St. Tammany Master Plan**
Habitat Creation to Attenuate Wave Energy, Reduce Erosion (marsh, ridge or coastal forest)	Nature-Based	CSRM	MAY	MAY	MAY	MTS	MTS	MTS	EXC	EXC	MAX	YES	YES
Riparian Habitat to Slow Inland Water Transfer	Nature-Based	FRM	MAY	MAY	MAY	MTS	MTS	MAY	EXC	EXC	MAX	NO	NO
Flood Proofing Residential (Dry and Wet)	Non-Structural	FRM/CSRM	IMP	IMP	NO	MTS	NO	MTS	EXC	EXC	MIN	YES	NO
Flood Proofing Critical Infrastructure (Dry and Wet)	Non-Structural	FRM/CSRM	IMP	IMP	NO	MTS	NO	MTS	EXC	EXC	MIN	YES	NO
Property Acquisition (Buyouts)	Non-Structural	CSRM	IMP	IMP	NO	MTS	NO	EXC	LKY	EXC	SHORT	NO	NO
Relocations	Non-Structural	CSRM	IMP	IMP	MAY	MTS	NO	LKY	LKY	MTS	SHORT	NO	NO
Evacuation Plans	Non-Structural	CSRM	NO	NO	MTS	MTS	NO	MTS	EXC	EXC	MIN	NO	NO
Optimize Operation of Existing Structures or Projects	Non-Structural	FRM/CSRM	MAY	MAY	MAY	MTS	LKY	MAY	MTS	MTS	MIN	NO	NO
Flood Warning System	Non-Structural	CSRM and FRM	NO	NO	MAY	MTS	NO	MTS	EXC	EXC	MIN	NO	NO
Elevations of Homes	Non-Structural	CSRM	IMP	IMP	NO	MTS	NO	MTS	NO	MAY	LONG	YES	NO
Levees and Floodwalls	Structural	CSRM and FRM	EXC	EXC	EXC	EXC	EXC	NO	NO	NO	MAX	YES	YES
Elevate Roadways	Structural	FRM and CSRM	IMP	IMP	EXC	MTS	MTS	MAY	MAY	EXC	MAX	NO	NO
Detention Ponds	Structural	FRM	MTS	MTS	MTS	IMP	MTS	MAY	MTS	MAY	MID	NO	NO
Bridge Improvements or Replacements	Structural	FRM	MTS	MTS	EXC	MTS	MAY	MAY	LKY	EXC	MAX	NO	NO
Breakwaters	Structural	CSRM	MTS	IMP	MAY	MTS	MAY	MAY	MAY	EXC	SHORT	NO	NO
Reservoir	Structural	FRM	EXC	IMP	MTS	MTS	MAY	MAY	MTS	NO	MID	NO	NO
Pumping Stations	Structural	FRM	IMP	MTS	MTS	MAY	NO	MAY	MTS	NO	SHORT	NO	NO
Seawall, Bulkhead	Structural	CSRM	IMP	IMP	LKY	MTS	MAY	MAY	MAY	MAY	MAX	NO	NO

Ring Berms	Structural	CSRM	IMP	IMP	LKY	MAY	NO	MAY	NO	NO	MAX	YES	YES
Flood Gates	Structural	CSRM	MTS	MTS	MTS	LKY	NO	NO	EXC	NO	MAX	YES	NO
Conveyance Channels	Structural	FRM	LKY	LKY	LKY	MTS	MAY	PSB	MAY	NO	SHORT	NO	NO
Diversion Channels	Structural	FRM	MAY	MTS	LKY	MTS	MAY	PSB	MAY	NO	SHORT	NO	NO
Snagging and Clearing	Structural	FRM	LKY	LKY	MAY	MTS	NO	NO	MTS	MAY	SHORT	NO	NO
Levee Setback	Structural	FRM/CSRM	MAY	MAY	MAY	MTS	MTS	MAY	NO	EXC	MAX	NO	NO
Revetments (shoreline)	Structural	FRM	LKY	LKY	LKY	MTS	MAY	MAY	MAY	NO	LONG	NO	NO
Dredging	Structural	FRM	LKY	LKY	MAY	MTS	MAY	NO	MAY	NO	SHORT	NO	NO
Weirs	Structural	FRM	MTS	MTS	LKY	LKY	NO	NO	MAY	MAY	LONG	NO	NO
Living Shoreline to break offshore waves, reduce erosion	Structural and Nature-Based	CSRM	MAY	MAY	MAY	MTS	MTS	MAY	EXC	EXC	LONG	NO	NO
No Action			NO	NO	NO	NO	NO	MAY	MTS	EXC	MAX	NO	NO

Scale Key:

Score	*Does the action meet project objectives?*	
0	NO	No
0.5	PSB	Possibly
1	MAY	May
1.5	LKY	Likely
2	MTS	Meets
2.5	IMP	Improves
3	EXC	Exceeds

Score	*Timescale*	
0	MAX	Maximum
1	LONG	Long
1.5	MID	Midrange
2	SHORT	Short
3	MIN	Minimum

Score	*Acceptability*
0	NO
2	YES

Table B:1-3. Site Specific Management Measures. (Measures used to develop the Initial Array of Alternatives and shown in bold.)

Nomenclature for Measure Identification (Measure ID). Nature-based measures are denoted with NB; Structural Measures are denoted with a S and Nonstructural Measures denoted with NS. Each measure within the NB, S and NS measure categories were given a unique numerical value within each category based on the order in which it was proposed and or documented during the study.

Site Specific Management Measure	**Measure ID**	**Category (structural, nonstructural, Nature Based)**	**Type**	**Location**	**Type of Flooding Addressed (CSRM/FRM)**	**Source**	**Moved Forward (MF) to Alternatives, Screened (S) with Justification, Does Not Meet (DNM)**
Guste Isle	NB-010	Nature Based	Ridge Restoration	Guste Isle	CSRM	Lake Pontchartrain Basin Foundation	S: Duplicative of another measure
Big Branch	NB-013	Nature Based	Living Shoreline	Lacombe	CSRM	St Tammany Coastal Protection and Restoration PO 167	S: Duplicative of another measure
Coastal Protection and Restoration Authority (CPRA) Planning Unit 1	NB-019	Nature Based	Marsh Creation and Restoration (Goose Point)	Lacombe	CSRM	CPRA	S: Duplicative of another measure
PO14 Green Point/Goose Point	NB-020	Nature Based	Marsh Creation and Restoration	Lacombe	CSRM	Coastal Wetlands Planning, Protection and Restoration Act, (CWPPRA)	S: Duplicative of another measure
East New Orleans Land Bridge	NB-022	Nature Based	restoration	Lake Pontchartrain	CSRM	Coast 2050 Region 1 Strategy	S: Duplicative of another measure
Old Mandeville Shoreline Protection	NB-025	Nature Based	Shoreline Protection	Mandeville	CSRM	City of Mandeville	S: Duplicative of another measure
Eden Isle PO- 21	NB-038	Nature Based	Shoreline Protection	Slidell	CSRM	CWPPRA	S: Duplicative of another measure
Tchefuncte Shoreline PO 167	NB-039	Nature Based	Shoreline Restoration	Tchefuncte	CSRM	St Tammany Coastal Protection and Restoration	S: Duplicative of another measure
St. Tammany Parish Marsh	NB-046	Nature Based	Marsh Restoration	Parishwide	CSRM	CPRA	S: Duplicative of another measure
Hog Island Restoration	NB-049	Nature Based	Marsh Restoration	Pearl River	CSRM	CWPPRA	S: Duplicative of another measure

Site Specific Management Measure	Measure ID	Category (structural, nonstructural, Nature Based)	Type	Location	Type of Flooding Addressed (CSRM/FRM)	Source	Moved Forward (MF) to Alternatives, Screened (S) with Justification, Does Not Meet (DNM)
LACPRA Planning Unit 1	NB-051	Nature Based; Structural	Shoreline Protection; Marsh Creation (Landbridge)	Slidell	CSRM	USACE	S: Duplicative of another measure
Landbridge	NB-063	Nature Based	Landbridge Restoration	Lake Pontchartrain	CSRM	St Tammany Coastal Protection and Restoration	S: Duplicative of another measure
PO 167 Fritchie Marsh	NB-064	Nature Based	Hydrologic Restoration	Slidell	CSRM	St Tammany Coastal Protection and Restoration	S: Duplicative of another measure
Bayou Chinchuba Plan (Mandeville)	NS-03	Nonstructural	Home Raising	Mandeville	FRM	Southeast Louisiana Urban Flood Damage Reduction Project (SELA) (SELA)	S: Duplicative of another measure
Home Raising	NS-04	Nonstructural	Home Raising	Parishwide	CSRM & FRM	USACE	S: Duplicative of another measure
Unknown Pass to Rigolets-01.SP.101	S-065	Structural	Shoreline Protection	Rigolets	CSRM	CPRA	S: Duplicative of another measure
Northshore Breakwater	S-066	Structural	Breakwaters	Slidell	CSRM	None Known	S: Duplicative of another measure
Northshore Eden Isle PO 167	S-067	Structural	Breakwaters	Slidell	CSRM	St Tammany Coastal Protection and Restoration	S: Duplicative of another measure
Ring Levees	S-068	Structural	Ring Levees	Slidell	CSRM	CPRA	S: Duplicative of another measure
PO-04 North Goose Point	NB-018	Nature Based	Marsh Creation and Restoration	Lacombe	CSRM	CWPPRA	S: Duplicative of another measure
Lake Ponchartrain Breakwaters	S-034	Structural	Offshore Breakwaters; Armored Shorelines; Shoreline Protection	Lake Pontchartrain	FRM	Lake Pontchartrain Basin Foundation	S: Duplicative of another measure captured in location specific breakwaters

Site Specific Management Measure	Measure ID	Category (structural, nonstructural, Nature Based)	Type	Location	Type of Flooding Addressed (CSRM/FRM)	Source	Moved Forward (MF) to Alternatives, Screened (S) with Justification, Does Not Meet (DNM)
Abita Springs Structure Raising	NS-01	Nonstructural	Structure Raising	Abita	FRM	SELA	S: Duplicative of another measure captured in nonstructural
Lacombe	NS-02	Nonstructural	Structure Raising	Lacombe	FRM & CSRM	SELA	S: Duplicative of another measure captured in nonstructural
St Tammany wise	NS-06	Nonstructural	Flood proofing, buyouts, relocations, raising, cluster structures	Parishwide	CSRM & FRM	CPRA	S: Duplicative of another measure captured in nonstructural
West Shoreline Protection	NB-43	Nature Based	Shoreline Protection	West Parish	CSRM	St Tammany Parish	S: Duplicative of another measure captured in Tchefuncte Shoreline Protection
Lake Tension Gate Barrier	S-035	Structural	Floodgate	Lake Pontchartrain	CSRM	None Known	S: Duplicative of another measure included in Surge Barrier Measures
Lake Pontchartrain Shoreline Integrity	NB-023	Nature Based	Maintain Shoreline Integrity	Lake Pontchartrain	CSRM	Coast 2050 Region 1 Strategy	S: Duplicative of another measure included with location specific shoreline measures
Tchefuncte Sub Area	NB-040	Nature Based	Shoreline Protection; Backfill	Tchefuncte	CSRM	Lake Pontchartrain Basin Foundation	S: Duplicative of another measure included with location specific shoreline measures
PO 167 Guste Island Living Shoreline	NB-08	Nature Based	Living Shoreline	Guste Isle	CSRM	St Tammany Coastal Protection and Restoration	S: Duplicative of another measure moved forward with Gust Isle measures
Lake Pontchartrain Surge Reduction Alignment	S-036	Structural	Barrier Wall	Lake Pontchartrain	CSRM	CPRA, USACE	S: Duplicative of another measure moved forward with Lake Pontchartrain Barrier Measures
Lake Pontchartrain	S-037	Structural	Closure Gates; Weirs	Lake Pontchartrain	CSRM	CPRA, USACE	S: Duplicative of another measure moved forward with

Site Specific Management Measure	Measure ID	Category (structural, nonstructural, Nature Based)	Type	Location	Type of Flooding Addressed (CSRM/FRM)	Source	Moved Forward (MF) to Alternatives, Screened (S) with Justification, Does Not Meet (DNM)
							Lake Pontchartrain Barrier Measures
Lake Pontchartrain Surge Reduction Alignment	S-038	Structural	Structures at Bayous & Canals	Lake Pontchartrain	CSRM	CPRA	S: Duplicative of another measure moved forward with Lake Pontchartrain Barrier Measures
Master Plan Nonstructural	NS-05	Nonstructural	Flood proofing, buyouts, relocations, raising, cluster structures	Parishwide	CSRM & FRM	CPRA	S: Duplicative of another measure of nonstructural measures
Faciane Canal	NB-05	Nature Based	Marsh Creation and Restoration	Bayou Bonofuca	FRM & CSRM	St Tammany Parish	S: Duplicative of another measure with Bayou Bonfouca and West Slidell nature based measures
Bayou Vincent Detention Pond	S-016	Structural	Detention Pond	Bayou Vincent	FRM	St Tammany Parish	S: Duplicative of another measure with Ben Thomas Pond
Cane Bayou	NB-06	Nature Based	Marsh Creation	Bayou Cane	CSRM	CWPPRA; St. Tammany Parish	S: Duplicative of another measure with Big Branch restoration
Bayou Lacombe	NB-014	Nature Based	Shoreline protection: living shoreline	Lacombe	CSRM	St Tammany Parish	S: Duplicative of another measure with Lacombe shoreline protection, breakwaters, living shoreline
Buyouts	**NS-08**	**Nonstructural**	**Buyouts**	**Parishwide**	**FRM or CSRM**	**PDT**	**MF**
Flood proofing	**NS-09**	**Nonstructural**	**flood proofing**	**Parishwide**	**FRM or CSRM**	**PDT**	**MF**
Relocations	**NS-010**	**Nonstructural**	**Relocations**	**Parishwide**	**FRM or CSRM**	**PDT**	**MF**
Structure Raising	**NS-011**	**Nonstructural**	**Structure Raising**	**Parishwide**	**FRM or CSRM**	**PDT, CPRA**	**MF**
Maintain East Orleans Land Bridge-Marsh and Shoreline	**NB-024**	**Nature Based**	**Landbridge Restoration**	**Landbridge**	**CSRM**	**CPRA**	**MF**

Site Specific Management Measure	Measure ID	Category (structural, nonstructural, Nature Based)	Type	Location	Type of Flooding Addressed (CSRM/FRM)	Source	Moved Forward (MF) to Alternatives, Screened (S) with Justification, Does Not Meet (DNM)
Pearl river island Marsh Creation	NB-030	Nature Based	Marsh Creation	Pearl River	CSRM	CPRA	MF
Pearl river island shoreline protection	NB-031	Nature Based	Shoreline Protection	Pearl River	CSRM	CPRA	MF
Lake Pontchartrain Barrier (001.HP.08)	S-039	Structural	Flood Gates-Rigolets	Lake Pontchartrain	CSRM	CPRA	MF
Lake Pontchartrain Barrier (001.HP.08)	S-040	Structural	Flood Gates-Chef Menteur	Lake Pontchartrain	CSRM	CPRA	MF
Bayou Lacombe restoration	NB-015	Nature Based	Marsh Creation and cypress restoration	Lacombe	CSRM	Parish	MF
Lacombe shoreline protection, breakwaters, living shoreline	NB-016	Nature Based	Shoreline Protection	Lacombe	CSRM	Parish	MF
Bayou Lacombe LA 434	S-026	Structural	Detention Ponds	Lacombe	FRM	Parish	MF
Big Branch	S-027	Structural	Detention Ponds	Lacombe	FRM	2016 STP Watershed Study	MF
Lacombe Levee-pump station	S-028	Structural	Levee, Flood Wall	Lacombe	CSRM	CPRA	MF
Combined Levee	S-120	Structural	Levees	Lacombe/ West Slidell	CSRM	PDT	MF
Bayou Bonfouca Breakwaters, living shoreline, marsh creation revetments, etc.	NB-03	Nature Based	Shoreline Protection	Bayou Bonfouca	CSRM	USACE	MF
Bayou Bonfouca Regional Detention Pond	S-004	Structural	Detention Ponds	Bayou Bonfouca	FRM	Parish	MF
Bayou Bonfouca	S-005	structural	Channel Improvements	Bayou Bonfouca	FRM	USACE	MF
Camp Salmen	S-006	Structural	Detention Pond	Bayou Bonfouca	FRM	St Tammany Parish	MF

Site Specific Management Measure	Measure ID	Category (structural, nonstructural, Nature Based)	Type	Location	Type of Flooding Addressed (CSRM/FRM)	Source	Moved Forward (MF) to Alternatives, Screened (S) with Justification, Does Not Meet (DNM)
Camp Villere	**S-007**	**Structural**	**Detention Ponds**	**Bayou Bonfouca**	**FRM**	**Parish**	**MF**
Bayou Liberty Snagging and Clearing	**S-010**	**Structural**	**Channel Improvements**	**Bayou Liberty**	**FRM**	**Bayou Liberty Watershed Plan**	**MF**
Belair North	**S-011**	**Structural**	**Detention Ponds**	**Bayou Liberty**	**FRM**	**Parish**	**MF**
Belair South	**S-012**	**Structural**	**Detention Ponds**	**Bayou Liberty**	**FRM**	**Parish**	**MF**
Upper Watershed	**S-013**	**Structural**	**Detention Ponds**	**Bayou Liberty**	**FRM**	**Parish**	**MF**
Bayou Vincent	**S-017**	**Structural**	**Channel Improvements**	**Bayou Vincent**	**FRM**	**Parish**	**MF**
Bayou Patassat	**S-080**	**structural**	**Channel Improvements**	**Slidell**	**FRM**	**USACE SELA**	**MF**
West Slidell Levee, pump station	**S-081**	**structural**	**Levee, Flood Wall**	**Slidell**	**CSRM**	**CPRA**	**MF**
Eden Isle breakwaters, shoreline protection, living shoreline	**NB-033**	**Nature Based**	**Shoreline Protection**	**Slidell**	**CSRM**	**CWPPRA**	**MF**
Eden Isle Levee	**S-070**	**Structural**	**Levee, Flood Wall**	**Slidell**	**CSRM**	**CPRA**	**MF**
Levee West of I-10	S-123	Structural	Levee	Eden Isle, Slidell	CSRM	St Tammany Parish	S: Efficiency criteria;
Levee East of I-10	S-124	Structural	Levee	Eden Isle, Slidell	CSRM	St Tammany Parish	S: Efficiency criteria; space for levee and 1-10 crossing
I-10 Median	S-125	Structural	Floodwall	Eden Isle, Slidell	CSRM	St Tammany Parish	S: Efficiency criteria
Floodwall East of I-10	S-126	Structural	Floodwall	Eden Isle, Slidell	CSRM	STPFS-PDT	S: Efficiency criteria
Eastern Lakefront Floodwall	S-127	Structural	Floodwall	Eden Isle, Slidell	CSRM	STPFS-PDT	S: Efficiency criteria

Site Specific Management Measure	Measure ID	Category (structural, nonstructural, Nature Based)	Type	Location	Type of Flooding Addressed (CSRM/FRM)	Source	Moved Forward (MF) to Alternatives, Screened (S) with Justification, Does Not Meet (DNM)
Levee Berm North Lakeview Drive	S-128	Structural	Levee	Eden Isle, Slidell	CSRM	St Tammany Parish	S: Efficiency criteria
Lake Surge Barrier	S-129	Structural	Surge Barrier	Eden Isle, Slidell	CSRM	St Tammany Parish	S: Efficiency criteria
Eden Isle Seawall with Backfill	S-130	Structural	Seawall	Eden Isle, Slidell	CSRM	STPFS-PDT	S: Efficiency criteria
Highway 11 T-wall Median	S-131	Structural	Floodwall	Eden Isle, Slidell	CSRM	St Tammany Parish	S: Efficiency criteria
Levee West of Railroad to Lake	S-132	Structural	Levee	Eden Isle, Slidell	CSRM	St Tammany Parish	MF
Levee East of Hwy 11	S-133	Structural	Levee	Eden Isle, Slidell	CSRM	St Tammany Parish	S: Could be included in optimization of S-132
Schneider Canal Pump Station Improvements	**S-074**	**Structural**	**Pump Stations**	**Slidell**	**CSRM**	**USACE**	**MF**
South Slidell Levees West of 1-10- would include pumps	**S-075**	**Structural**	**Levee, , Flood Wall**	**Slidell**	**CSRM**	**CPRA, St Tammany Parish USACE**	**MF**
South Slidell Levees East of 1-10- would include pumps	**S-076**	**Structural**	**Levee, Flood Wall**	**Slidell**	**CSRM**	**Slidell**	**MF**
W-14 Pump Station	**S-077**	**Structural**	**Pump Stations**	**Slidell**	**FRM**	**SELA**	**MF**
Fritchie North Marsh Creation	**NB-34**	**Nature Based**	**Marsh Creation**	**Slidell**	**CSRM**	**St Tammany Parish**	**MF**
Levee North of 1-10 along Pearl River- pump station is needed	**S-060**	**Structural**	**Levee, Flood Wall**	**Pearl River**	**FRM**	**USACE**	**MF**
Levee South of 1-10 along Pearl River-	**S-061**	**Structural**	**Levee, Flood Wall**	**Pearl River**	**FRM**	**USACE**	**MF**

Site Specific Management Measure	Measure ID	Category (structural, nonstructural, Nature Based)	Type	Location	Type of Flooding Addressed (CSRM/FRM)	Source	Moved Forward (MF) to Alternatives, Screened (S) with Justification, Does Not Meet (DNM)
pump station is needed							
Doubloon Bayou	S-069	Structural	Channel Improvements	Slidell	FRM	Public	MF
French Branch	S-071	Structural	Channel Improvements	Slidell	FRM	St Tammany Parish	MF
Gum Bayou Diversion	S-072	Structural	Channel Improvements	Slidell	FRM	St Tammany Parish	MF
Poor Boy	S-073	Structural	Channel Improvements	Slidell	FRM	USACE	MF
W-15 Detention Facility	S-078	Structural	Detention Ponds	Slidell	FRM	SELA	MF
W-15 diversion/ lateral	S-079	Structural	Channel Improvements	Slidell	FRM	PDT	MF
W-15 French Branch	S-119	Structural	Channel Improvements	Slidell	FRM	St Tammany Parish	MF
Mile Branch	S-057	Structural	Channel Improvements	Mile Branch, Covington	FRM	USACE SELA	MF
Bridge restrictions new bridge LA 21 and Tchefuncte	S-101	Structural	channel improvements	Tchefuncte	FRM	Public	MF
Diverting water west from the Tchefuncte and then south to Lake Pontchartrain	S-105	Structural	Diversion Channel	Tchefuncte	FRM	USACE	MF
Upper Tchefuncte	S-106	Structural	Detention Ponds	Tchefuncte	FRM	St Tammany Parish	MF
Mile Branch- Lateral A	S-121	Structural	Channel Improvements	Mile Branch, Covington	FRM	USACE, SELA	MF
Mandeville Lakefront Living shoreline	NB-026	Nature Based	Shoreline Protection	Mandeville	CSRM	CPRA	MF
Mandeville Lakefront Wetlands Restoration	NB-027	Nature Based	Shoreline Protection	Mandeville	CSRM	CPRA	MF

Site Specific Management Measure	Measure ID	Category (structural, nonstructural, Nature Based)	Type	Location	Type of Flooding Addressed (CSRM/FRM)	Source	Moved Forward (MF) to Alternatives, Screened (S) with Justification, Does Not Meet (DNM)
Mandeville Seawall Replacement	**S-046**	**Structural**	**Levee, Flood Wall**	**Mandeville**	**CSRM**	**CPRA, STPG**	**MF**
Raise Seawall with Passive Drainage	**S-047**	**Structural**	**Levee Flood Wall**	**Mandeville**	**CSRM**	**CPRA**	**MF**
Raise Seawall with Pump Stations	**S-048**	**Structural**	**Levee, Flood Wall**	**Mandeville**	**CSRM**	**CPRA**	**MF**
Mandeville Flood Barrier/ Floodwall	**S-118**	**Structural**	**Flood Barrier**	**Mandeville**	**FRM**	**USACE**	**MF**
Mandeville Seawall 18 ft. (100 year)	**S-122**	**Structural**	**Levee, Flood Wall**	**Mandeville**	**CSRM**	**USACE**	**MF**
Bayou Chinchuba	**S-045**	**Structural**	**Channel Improvements**	**Mandeville**	**FRM**	**SELA**	**MF**
Abita River Diversion Channel to Lake	**S-001**	**Structural**	**Channel Improvements**	**Abita**	**FRM**	**PDT**	**MF**
Bush Levee Alignment	**S-019**	**Structural**	**Levee, Flood Wall**	**Bogue Chitto**	**FRM**	**PDT**	**MF**
Sun Levee Alignment	**S-020**	**Structural**	**Levee, Flood Wall**	**Bogue Chitto**	**FRM**	**USACE**	**MF**
Lower Tchefuncte Shoreline Protection	**NB-041**	**Nature Based**	**Shoreline Protection**	**Tchefuncte**	**CSRM**	**CWPPRA**	**MF**
Lower Tchefuncte Marsh Creation	**NB-042**	**Nature Based**	**Marsh Creation**	**Tchefuncte**	**CSRM**	**CWPPRA**	**MF**
Tchefuncte and West St. Tammany Shoreline Restoration	**NB-044**	**Nature Based**	**Shoreline Protection**	**West Parish**	**CSRM**	**CPRA**	**MF**
Big Branch (BBMNWR); Fontainebleau State Park	NB-017	Nature Based	Dredging and Marsh restoration and creation	Lacombe	CSRM	Lake Pontchartrain Basin Foundation	S: DNM study objectives
White Kitchen Preserve	NB-035	Nature Based	Restoration	Slidell	CSRM	Nature Conservancy	S: DNM study objectives
Tchefuncte River/ Madisonville Lighthouse	S-102	Structural	Breakwaters	Tchefuncte	CSRM	Lake Pontchartrain Basin Foundation	S: DNM study objectives
Bayou Lacombe	NS-07	Non-Structural	Dredging, Navigation	Lacombe		USACE	S: Authorized under another USACE project

Site Specific Management Measure	Measure ID	Category (structural, nonstructural, Nature Based)	Type	Location	Type of Flooding Addressed (CSRM/FRM)	Source	Moved Forward (MF) to Alternatives, Screened (S) with Justification, Does Not Meet (DNM)
Tchefuncte River/ Bogue Falaya	S-103	Structural	Dredging, Navigation	Tchefuncte	FRM	St Tammany Parish	S: Already Authorized Project
Tchefuncte River/Bogue Falaya	S-113	Structural	Channel Improvements	Tchefuncte	FRM & CSRM	USACE O&M	S: Already Authorized Project
Schneider Canal	S-083	Structural	Levee; Floodwall	Slidell	CSRM	USACE SELA	S: Authorized; alternate alignment moved forward
East Fork Little Bogue Falaya	S-021	Structural	Detention Pond	Bogue Falaya	FRM	2020 St Tammany Parish Watershed Study	S: Based on available storage capacity
Parish Wide	S-058	Structural	Drainage Improvements	Parishwide	FRM& CSRM	NRCS, STPG, Coast Guard, FEMA	S: Captured in other specific measures
Talisheek Pine Wetlands Preserve	NB-01	Nature Based	Restoration	Abita	FRM	Nature Conservancy	S: Constructed
Abita Creek Flatwoods Preserve	NB-02	Nature Based	Restoration	Abita	FRM	Nature Conservancy	S: Constructed
PO-48 Green Property Preservation	NB-054	Land Acquisition	Preservation of ~22 acres near Lacombe	Lacombe	CSRM	Coastal Impact Assistance Program (CIAP);; LA Recovery Authority	S: Constructed
Big Branch; BBMNWR	NB-057	Land Acquisition	6,000 acres of lands	Lacombe	CSRM	Lake Pontchartrain Basin Foundation	S: Constructed
W STP at Lake Pontchartrain	NB-059	Land Acquisition	West STP Coastal Wetland Habitat Purchase	West Parish	CSRM	Lake Pontchartrain Basin Foundation	S: Constructed
Tammany Trace Detention Ponds	S-051	Structural	Detention Ponds	Mandeville	FRM	St Tammany Parish	S: Constructed
City of Slidell (W15; Eastwood; Markhalm/Peachtree)	S-084	Structural	Channel Improvements	Slidell	FRM	FEMA	S: Constructed
S Slidell PO 89	S-085	Structural	Levee Improvements	Slidell	CSRM	CWPPRA;	S: Constructed
Bayou Bonfouca; Northshore Beach	NB-04	Nature Based	Marsh Creation and Restoration	Bayou Bonfuca	CSRM	Lake Pontchartrain Basin Foundation; CIAP; St Tammany Parish	S: Constructed

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Fritchie Marsh	NB-036	Nature Based	marsh creation	Slidell	CSRM	CIAP; St Tammany Parish	S: Constructed
Fritchie North PO 172	NB-037	Nature Based	Marsh Creation & Terracing	Slidell	CSRM	CWPPRA	S: Constructed
Fritchie North Marsh Creation	NB-050	Nature Based	Marsh Creation & Terracing	Slidell	CSRM	CWPPRA; NMFS; STPG	S: Constructed
Abita Detention Pond	S-002	Structural	Detention Ponds	Abita	FRM	St Tammany Parish	S: Constructed
Abita River	S-003	Structural	Detention Pond	Abita	FRM	St. Tammany Parish	S: Constructed
Huntwyck Village	S-018	Structural	Detention Pond	Bayou Vincent	FRM	St. Tammany Parish	S: Constructed
Graci Drive & Briar Lakes Detention Pond	S-031	Structural	Detention Pond	Lacombe	FRM	St. Tammany Parish	S: Constructed
Bayou Castine	S-049	Structural	Detention Pond; Channel Improvements	Mandeville	FRM	St Tammany Parish	S: Constructed
Riverwood Subdivision & Country Club Estates	S-062	Structural	Detention Pond & Drainage Improvements	Ponchitalawa	FRM	St Tammany Parish	S: Constructed
Lake Village Area Slidell	S-086	Structural	Drainage Improvements	Slidell	FRM	St. Tammany Parish	S: Constructed
Robert Road	S-087	Structural	Detention Pond	Slidell	FRM	2024 St Tammany Parish Watershed Study	S: Constructed
Quail Creek/Hidden Pines	S-107	Structural	Detention Pond	Bayou Castine	FRM	St Tammany Parish	S: Constructed
PO-07 Big Branch	NB-045	Nature Based	Cypress Plantings	Lacombe	CSRM	CWPPRA; Nature Conservancy	S: Constructed; duplicative
Cane Bayou; Tammany Trace	NB-052	Land Acquisition	Conservation of natural forest	Bayou Cane	CSRM & FRM	Lake Pontchartrain Basin Foundation	S: DNM study objectives
Big Branch; Expand BBMNWR	NB-055	Land Acquisition	Expand BBMNWR North of current boundary	Lacombe	CSRM	Lake Pontchartrain Basin Foundation	S: DNM study objectives
Green Property Preservation Study	NB-056	Land Acquisition	purchase 27.2 acres cypress swamp and	Lacombe	CSRM	Lake Pontchartrain Basin Foundation	S: DNM study objectives

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			bottomland hardwood (BLH)				
Big Branch; BBMNWR	NB-61	Restoration	Restore pine Flatwoods and savannahs.	Lacombe	CSRM	Lake Pontchartrain Basin Foundation	S: DNM study objectives
Big Branch; BBMNWR	NB-062	Restoration	Prescribed Burning; restoration around ponds	Lacombe	CSRM	Lake Pontchartrain Basin Foundation	S: DNM study objectives
Tammany Trace Bridge Improvements	S-088	Structural	Channel Improvements	Slidell	FRM	St Tammany Parish 2012 Study	S: DNM study objectives
Brewster Road	S-041	Structural	Detention Pond	Madisonville	FRM	St Tammany Parish	S: DNM study objectives; effectiveness
Guste Isle	NB-09	Nature Based	Restoration of Natural Drainage	Guste Isle	CSRM	Lake Pontchartrain Basin Foundation	S: Does not meet objectives
Guste Island purchase	NB-053	Land Acquisition	Incorporate Guste Isle into BBMNWR	Guste Isle	CSRM	Lake Pontchartrain Basin Foundation	S: Does not meet objectives
LA 30; Lake Pontchartrain	S-109	Structural	Debris Removal	Lake Pontchartrain	CSRM	FEMA	S: Does not meet objectives
Northwood Drive/ W15 canal	S-112	Structural	Channel Improvements	Slidell	FRM & CSRM	St Tammany Parish	S: Duplicative
Bayou Chinchuba	S-114	Structure	Detention Pond	Mandeville	FRM	St Tammany Parish	S: Duplicative of another measure
W15 canal	S-089	Structural	Channel Improvements	Slidell	FRM	St Tammany Parish	S: Duplicative (SELA)
PO-09 NW Lake Pontchartrain Shoreline Protection	S-104	Structural	Breakwaters	Tchefuncte	CSRM	CWPPRA; NRCS; CPRA	S: Duplicative included in measures lower Tchefuncte
Tributary 1 to Cypress Bayou	S-108	Structural	Detention Pond	Lacombe	FRM	St Tammany Parish	S: Duplicative to Constructed Project
W14 W Diversion	S-090	Structural	Detention Pond	Slidell	FRM	St Tammany Parish Watershed Study	S: Duplicative of another measure: Constructed
Cypress Bayou	S-032	Structural	Detention Pond	Lacombe	FRM	St Tammany Parish	S: Duplicative of another measure; local drainage

Site Specific Management Measure	Measure ID	Category (structural, nonstructural, Nature Based)	Type	Location	Type of Flooding Addressed (CSRM/FRM)	Source	Moved Forward (MF) to Alternatives, Screened (S) with Justification, Does Not Meet (DNM)
S of North Blvd, Slidell	S-091	Structural	Detention Pond	Slidell	FRM	St. Tammany Parish	S: Duplicative of another measure; W14 W Diversion
Hog Island Restoration	NB-048	Nature Based	Plantings; Restoration	Peal River	CSRM	St Tammany Parish	S: Effectiveness in meeting study objectives
Bayou de Zaire (Myrtle Grove)	S-043	Structural	Channel improvements/ Detention Pond	Madisonville	FRM &CSRM	St Tammany Parish	S: Effectiveness: Not recommended in previous study
Invisible Floodwall Mandeville Lakefront	S-052	Structural	Floodwall	Mandeville	CSRM	Public	S: Efficiency in meeting study objectives
PO 0184 Levee	S-117	Structural	Levee	Slidell	CSRM	CPRA	S: In design; S: Duplicative of another measure
Guste Isle	NB-11	Nature Based	Marsh Creation	Guste Isle	CSRM	Lake Pontchartrain Basin Foundation: CWPPRA: CPRA: St Tammany Parish	S: Incorporated into West STP/lower Tchefuncte nature based shoreline protection measure to move forward.
Guste Isle	NB-12	Nature Based	Restore Cypress Shoreline; Breakwaters	Guste Isle	CSRM	Lake Pontchartrain Basin Foundation	S: Incorporated into West STP/lower Tchefuncte nature-based shoreline protection measure to move forward.
J Smith Pond	S-092	Structural	Detention Pond	Slidell	FRM	St Tammany Parish	S: Limited Information; Local Drainage
Storage Facility North of Cane Bayou Estates	S-008	Structural	Detention Pond	Bayou Cane	FRM	St Tammany Parish	S: local drainage
New Canaan Hills	S-009	Structural	Detention Pond; Channel Improvements	Bayou Castine	FRM	St Tammany Parish	S: local drainage
Drainage Connector to I 12 (Bayou Pacquet)	S-014	Structural	Channel Improvements	Bayou Pacquet	FRM	St Tammany Parish	S: Local Drainage
Century Oaks	S-015	Structural	Detention Pond	Bayou Tete L'Ours	FRM	St Tammany Parish	S: Local Drainage
LA Tice Branch	S-023	Structural	Detention Pond	Covington	FRM	2019 St Tammany Parish Watershed Study	S: Local Drainage
S I12/W HWY 1077	S-024	Structural	Detention Pond	Covington	FRM	St Tammany Parish	S: Local drainage

Site Specific Management Measure	Measure ID	Category (structural, nonstructural, Nature Based)	Type	Location	Type of Flooding Addressed (CSRM/FRM)	Source	Moved Forward (MF) to Alternatives, Screened (S) with Justification, Does Not Meet (DNM)
Cloverland Acres Channel relocation & Storage	S-029	Structural	Conveyance Channel; Detention Pond	Lacombe	FRM	St. Tammany Parish	S: Local drainage
N Cloverland Acres	S-030	Structural	Detention Pond	Lacombe	FRM	St Tammany Parish	S: Local Drainage
Cypress Bayou Intermediate Pond	S-033	Structural	Detention Pond	Lacombe	FRM	St. Tammany Parish	S: Local drainage
Dominion; Ruelle de Chenne	S-042	Structural	Channel Improvements/ Detention Pond	Madisonville	FRM	St. Tammany Parish	S: Local Drainage
N Perriloux Rd (Fox Branch Pond)	S-044	Structural	Detention Pond	Madisonville	FRM	St. Tammany Parish	S: Local drainage
Westwood Regional Detention Pond	S-054	Structural	Detention Pond	Mandeville	FRM	St Tammany Parish (Watershed Initiative)	S: Local drainage
Woodlands & LBC HMGP Project	S-055	Structural	Detention Pond	Mandeville	FRM	St Tammany Parish	S: Local drainage
Controls at Lakes (Greenleaves)	S-056	Structural	Control Structures	Mandeville	FRM	St Tammany Parish	S: Local drainage
Western STP	S-059	Structural	Channel Improvements	Parishwide	FRM	St Tammany Parish	S: Local Drainage
Crestwood outfall to Harold Park	S-063	Structural	Dry Detention Pond	Ponchitalawa	FRM	St. Tammany Parish	S: Local drainage
Soell St Area	S-064	Structural	Raise Mire Dr	Ponchitalawa	FRM & CSRM	St. Tammany Parish	S: Local Drainage
Cherrywood Subdivision (Slidell)	S-093	Structural	Detention Pond	Slidell	FRM	St Tammany Parish	S: Local drainage
Extend Lowe Pond Canal	S-094	Structural	Channel Improvements	Slidell	FRM	St Tammany Parish	S: Local Drainage
Haas RD Pond	S-095	Structural	Detention Pond	Slidell	FRM	St Tammany Parish	S: Local Drainage
Lakewood Subdivision Channel Improvements & Storage	S-096	Structural	Channel Improvements & Detention Pond	Slidell	FRM	St Tammany Parish	S: Local Drainage
N Forest Subdivision; Queens Property	S-097	Structural	Drainage Improvements	Slidell	FRM	St Tammany Parish	S: Local Drainage
Revere Road	S-110	Structural	Detention Pond	Madisonville	FRM	St. Tammany Parish	S: Local drainage

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Harrison Avenue Singing River Subdivision	S-115	Structural	Drainage Improvements	Abita	FRM	St. Tammany Parish	S: Local Drainage
Lynnwood Drive	S-116	Structural	Conveyance Channel	Lacombe	FRM	St. Tammany Parish	S: Local Drainage
N Forest Brook, Pine View Heights Farm	S-082	Structural	Detention Pond	Slidell	FRM	St. Tammany Parish	S: Local Drainage)
Venchy Branch	S-025	Structural	Detention Pond	Covington	FRM	2023 St Tammany Parish Watershed Study	S: Local Drainage/ Development
Pawns LN	S-098	Structural	Channel Improvements (Concrete Lining)	Slidell	FRM	St Tammany Parish	S: Localized benefits
Sludge Pond	S-099	Structural	Sludge Pond	Slidell	FRM	SELA	S: Mitigation Project
LA-39 Coastwide	NB-028	Nature Based	Plantings	Parishwide	CSRM	CWPPRA; CPRA; NRCS	S: Ongoing Construction
Charter Oak Preserve	NB-032	Nature Based	Marsh Restoration	Pearl River	CSRM	Nature Conservancy	S: Ongoing Construction
National Resource Conservation Service (NRCS) Vegetative Plantings	NB-047	Nature Based	Restoration Plantings	Parishwide	CSRM	CPRA; NCRS; LA State Program	S: Ongoing Construction
LA-13 Coastal Forest Conservation Initiative	NB-058	Land Acquisition	Coast Forest Initiative	Parishwide	CSRM	CIAP; BOEMRE	S: Ongoing Construction
Goose Point	NB-021	Nature Based	Vegetative Plantings; Restoration	Lacombe	CSRM	St Tammany Parish	S: Ongoing Construction
Lake Ramsey Preserve	NB-07	Nature Based	Marsh Creation and Restoration	Covington	FRM	Nature Conservancy; LDWF	S: Ongoing project
Mandeville Hurricane Risk Reduction	S-053	Structural	Levee	Mandeville	FRM	SELA	S: Public Acceptability/ Sponsor Support
NRCS Biomass Production Program (Coastwide)	NB-060	Research; Nature Based	Restoration Research	Parishwide	CSRM	CPRA; NCRS; LA State Program	S: Research

Site Specific Management Measure	**Measure ID**	**Category (structural, nonstructural, Nature Based)**	**Type**	**Location**	**Type of Flooding Addressed (CSRM/FRM)**	**Source**	**Moved Forward (MF) to Alternatives, Screened (S) with Justification, Does Not Meet (DNM)**
LA-16 Shoreline Protection Demonstration	NB-029	Nature Based	Shoreline Protection (Research on non-rock)	Parishwide	CSRM	CWPPRA; NCRS	S: Research: DNM study objectives
Fairway Drive E Detention	S-050	Structural	Detention Pond	Mandeville	FRM	St Tammany Parish	S: Similar Project Constructed
Little Bogue Falaya	S-022	Structural	Detention Pond	Bogue Falaya	FRM	2021 STP Watershed Study	S: Local Benefits only
Mayhaw Branch Detention	S-111	Structural	Detention Pond	Mandeville	FRM	St Tammany Parish	S: Unknown location
W13, W14, W15 Canals Slidell	S-100	Structural	Channel Improvements, Detention Pond expansion, Culverts, Pump station	Slidell	FRM	SELA	S: W-14 authorized and W-13 and W-15 duplicative of other measures

Measures used to develop the Initial Array of Alternatives and shown in bold

Section 2

Formulation of Alternatives

The remaining initial 61 site-specific management measures, denoted in bold in Table B:1-3, were identified and used to develop the initial alternative plans. Because the study area has separate gravity drainage basins based on USGS hydrologic sub-basins, alternative plans were developed separately for each distinct drainage area. The distinct drainage areas were evaluated independently to determine the measures and alternatives that were incrementally justified. In areas where multiple causes for flooding are documented, measures to reduce the risk from the multiple sources were included in an alternative. Alternatives and measures from the different drainage areas or sub-basins were not compared to each other at this point in the study process. The justified measures from the alternatives if the entire alternatives were then combined into a comprehensive alternative that reduces flood risk to multiple parts of the study area as the study moved through the plan formulation process toward the TSP.

This section provides information on the development and screening of the Initial Array of Alternatives and the Focused Array of Alternatives. Also provided is supplementary information on the Final Array of Alternatives that are included in the Report in Section 4 of the main report.

2.1 INITIAL ARRAY OF ALTERNATIVE PLANS

Thirteen (13) initial alternatives were assembled by combining the remaining 61 management measures by geographic area/hydrologic sub-units. Alternatives were developed for each of the following areas: Lacombe, Mandeville Lakefront, Bayou Chinchuba, Abita, Bogue Chitto, Lower Tchefuncte, Upper Tchefuncte, Eastern Slidell, South Slidell, Bayou Liberty, Bayou Bonfouca Bayou Vincent and Lake Pontchartrain Surge. In some areas the such as Bayou Liberty, Bayou Bonfouca and Bayou Vincent the drainage areas and hydraulic influence overlap and these areas were looked at in combination with adjacent areas. In addition to these areas, nonstructural measures were considered across the study area along with a no action plan alternative. The separate alternatives were developed by combining all measures related to a given area or source of flooding into a geographic based alternative. The evaluation of alternatives was done by assessing each area and source of flooding separately and were not compared to each other or flood source type. For example, an alternative to address flooding along the Mandeville Lakefront was evaluated and screened separately from the alternative that looked at measures in the north eastern part of the parish to address flooding from the Bogue Chitto River.

Figure B:2-1 and Table B:2-1 provides an overview of the measures included in the Initial Array of Alternatives. Figures B:2-2 to Figure B:2-13 show each alternative considered in the initial array. Table B: 2-2 provides screening notes on the Initial Array of Alternatives and what alternatives were not carried forward to the Focused Array of Alternatives.

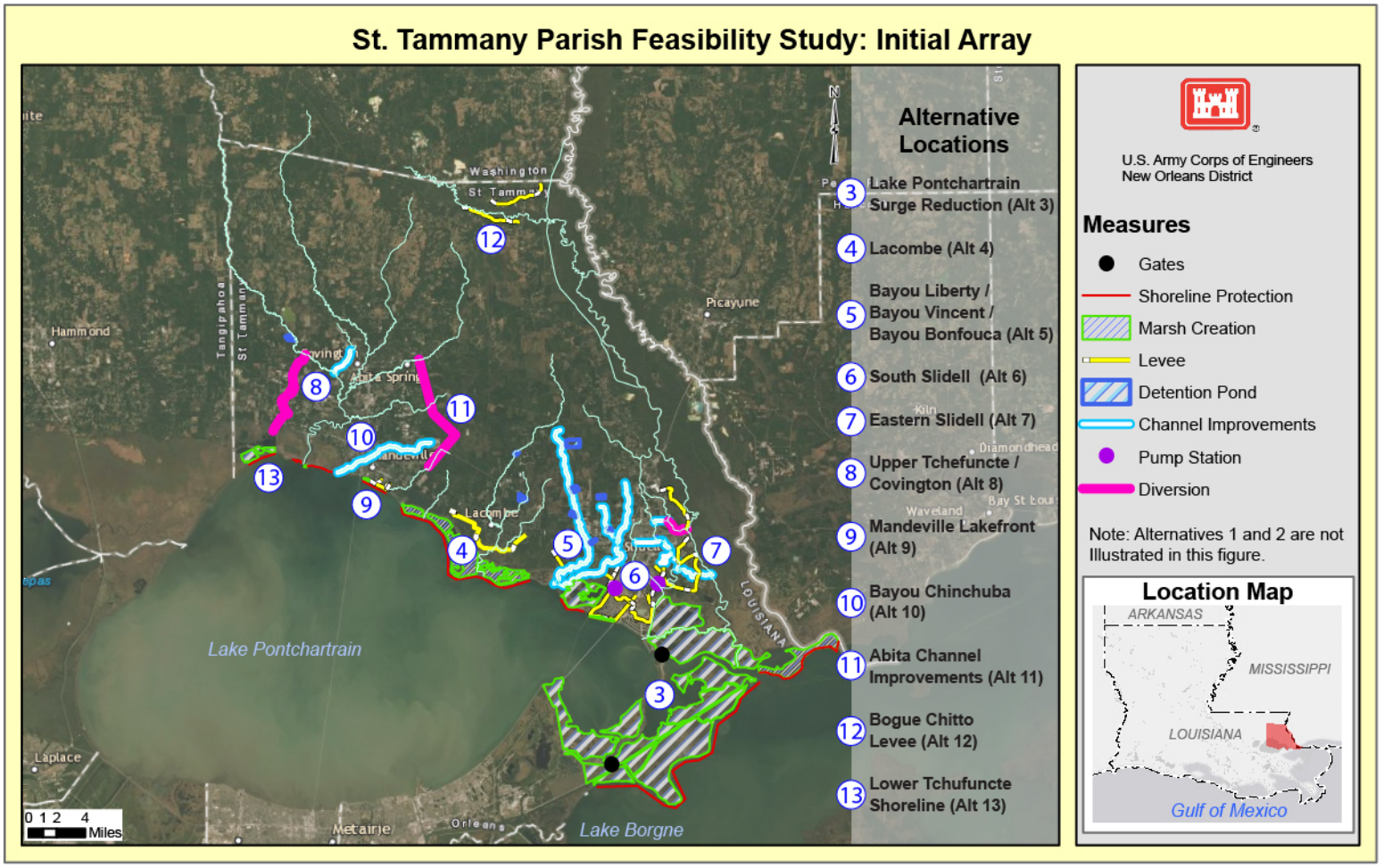

Figure B:2-1. Initial Array of Alternatives (Alternative 1 and Alternative 2 are not depicted on the map)

Table B:2-1. Initial Array of Alternatives (Bolded superscript denotes subbasins with expected flood risk reduction)

	Alternative Name	**Management Measures**								
		Detention ponds	*Channel / restriction improve*	*Diversion channel*	*Pump stations*	*Levee, floodwall, seawall*	*Flood gates*	*Shoreline protection breakwater*	*Marsh creation*	*Non structural*
		FRM	*FRM/ CSRM*	*FRM*	*FRM/ CSRM*	*FRM/ CSRM*	*CSRM*	*CSRM*	*CSRM*	*FRM/ CSRM*
1	*No Action* **Parish-wide**									
2	*Nonstructural* **Parish-wide**									*NS-008, NS-009, NS-010, NS-011*
3	*Lake Pontchartrain Surge Reduction* **1, 2, 8, 18, 22, 23, 25, 30, 35**					*S-039, S-040*	*S-039, S-040*	*NB-024, NB-031*	*NB-024, NB-030*	*NS-008, NS-009, NS-010, NS-011*
4	*Lacombe* **18**	*S-026, S-027*			*S-028,*	*S-028,*	*S-028,*	*NB-016*	*NB-015*	*NS-008, NS-009, NS-010, NS-011*
5	*Bayou Liberty/Bayou Vincent/Bayou Bonfouca* **1 & 35**	*S-004, S-006, S-007, S-011, S-012, S-13*	*S-005, S-017, S-010,*		*S-80, , S-81*	*S-80, S-081,*	*S-80, S-081*	*NB-003*	*NB-003*	*NS-008, NS-009, NS-010, NS-011*
6	*South Slidell* **1 & 23**				*S-74, S-075, S-076, S-077*	*S-70, S-075, S-076*	*S-70, S-075, S-076*	*NB-33*		*NS-008, NS-009, NS-010, NS-011*
7	*Eastern Slidell* **1, 13, 17, 23**	*S-078*	*S-069, S-071, S-073, S-119*	*S-072, S-079*	*S-060, S-061*	*S-060, S-061*	*S-060, S-061*		*NB-34*	*NS-008, NS-009, NS-010, NS-011*

	Alternative Name	Management Measures								
		Detention ponds	Channel / restriction improve	Diversion channel	Pump stations	Levee, floodwall, seawall	Flood gates	Shoreline protection breakwater	Marsh creation	Non structural
8	Upper Tchefuncte/Covington [2, 10, 31]	S-106	S-057, S-101, S-121	S-105						NS-008, NS-009, NS-010, NS-011
9	Mandeville Lakefront [8]				S-048	S-046, S-118,	S-047	NB-026	NB-027	NS-008, NS-009, NS-010, NS-011
10	Bayou Chinchuba [30]		S-045							NS-008, NS-009, NS-010, NS-011
11	Abita Channel Improvements [2, 24, 31]			S-001						NS-008, NS-009, NS-010, NS-011
12	Bogue Chitto Levee [6]				S-019, S-020	S-019, S-020	S-019, S-020			NS-008, NS-009, NS-010, NS-011
13	Lower Tchefuncte Shoreline [2,22]							NB-041, NB-044	NB-042	NS-008, NS-009, NS-010, NS-011

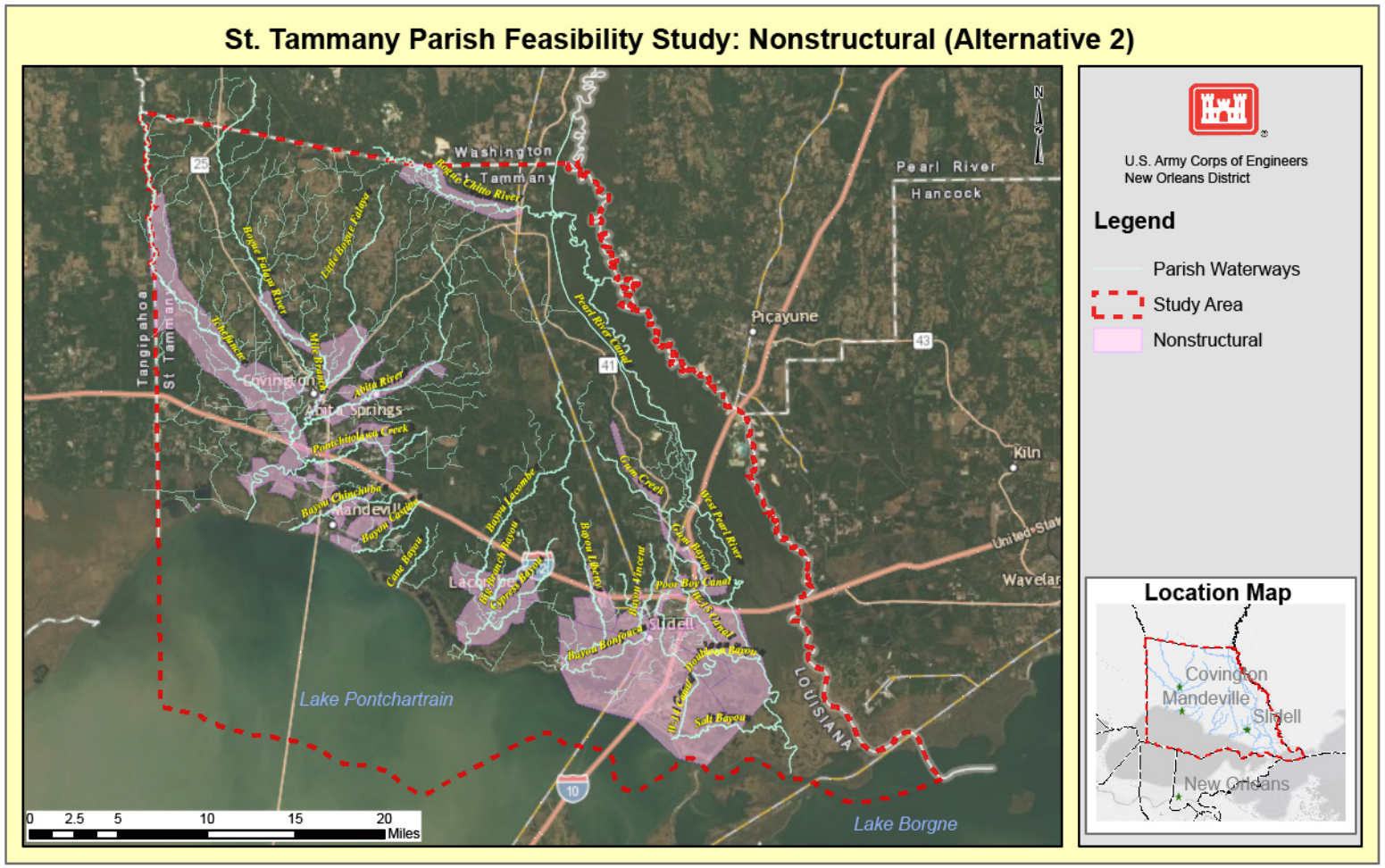

Figure B:2-2. Alternative 2- Nonstructural

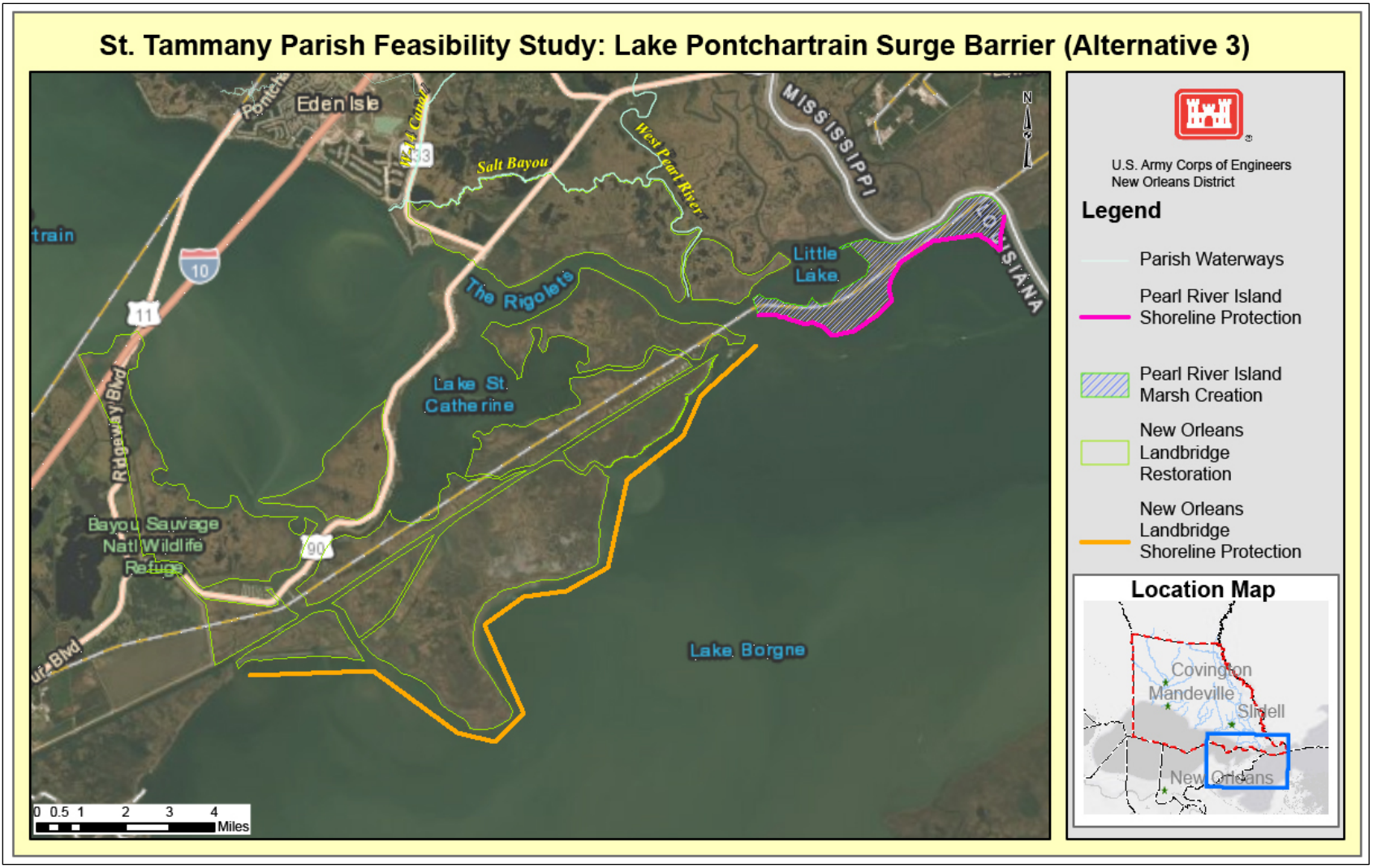

Figure B: 2-3. Alternative 3- Lake Pontchartrain Surge Barrier

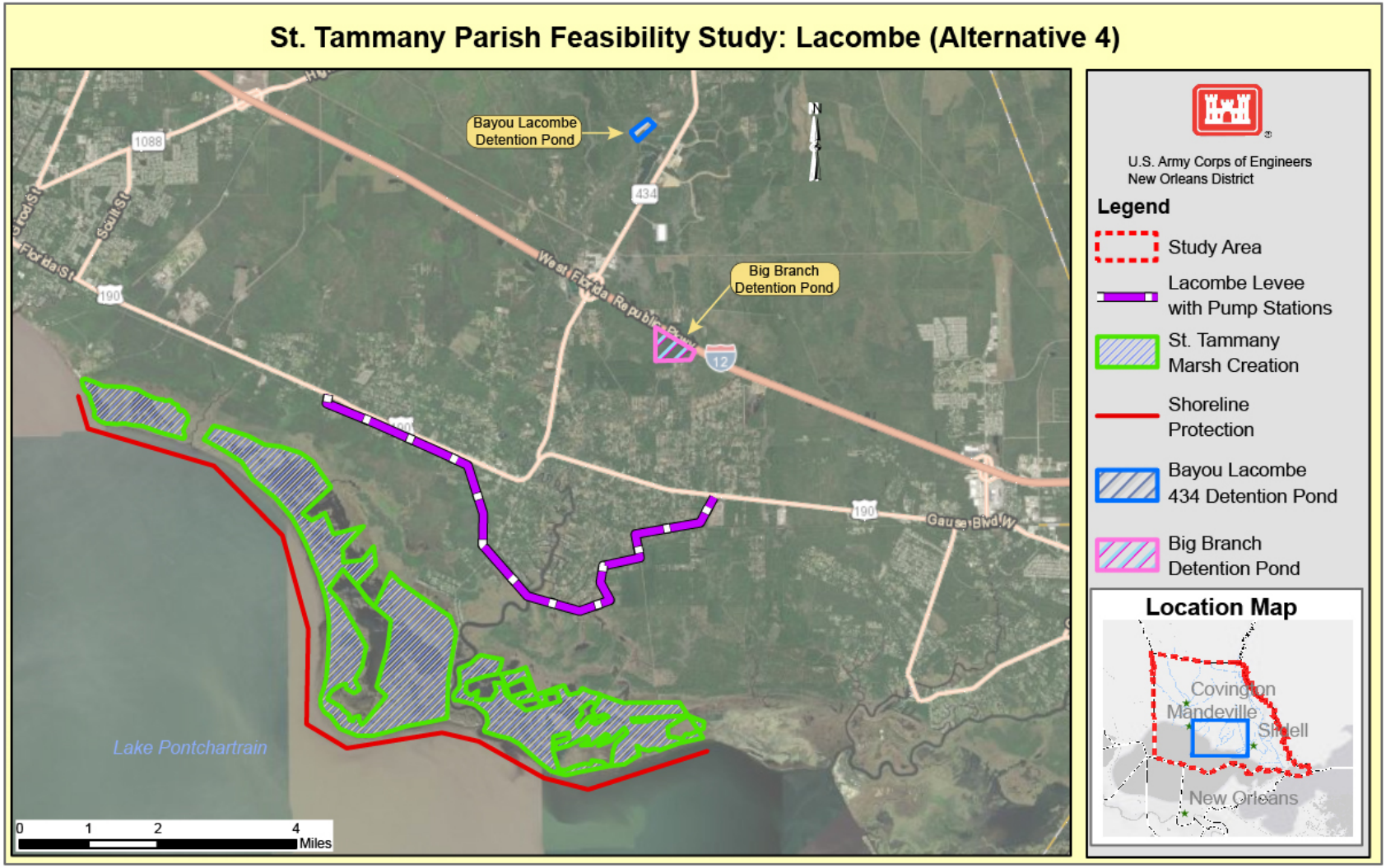

Figure B: 2-4. Alternative 4- Lacombe

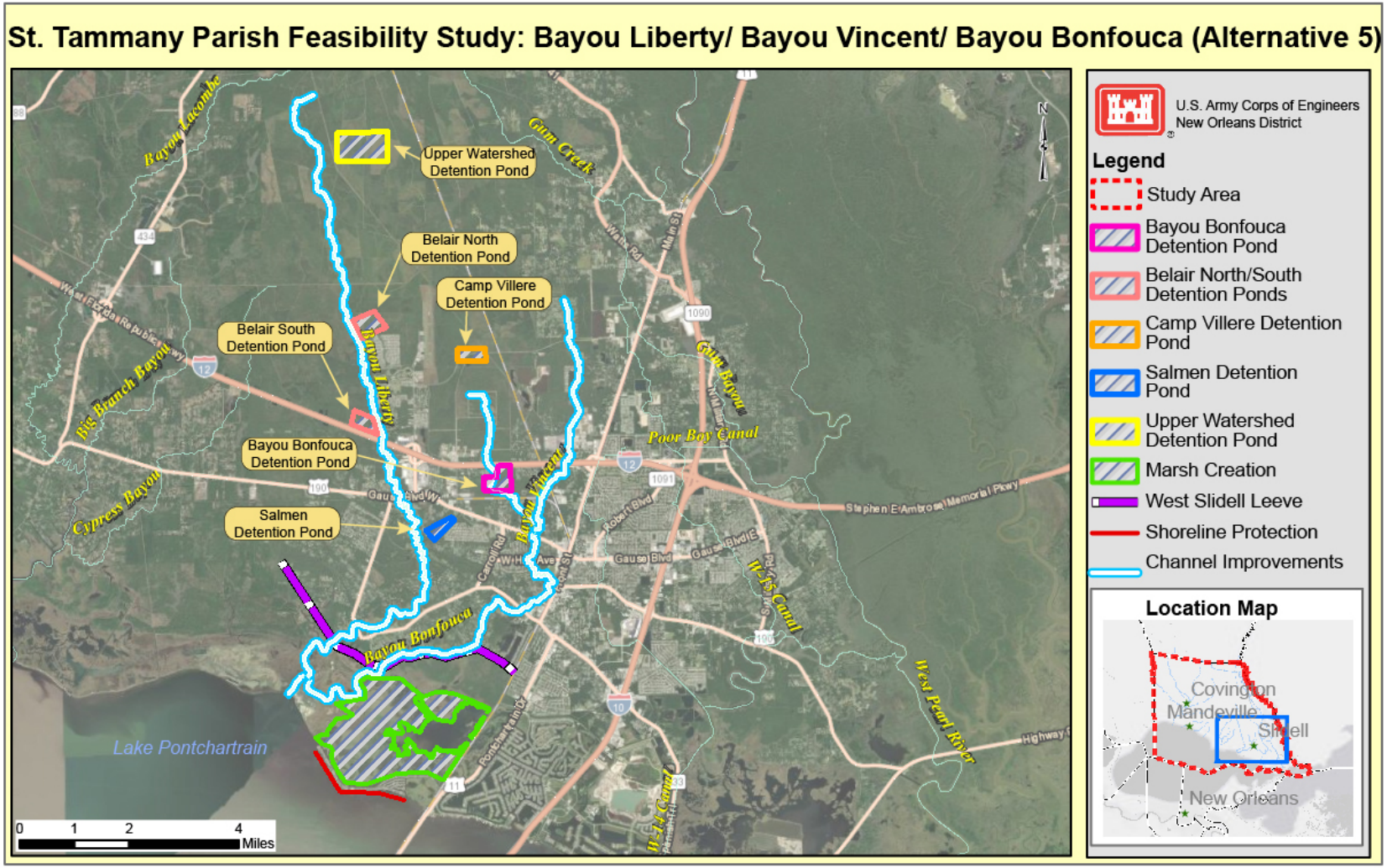

Figure B: 2-5. Alternative 5- Bayou Vincent/ Bayou Liberty/ Bayou Bonfouca

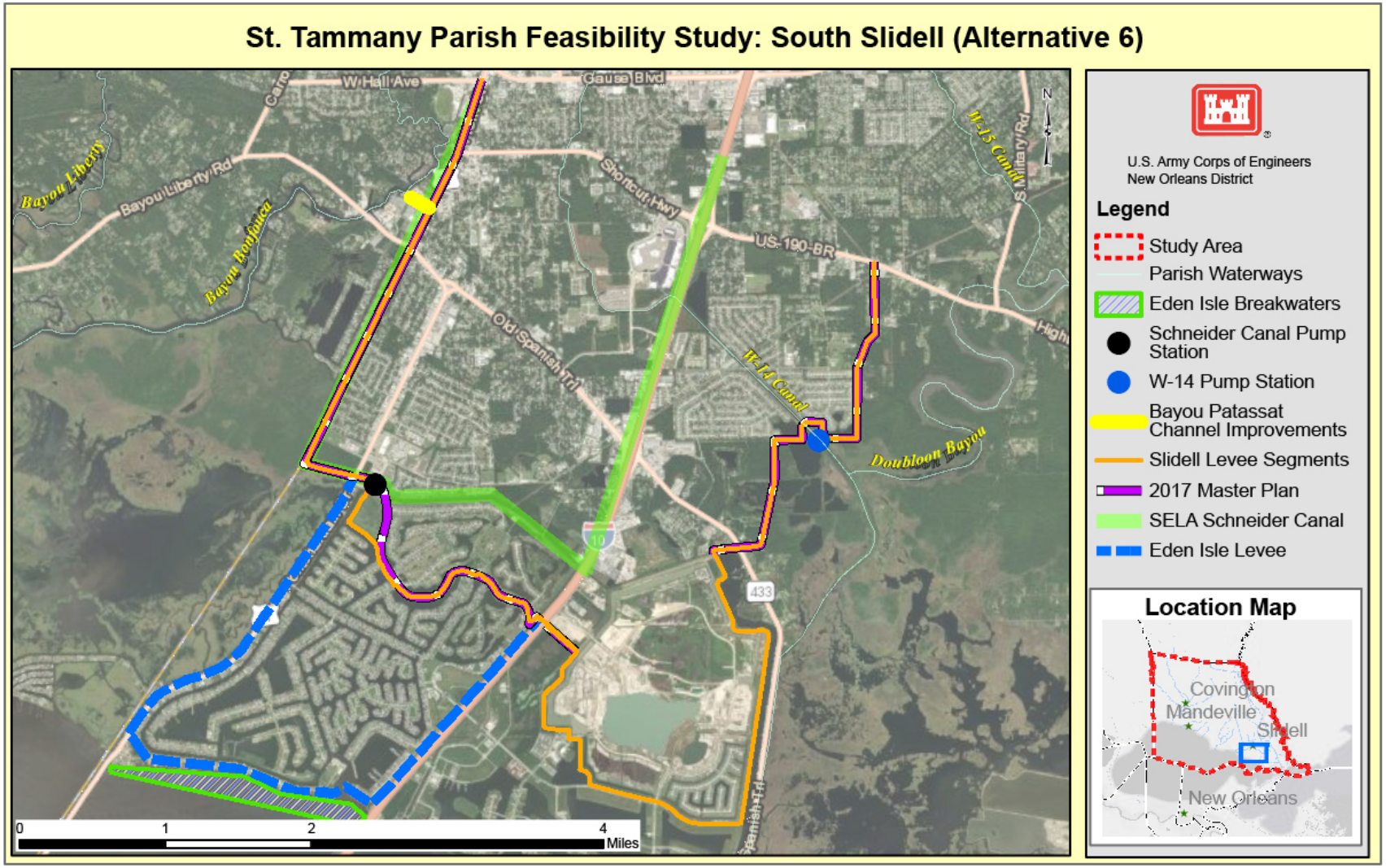

Figure B:2-6. Alternative 6- South Slidell

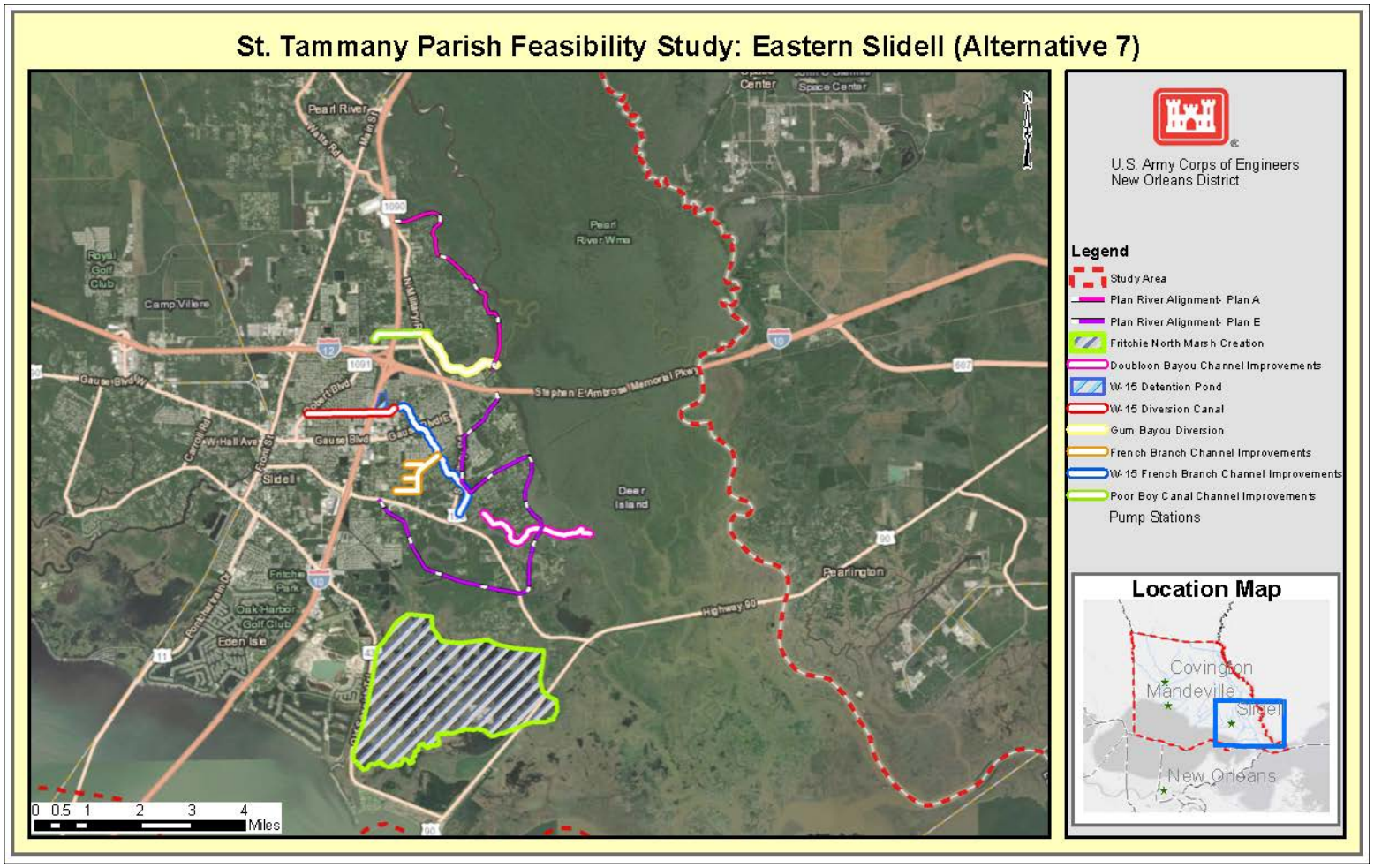

Figure B:2-7. Alternative 7- Eastern Slidell

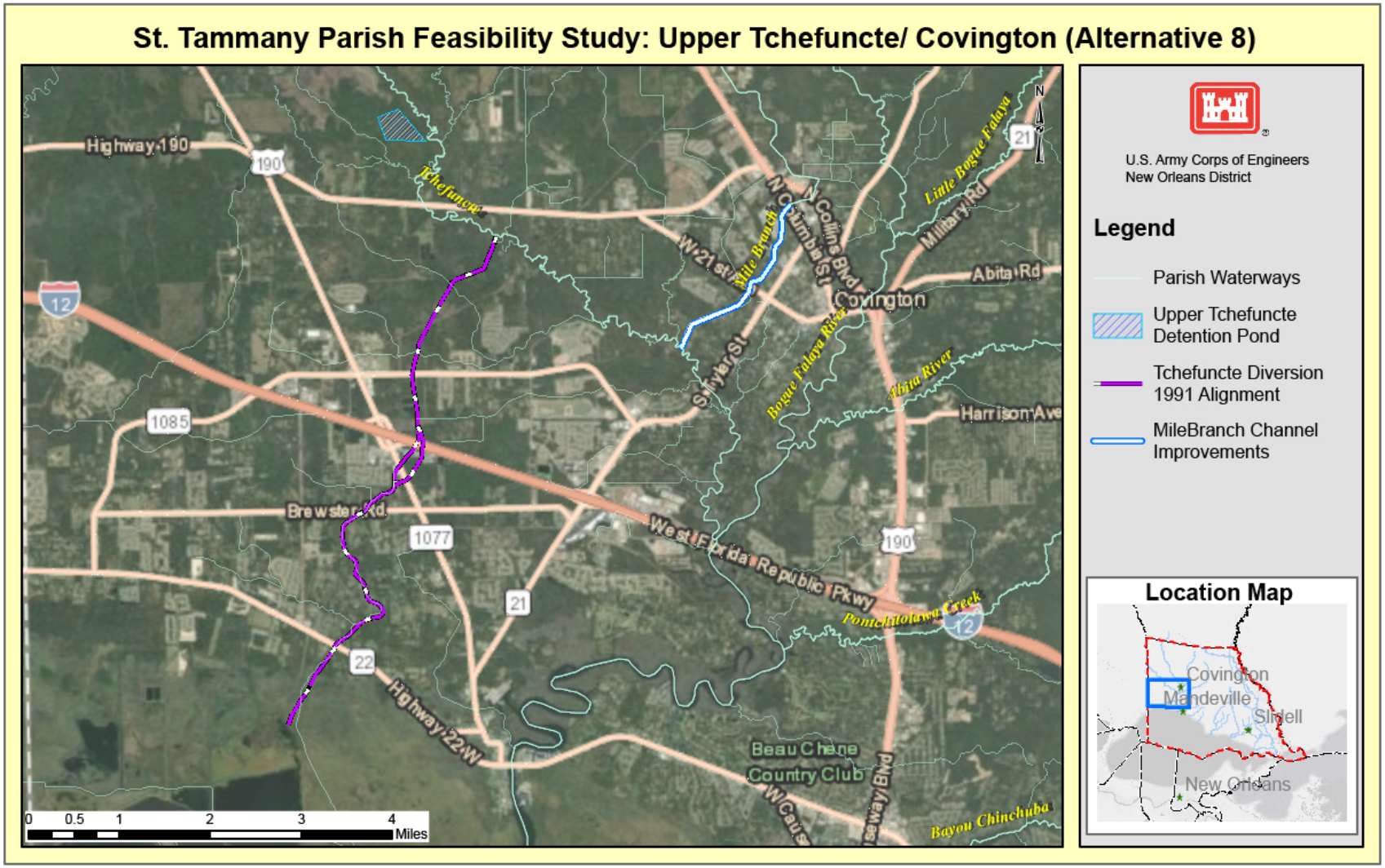

Figure B:2-8. Alternative 8- Upper Tchefuncte/Covington

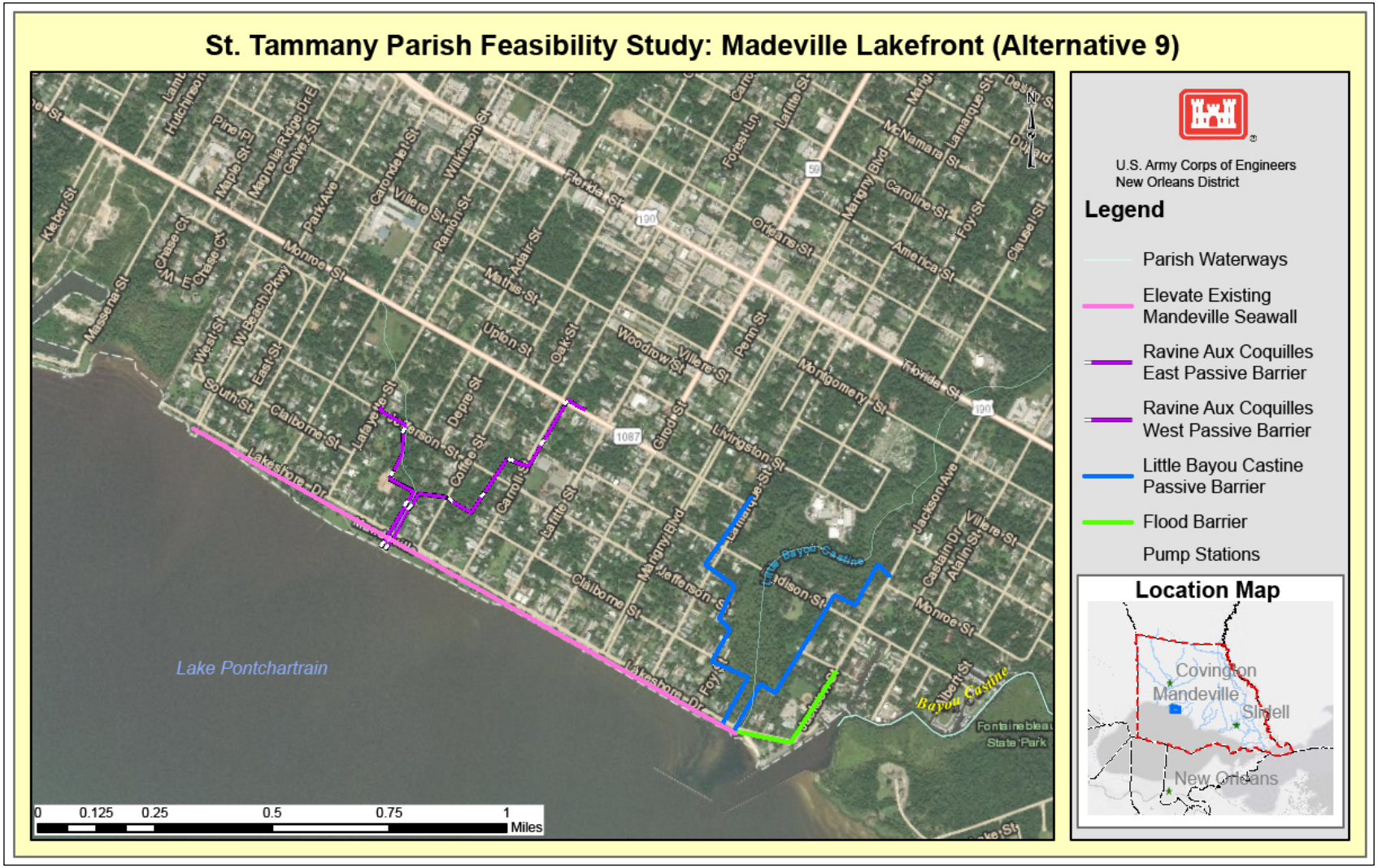

Figure B:2-9. Alternative 9- Mandeville Lakefront

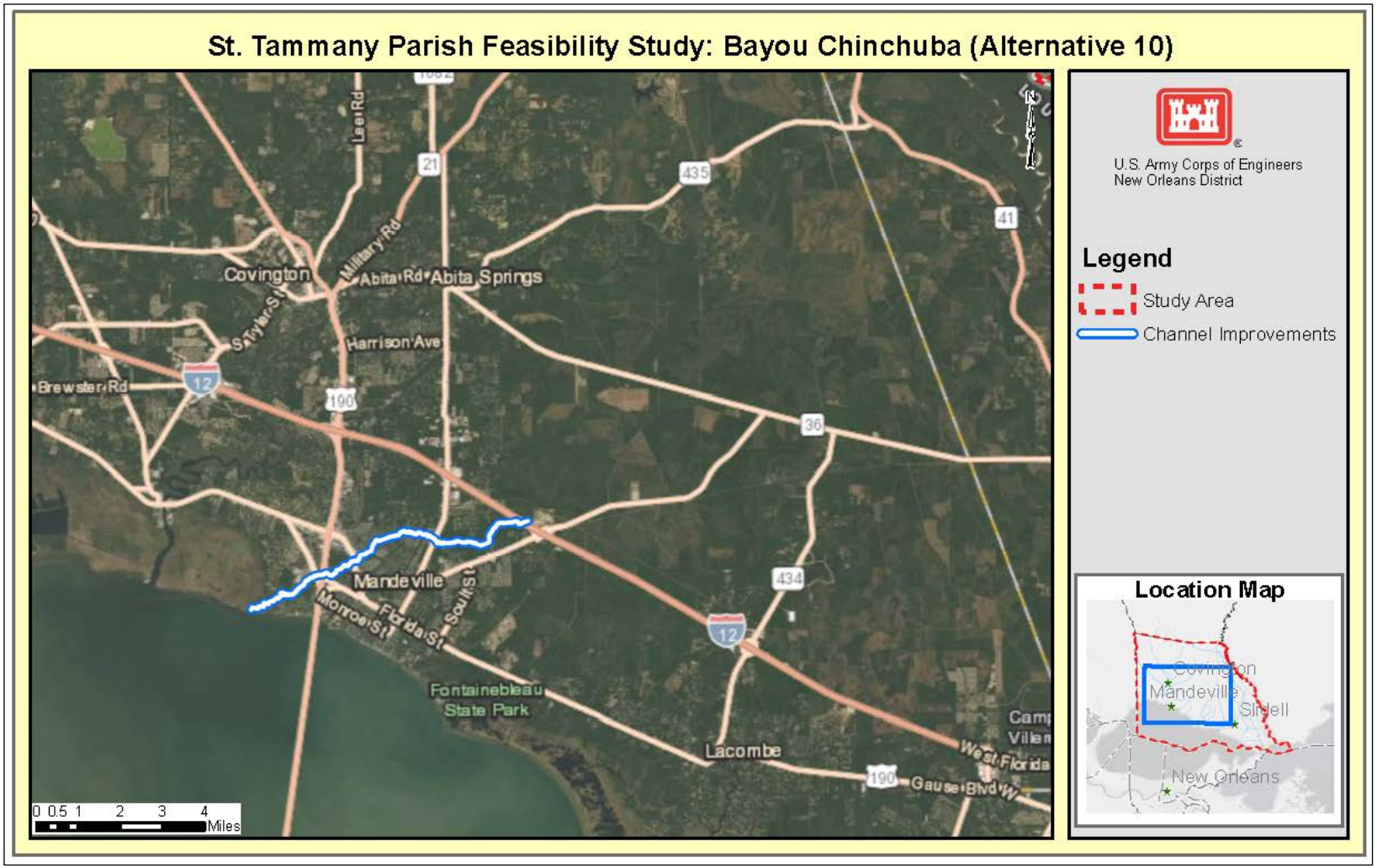

Figure B:2-10. Alternative 10- Bayou Chinchuba

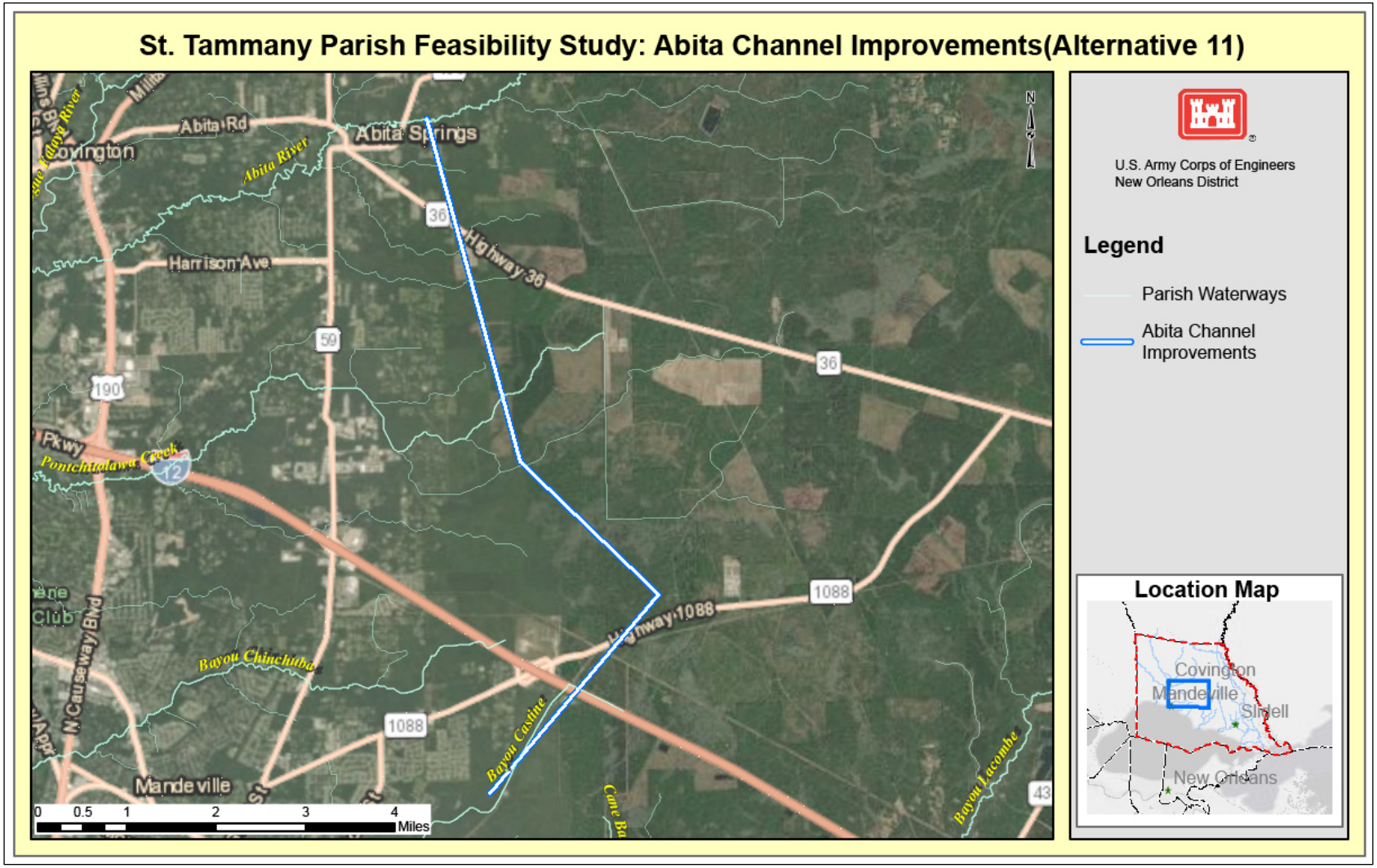

Figure B:2-11. Alternative 11- Abita Channel Improvements

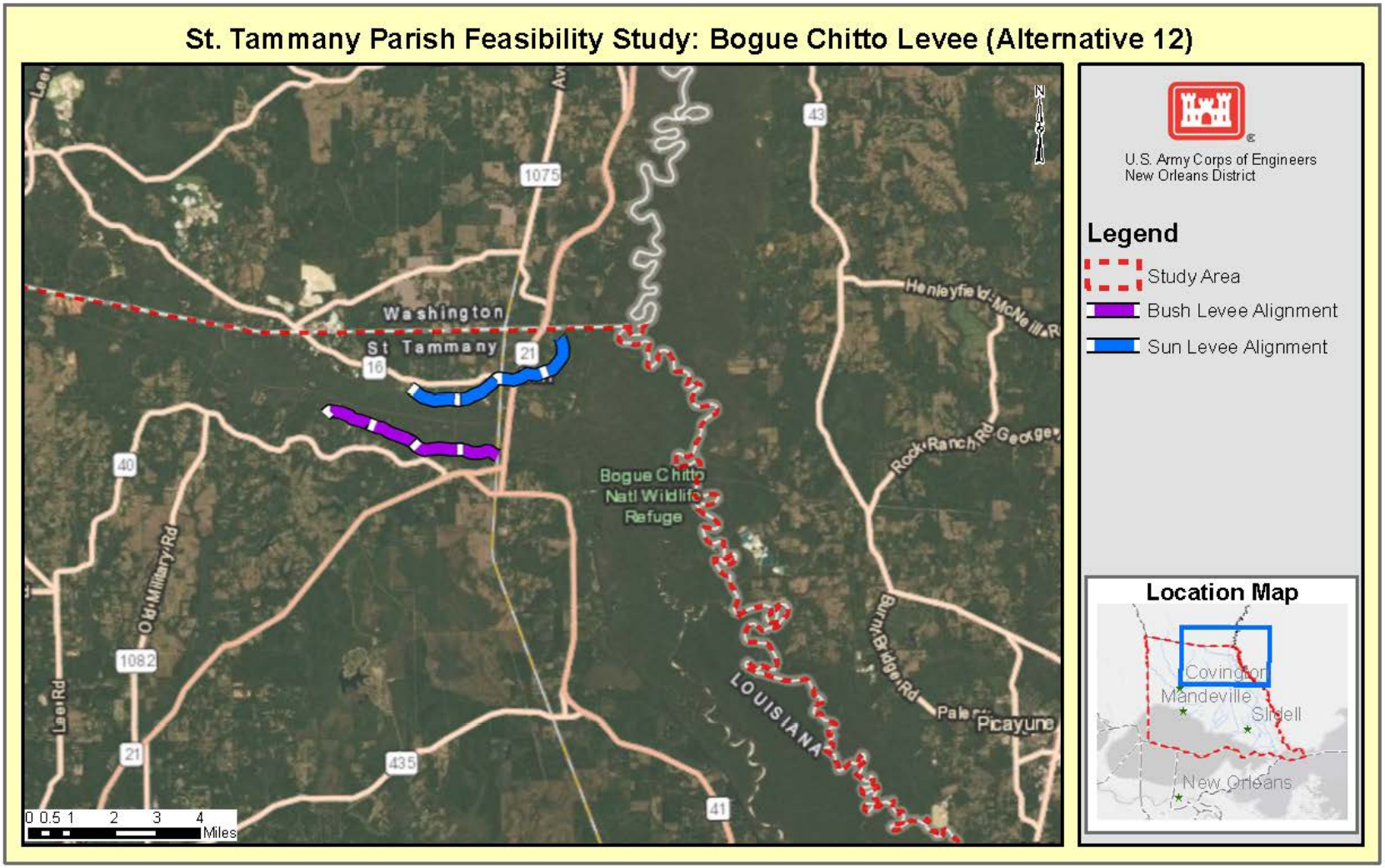

Figure B:2-12. Alternative 12- Bogue Chitto Levee

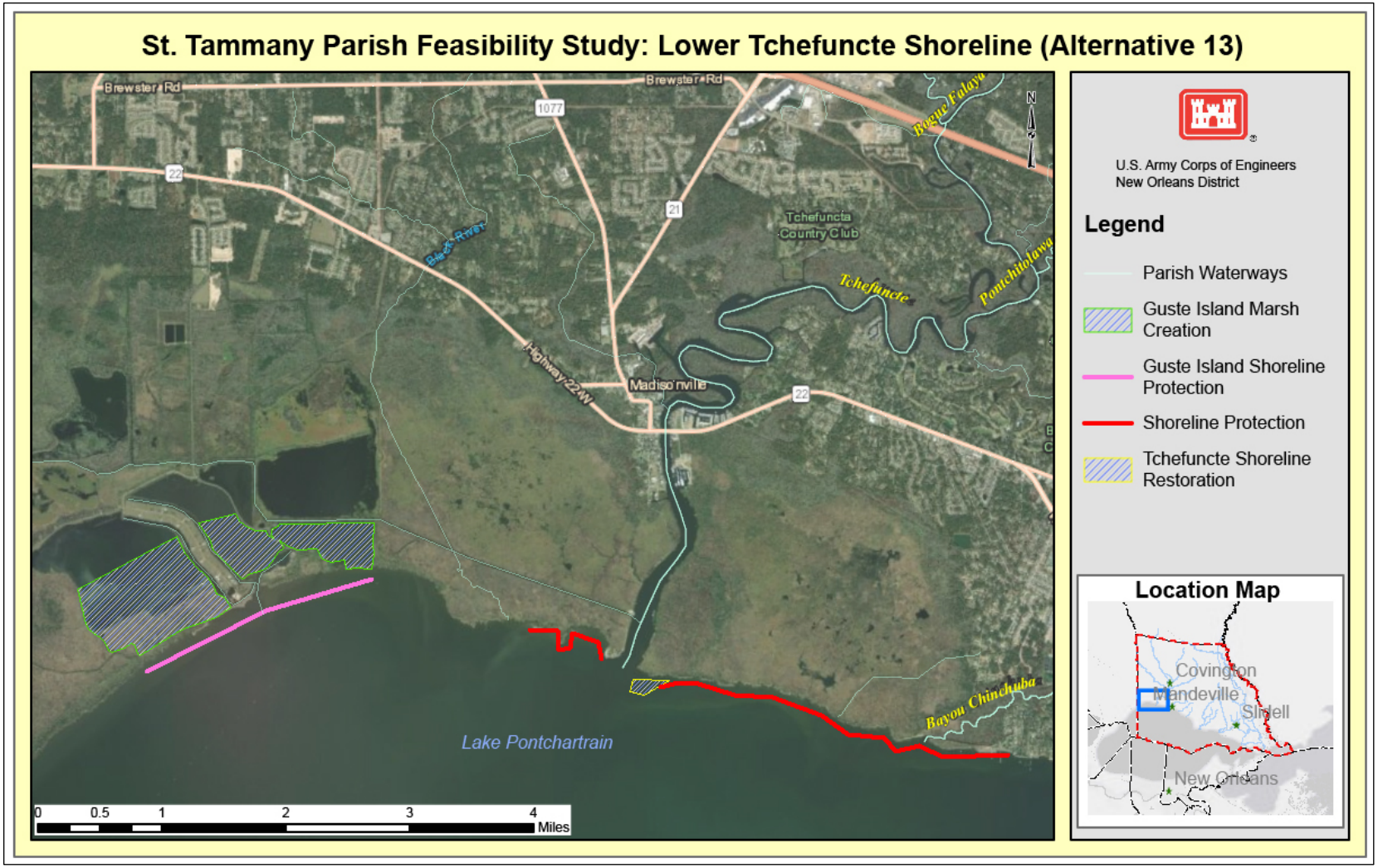

Figure B:2-13. Alternative 13- Lower Tchefuncte Shoreline

The PDT evaluated each independent measure within the Initial Array of Alternatives separately to determine if the measure was justified in accordance with ER 1105-2-100 and WRDA Act 1986. Table B:2-2 presents the results of the screening process used to evaluate the Initial Array and develop a refined set of alternatives; this next smaller set of alternatives is called the Focused Array. Geographic areas that were screened from the structural alternatives continued to be evaluated for nonstructural measures throughout the process. The following criteria were used to screen the Initial Array of 13 alternatives:

- Meets study objectives.
- Meets USACE definition for flood risk management vs local storm drainage- ER-1165-2-21, with flows greater than 800 cfs.
- Scale-Detention Ponds can store at least 1,000-acre feet of water.
- Potential Damages do not exceed implementation cost. For the initial economic analysis, the estimated annual damages (EAD) over the 50 year period were calculated using the Flood Damage Reduction Analysis (HEC-FDA) software based on preliminary existing condition H&H modeling at the subbasin level. The expected maximum cost of a project that could be implemented based on the estimated damages was calculated from the without project EAD. For the screening of the initial array we assumed we could capture 75 percent of benefits of an implemented measure or alternative. We then compared the maximum cost supported estimate for each measure to cost estimates gathered from previous reports and previous similar projects. Criteria for justification requires a benefit cost ratio of <1.
- The proposed solutions are in line with and does not contradict with the St. Tammany Master Plan and the LACPRA Master Plan.
- Meets the four P&G criteria from the - https://planning.erdc.dren.mil/toolbox/library/Guidance/Planning%20Manual.pdf
    - Completeness- The extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other Federal and non-Federal entities.
    - Effectiveness- The extent to which the alternative plans contribute to achieve the planning objectives.
    - Efficiency- The extent to which an alternative plan is the most cost-effective means of achieving the objectives.
    - Acceptability- The extent to which the alternative plans are acceptable in terms of applicable laws, regulations and public policies.
- Avoids violating study constraints.

Table B:2-2. Initial Array of Alternatives

	Initial Array of Alternatives	Screening Notes
1	No Action	Moved forward to the focused array.
2	Nonstructural	All measures moved forward to the focused array: NS- 08, NS- 09, NS- 10 and NS- 11.
3	Lake Pontchartrain Surge Reduction	Measures moved forward to the focused array: NB-024, NB-030 and NB- 031. **Screened Measures: S-039 and S-040.** **Structural measures including the weir and gates were removed from consideration based on the effectiveness of the measure reducing flood risk and the estimated implementation cost being higher than potential damages avoided.**
4	Lacombe	Measures moved forward to the focused array: S-028, , NB-015 and NB-016. **Screened: S-026 and S-027.** **FRM Detention ponds were removed from this alternative. Potential damages avoided do not exceed implementation cost for the Lacombe detention ponds.** **Potential concerns were raised related to impacts to adjacent the Wildlife refuge from S-028; the team documented that the levee will be designed to avoid and minimize impacts.**
5	Bayou Liberty/ Bayou Vincent/Bayou Bonfouca	Measures moved forward to the focused array: S-004, S-010, S-013, S-017, S-080, S-081, and NB-003. **Screened Measures: S-005, S-006, S-007, S-011, and S-012.** **Salmen Property Detention Pond was removed from consideration because it violated the recreation planning consideration. The estimated costs for the Belair North and South Detention Ponds exceeded the damages avoided. Additional information was obtained for the Camp Villerie site and it was determined to not meet the Scale screening criteria.** **Channel improvements along Bayou Bonfouca were screened due to violating the project constraint related to HTRW.**
6	South Slidell	Measures moved forward to the focused array: S-070, S-074, S-075, S076, S-077 and NB-33.
7	Eastern Slidell	Measures moved forward to the focused array: S-060, S-061, S-069, S-071, S072, S-073, S-078, S-079, S-119 and NB-34
8	Upper Tchefuncte/ Covington	Measures moved forward to the focused array: S-057, S-105, S-106 and S-121. **Screened Measures: S-101 bridge restriction was screened after further analysis did not show significant hydrology restrictions at the proposed location; action would not reduce flood damages.**
9	Mandeville Lakefront	Measures moved forward to the focused array: S-046, S-047, S-048, S-118. **Screened Measures: NB-26 and NB-27. Shoreline protection and marsh creation were screened out due to effectiveness; these measures would not**

	Initial Array of Alternatives	Screening Notes
		provide a measurable benefit beyond the surge reduction already received from the seawall.
10	Bayou Chinchuba	Not carried forward to the focused array. **Screened Measures: S-045** **After further coordination the St. Tammany Parish Government informed that a detention pond was constructed in 2012 and they reported that there has not been continued documented flooding issues.**
11	Abita Channel Improvements	Measures moved forward to the focused array: S-001. Estimated to contribute ~21-32% of the total flow where the Tchefuncte, Bogue Falaya and Abita Rivers meet.
12	Bogue Chitto Levee	Not carried forward to the focused array. **Screened Measures: S-019 and S-020.** **Avoided damages are less than the implementation cost for a structural feature.**
13	Lower Tchefuncte Shoreline	Not carried forward to the focused array. **Screened Measure: NB 41, NB 42, and NB 44.** **This alternative was estimated to have limited coastal storm risk reduction. Storm surge was documented to go around and over the marsh and shoreline, and in this particular case, also up the Tchefuncte River.**

Three full alternatives (10, 12 and 13) in the initial array of 13 alternatives were screened and removed from consideration. Alternative 10 was screened due to limited opportunities for improvement based on recently constructed projects. Alternative 12, which proposed levees to reduce risk from riverine flooding from the Bogue Chitto River, was screened because the estimated damages avoided were lower than the estimated implementation cost. The nature-based measures in Alternative 13 were screened due to the limited costal storm risk reduction benefits.

In some instances, during the evaluation of the Initial Array of Alternatives, some of the management measures within alternatives were determined not to be justified. In those cases, the measures that were not justified were removed from the alternatives that moved forward to the focused array to reflect only the management measures that were justified (Table B:2-2).

The following measures within alternatives were screened (see Table B:2-2 for justification for each): Alternative 3 Structural Measure, Alternative 4 Detention Ponds, and in Alternative 5, Detention Ponds at the Salmen, Belair North, Belair South, and Villere sites and channel improvements along Bayou Bonfouca. Alternative 9 was modified to no longer include nature-based measures. A total of 18 measures were screened from the Initial Array of Alternatives. Nonstructural alternatives were still considered and moved forward in the subbasins and areas where these structural and nature-based measure were screened.

2.2 FOCUSED ARRAY OF ALTERNATIVES

Additional details on the Focused Array of Alternatives, which were the alternatives that remained after screening the initial array, are included below. The focused array included 11 alternatives made up of 43 measures and is illustrated in Table B:2-3. Maps depicting the focused array are presented in Figures B:2-14 through B:2-23. A summary of the screening of the Focused Array to determine the Final Array of Alternatives can be found in Table B:2-4.

Table B:2-3. Focused Array of Alternatives (Bolded superscript denotes subbasins with expected flood risk reduction)

	Alternative Name	**Management Measures**								
		Detention ponds	*Channel / restriction improve*	*Diversion channel*	*Pump stations*	*Levee, floodwall, seawall*	*Flood gates*	*Shoreline protection breakwater*	*Marsh creation*	*Non structural*
	Focused Array	*FRM*	*FRM/ CSRM*	*FRM*	*FRM/ CSRM*	*FRM/ CSRM*	*CSRM*	*CSRM*	*CSRM*	*FRM/ CSRM*
1	*No Action* **Parish-wide**									
2	*Nonstructural* **Parish-wide**									*NS-008, NS-009, NS-010, NS-011*
3	*Lake Pontchartrain Surge Reduction* **1, 2, 8, 18, 22, 23, 25, 30, 35**							*NB-024, NB-031*	*NB-024, NB-030*	*NS-008, NS-009, NS-010, NS-011*
4	*Lacombe* **18**				*S-028,*	*S-028,*	*S-028, S-*	*NB-016*	*NB-015*	*NS-008, NS-009, NS-010, NS-011*
5	*Bayou Liberty/Bayou Vincent/Bayou Bonfouca* **1 & 35**	*S-004, S-13*	*S-010, S-017, S-080*		*S-81,*	*S-81,*	*S-081*	*NB-003*	*NB-003*	*NS-008, NS-009, NS-010, NS-011*
6	*South Slidell* **1 & 23**				*S-74, S-075, S-076, S-077*	*S-70, S-075, S-076*	*S-70, S-075,*	*NB-33*		*NS-008, NS-009, NS-010, NS-011*

	Alternative Name	Management Measures								
		Detention ponds	Channel / restriction improve	Diversion channel	Pump stations	Levee, floodwall, seawall	Flood gates	Shoreline protection breakwater	Marsh creation	Non structural
							S-076			
7	Eastern Slidell [1, 13, 17, 23]	S-078	S-069, S-071, S-073, S-119	S-072, S-079	S-060, S-061	S-060, S-061	S-060, S-061		NB-34	NS-008, NS-009, NS-010, NS-011
8	Upper Tchefuncte/Covington [2, 10, 31]	S-106	S-057, S-101, S-121	S-105						NS-008, NS-009, NS-010, NS-011
9	Mandeville Lakefront [8]				S-048	S-046, S-118,	S-047			NS-008, NS-009, NS-010, NS-011
11	Abita Channel Improvements [2, 24, 31]			S-001						NS-008, NS-009, NS-010, NS-011

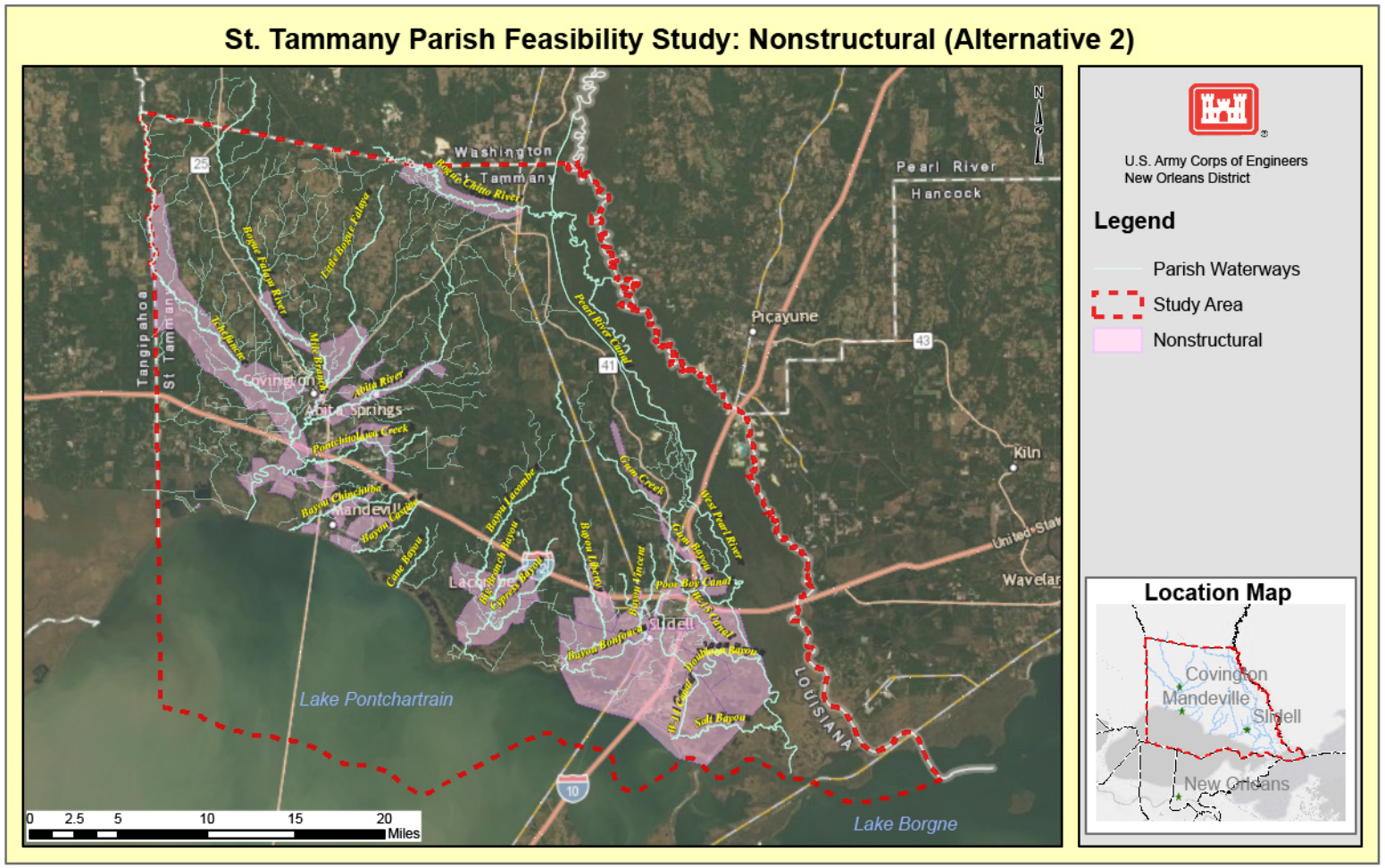

Figure B:2-15. Alternative 2- Nonstructural

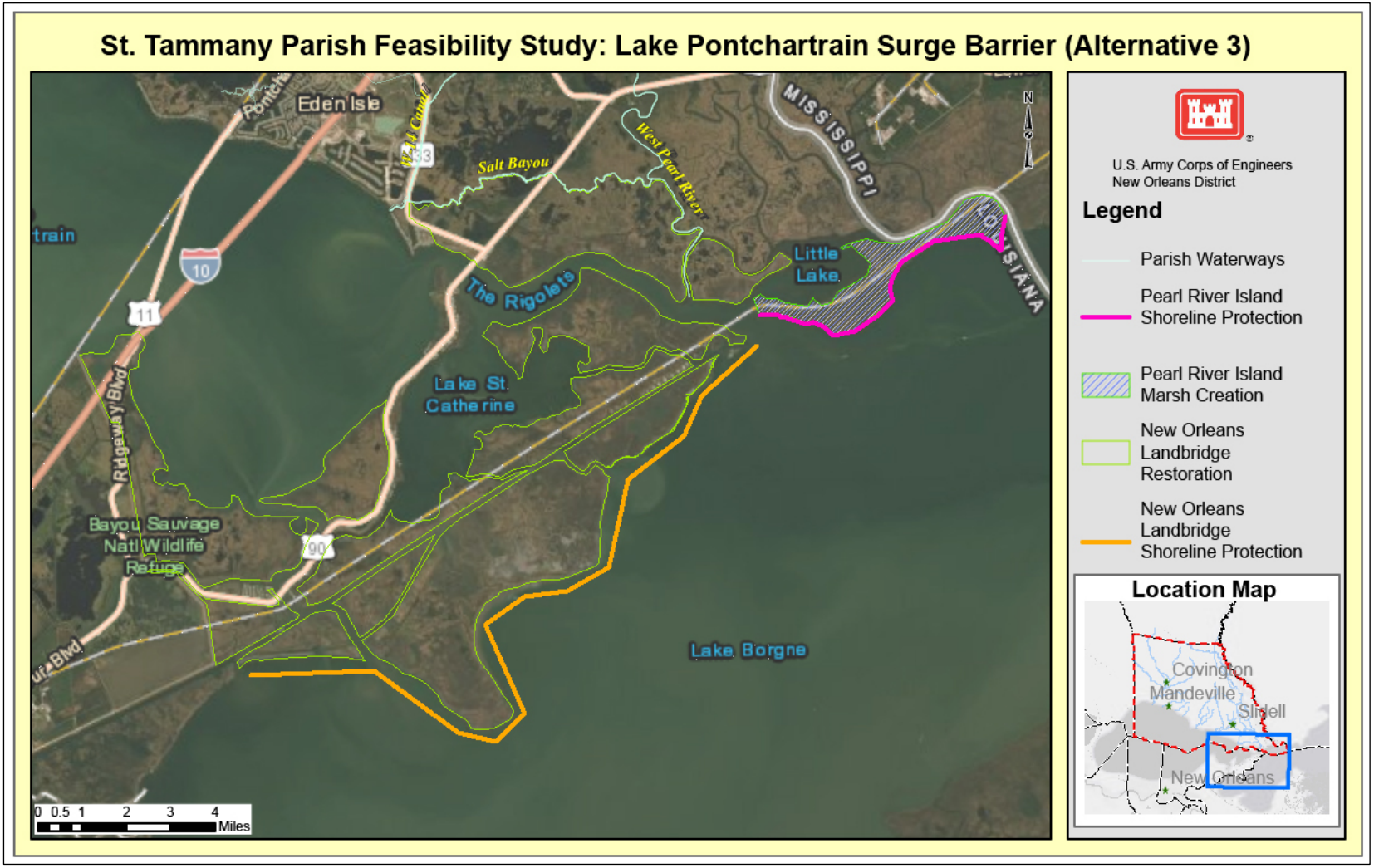

Figure B:2-15. Alternative 3- Lake Pontchartrain Surge Barrier

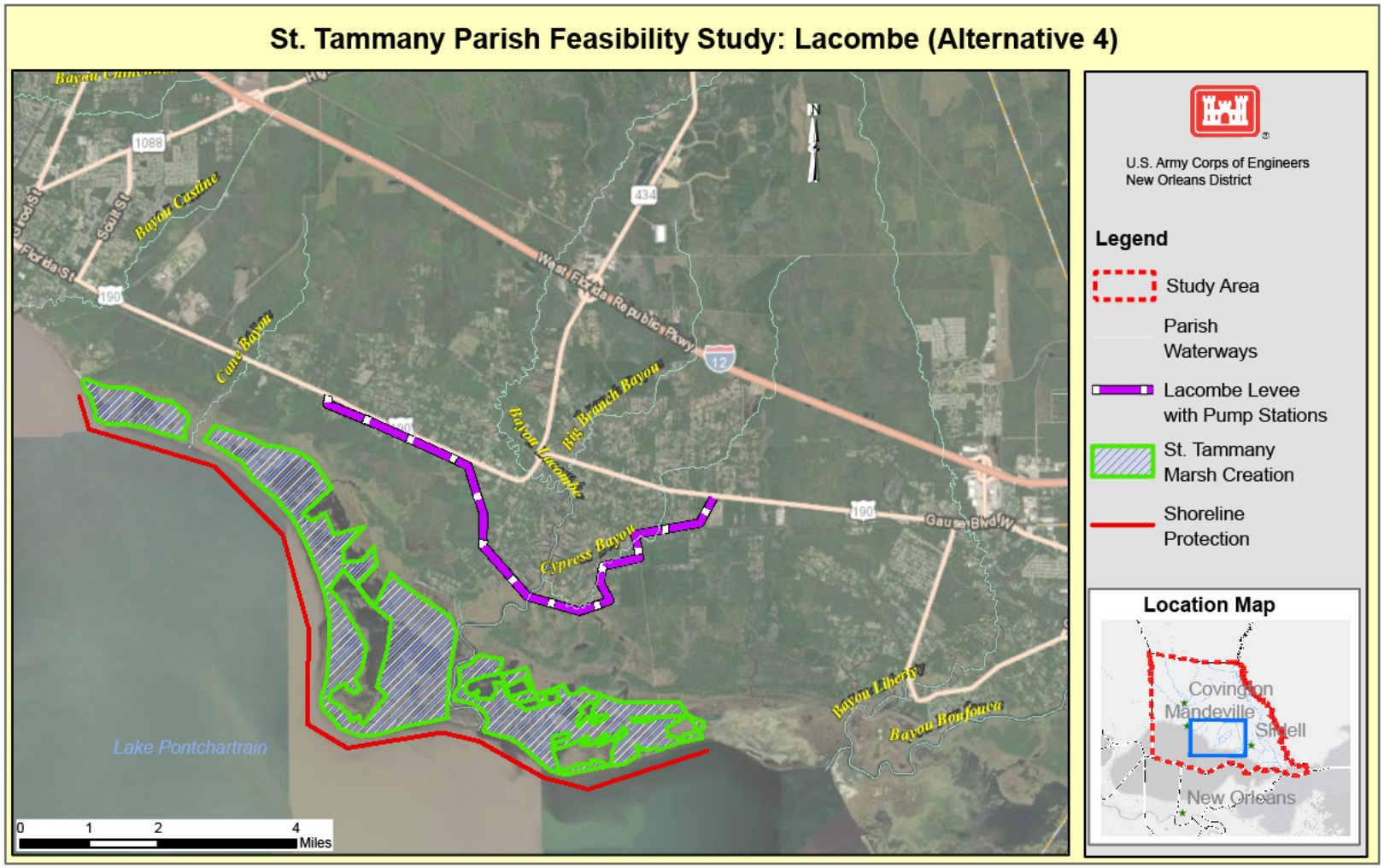

Figure B:2-16. Alternative 4- Lacombe

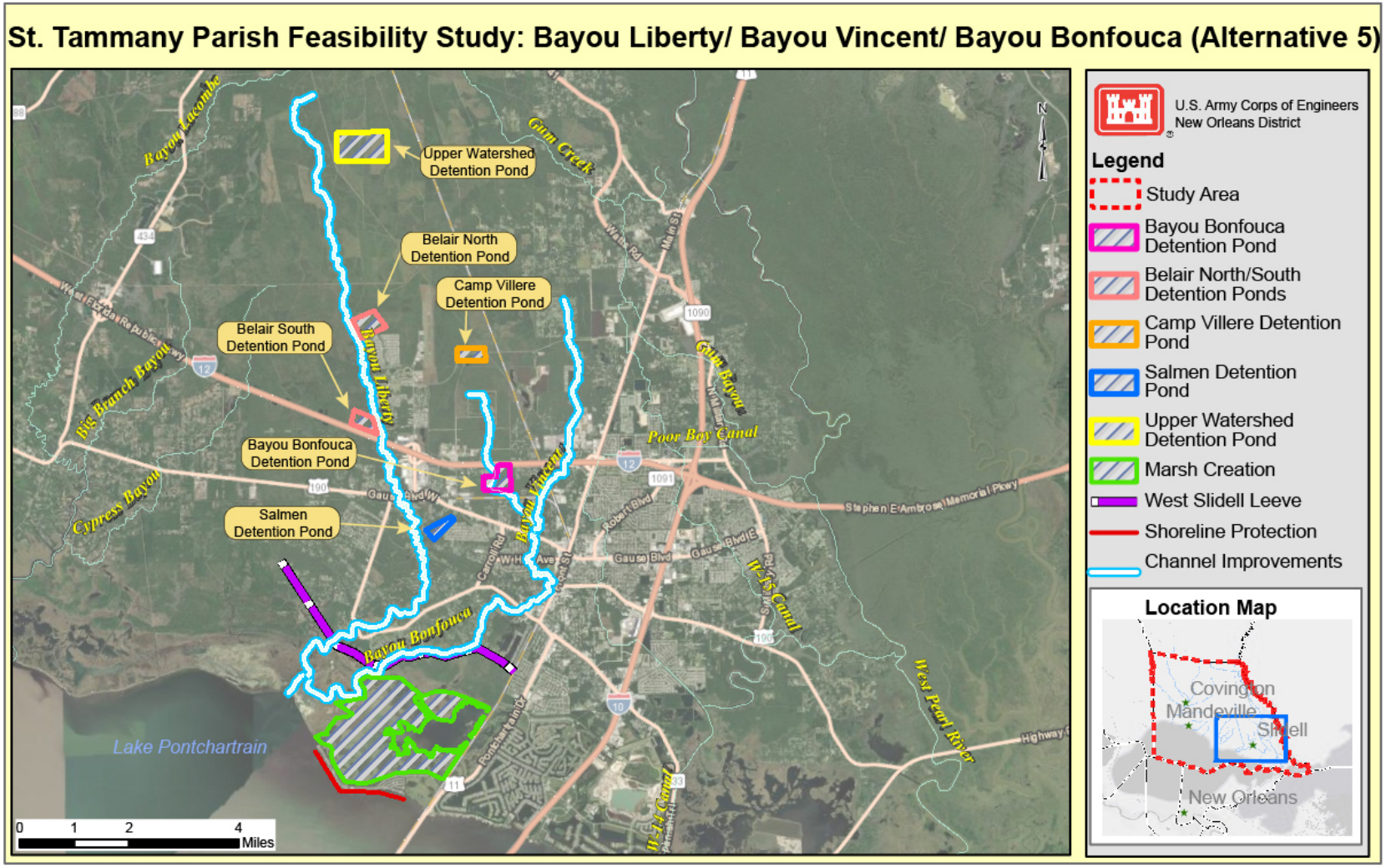

Figure B:2-17. Alternative 5- Bayou Liberty/ Bayou Vincent/ Bayou Bonfouca

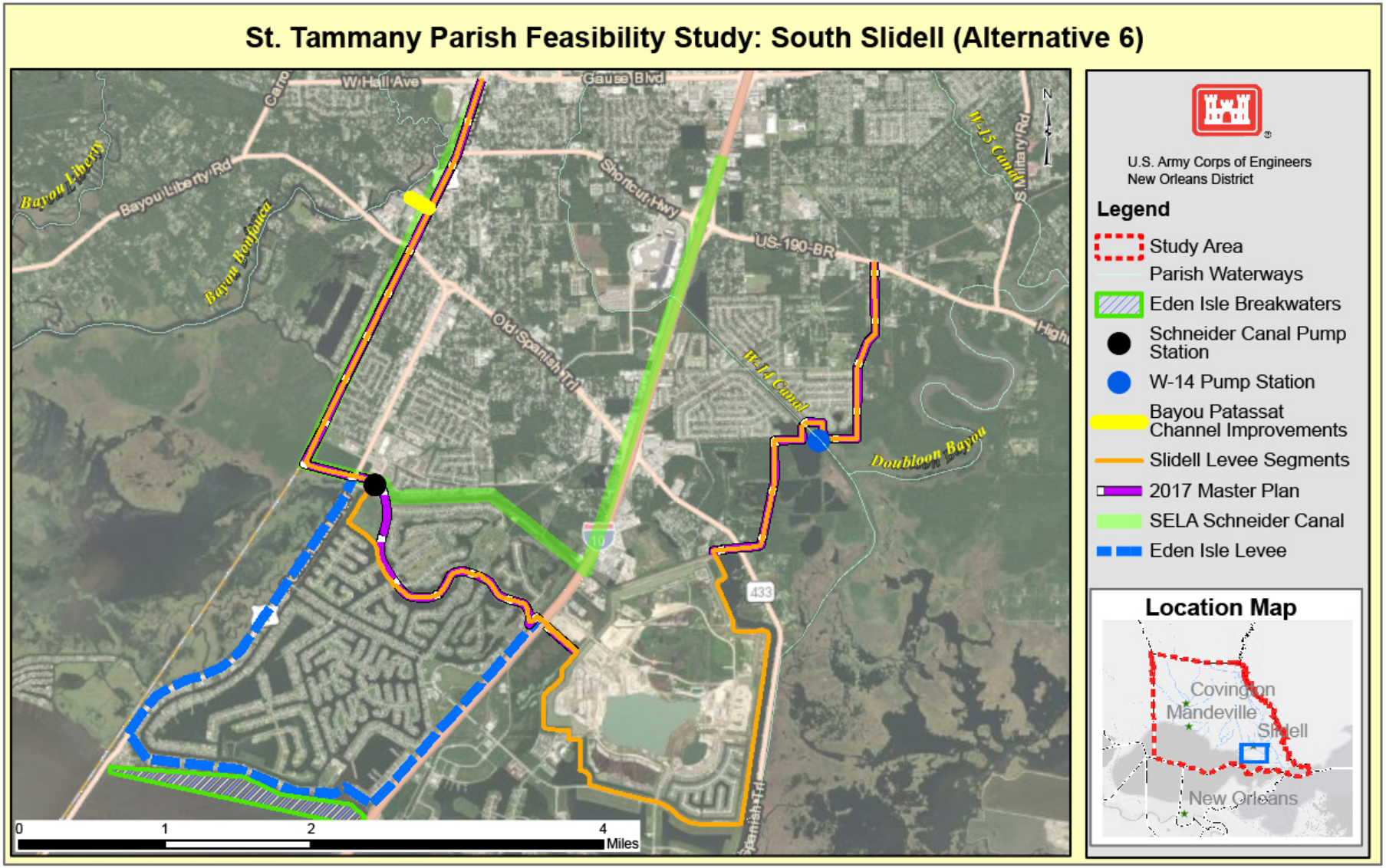

Figure B:2-18. Alternative 6- South Slidell

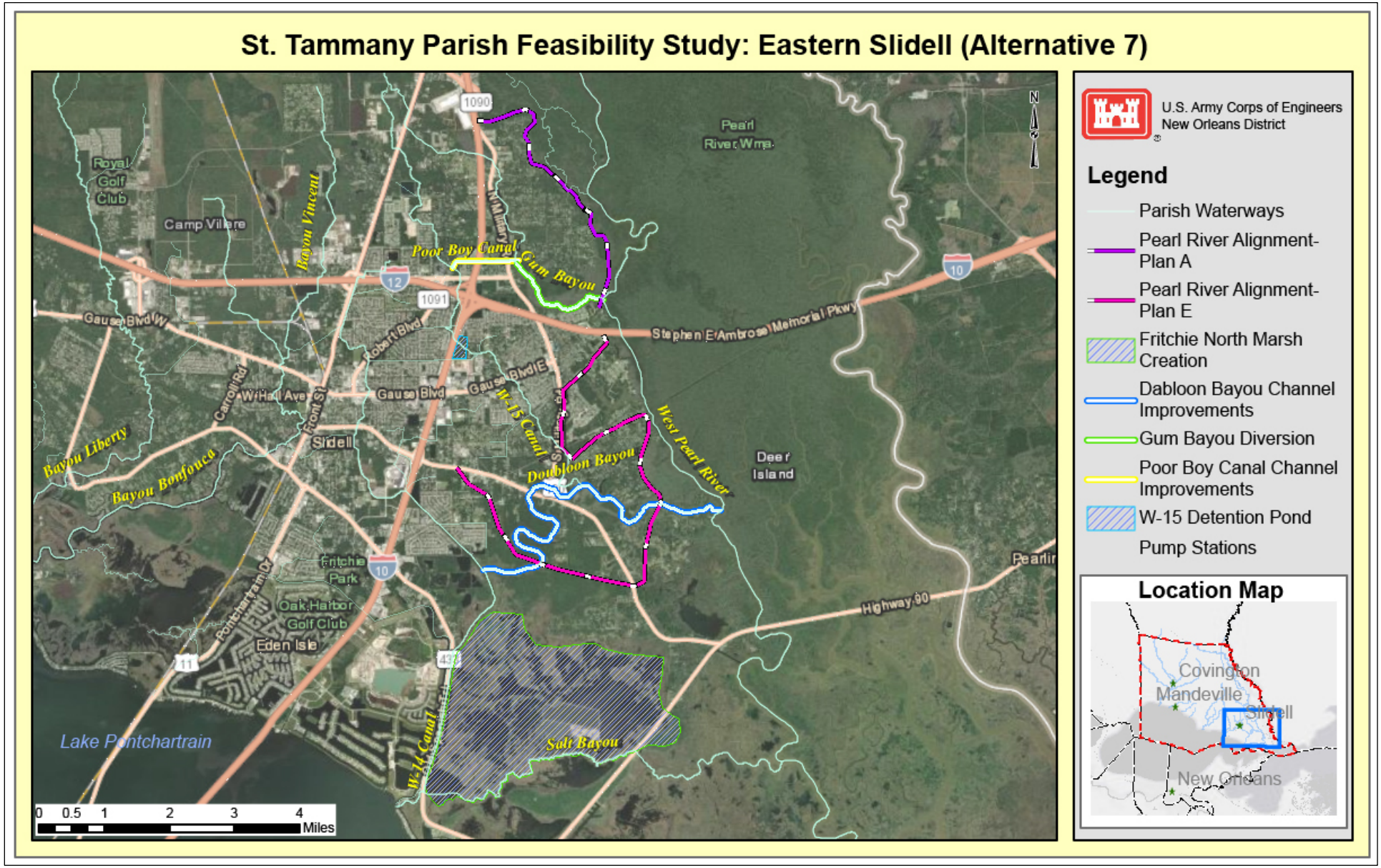

Figure B:2-19. Alternative 7- Eastern Slidell

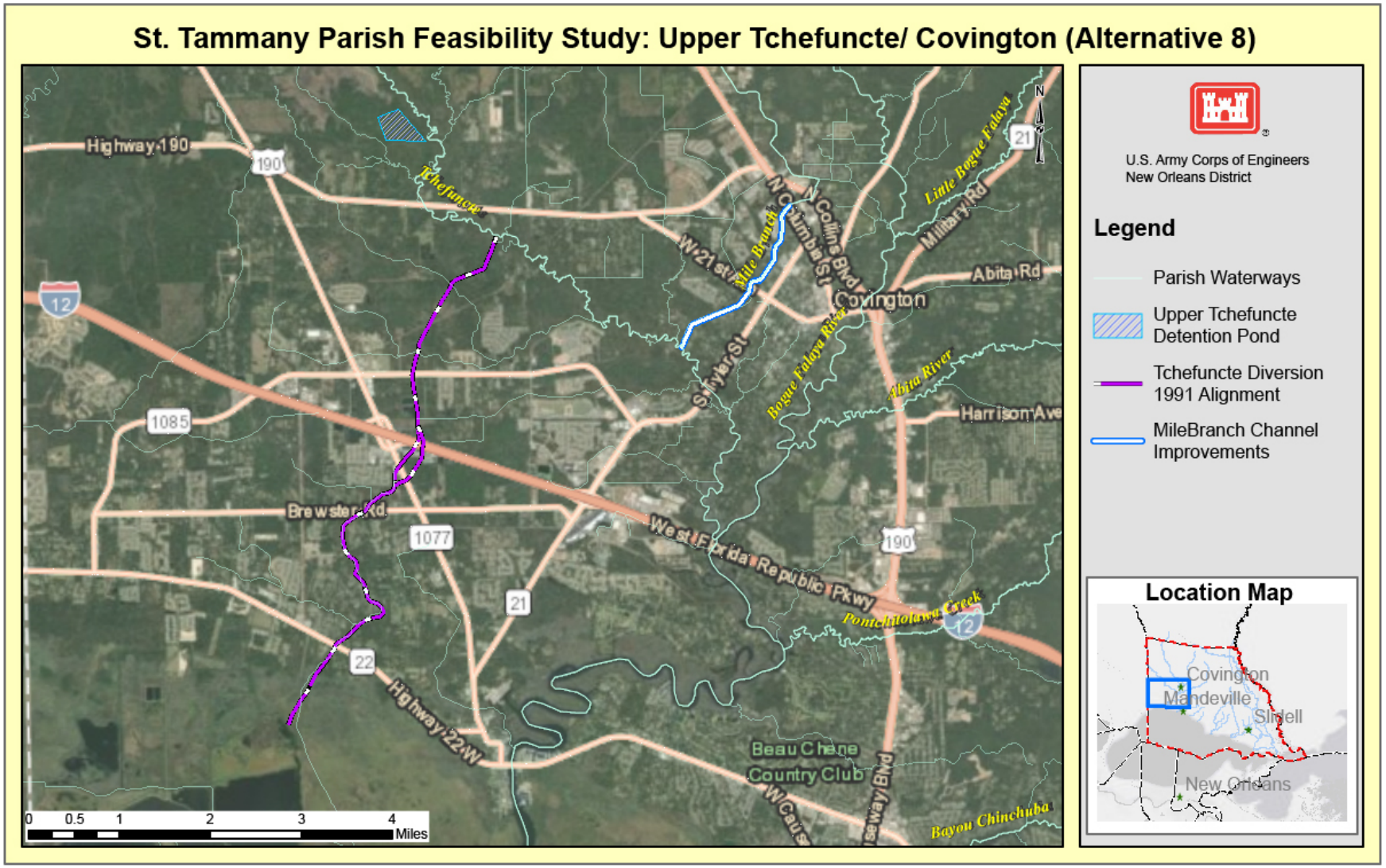

Figure B:2-20. Alternative 8- Upper Tchefuncte/ Covington

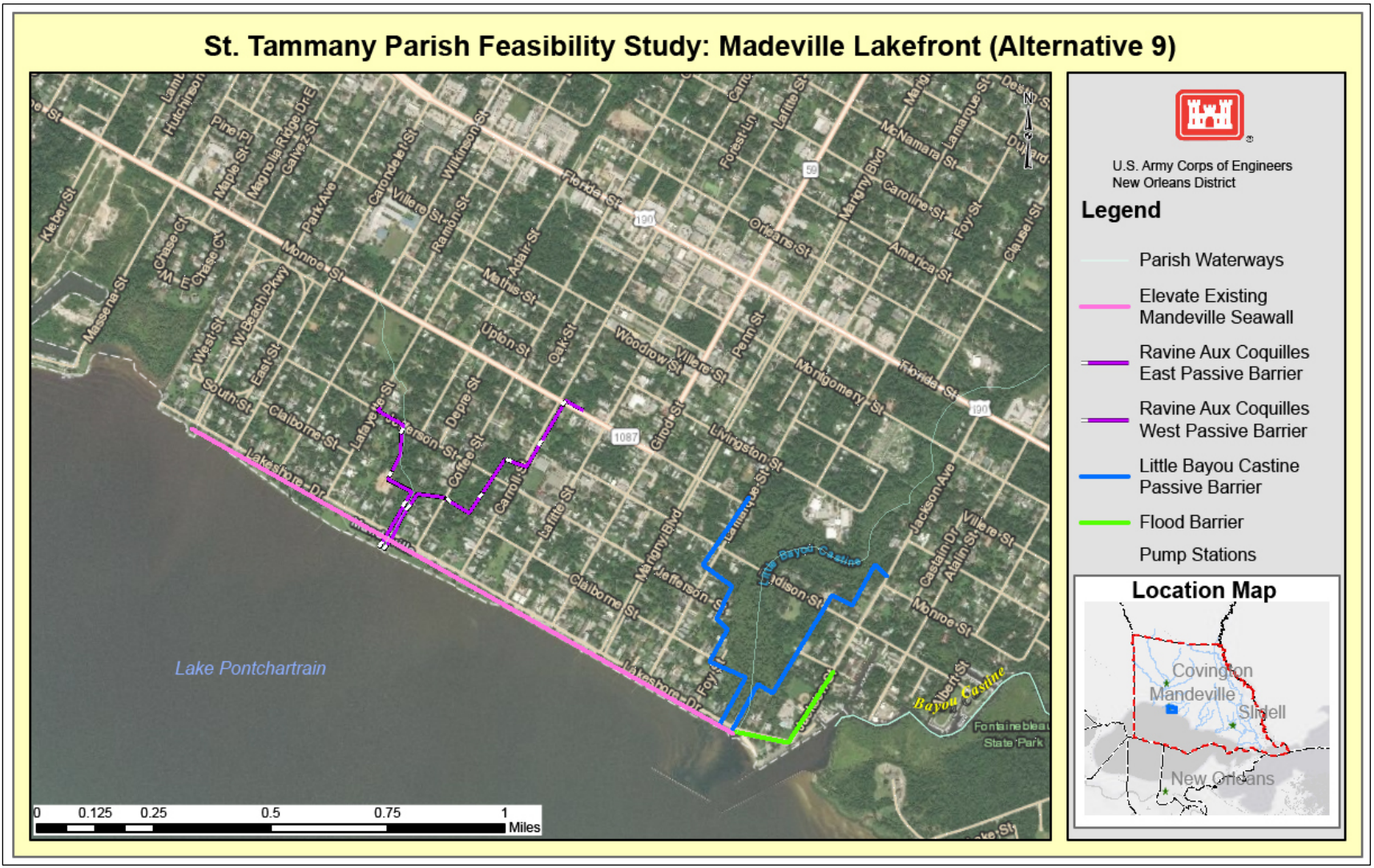

Figure B:2-21. Alternative 9- Mandeville Lakefront

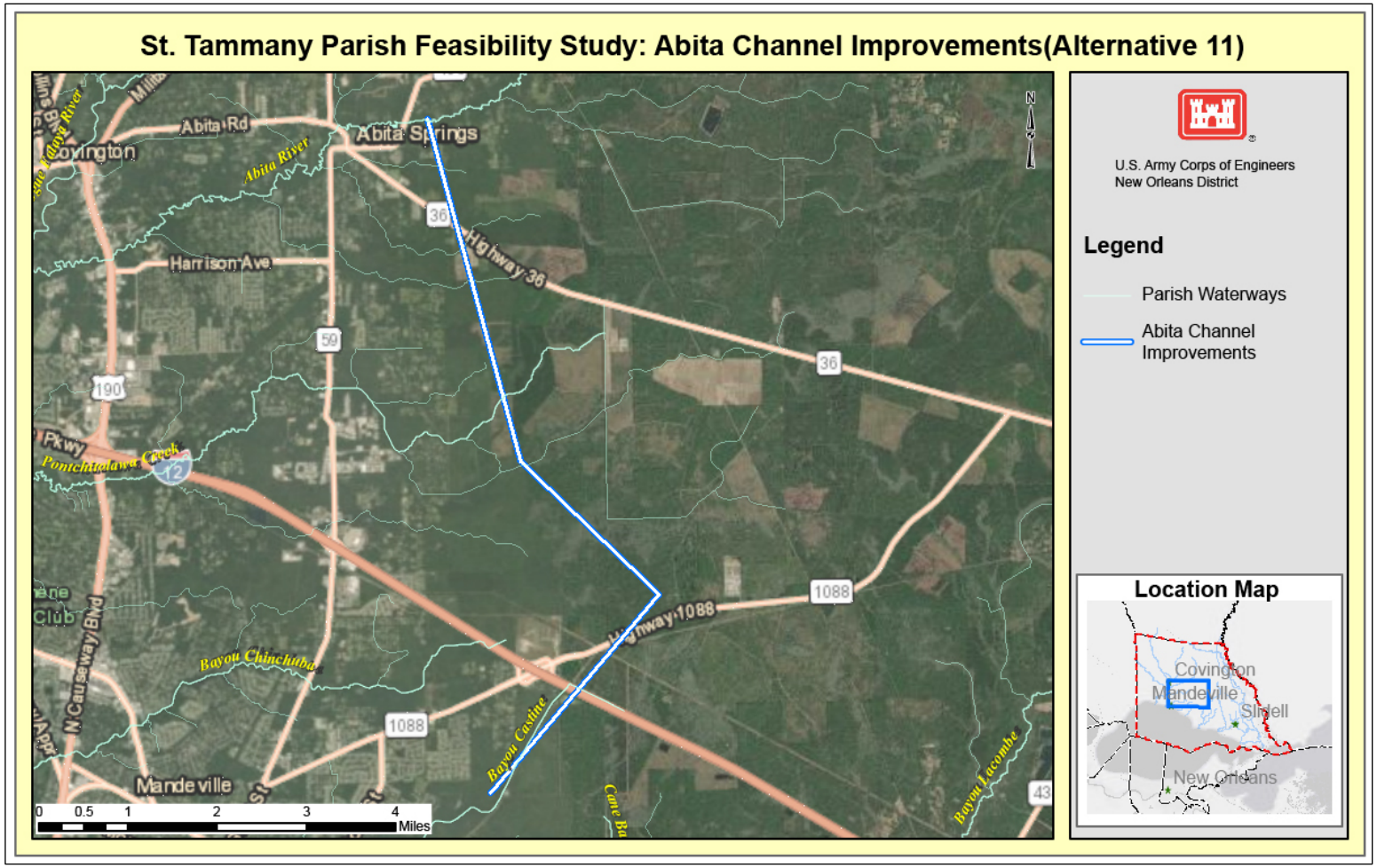

Figure B:2-22. Alternative 11- Abita Channel Improvements

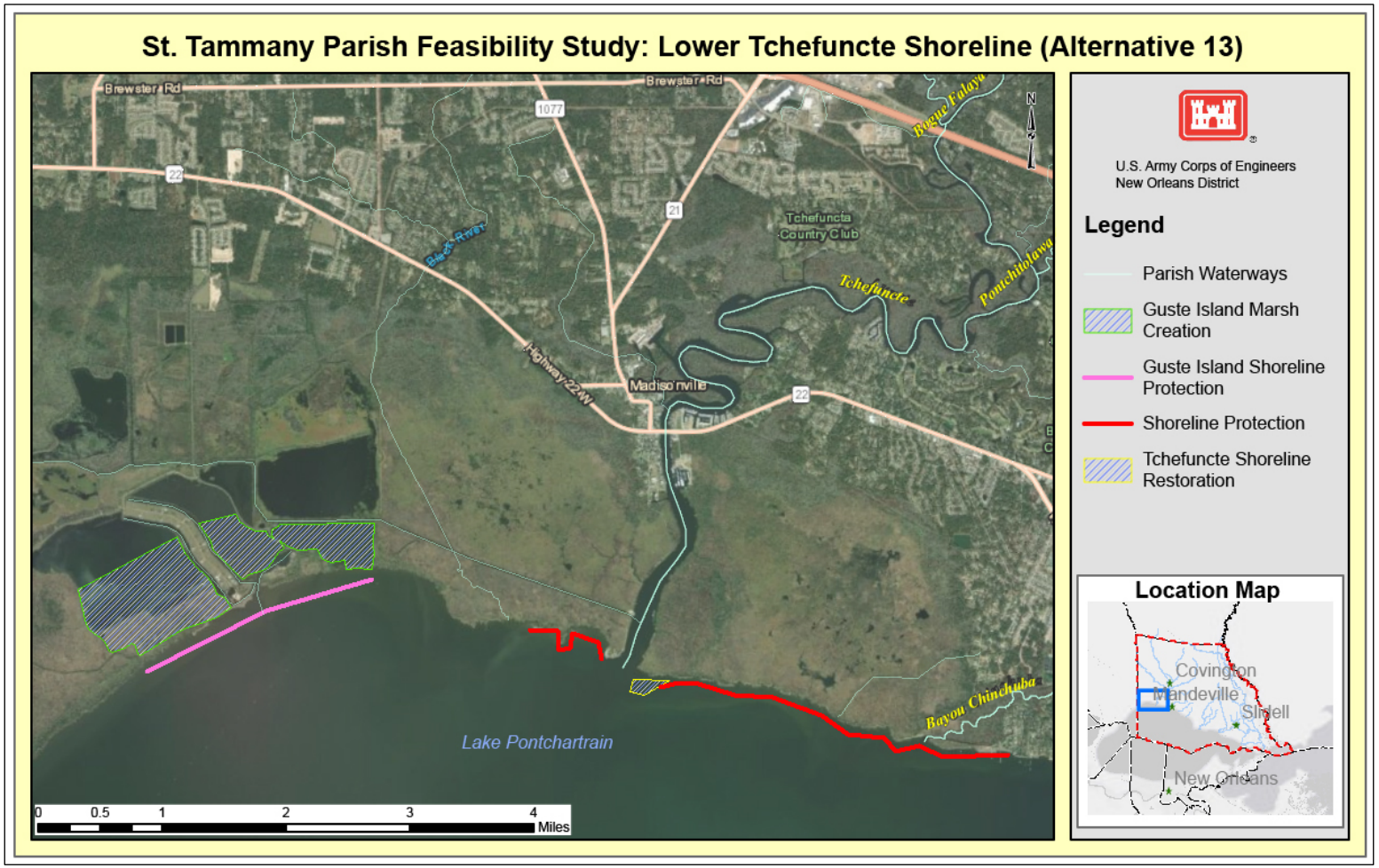

Figure B:2-23. Alternative 13- Lower Tchefuncte Shoreline

The Focused Array of Alternatives was evaluated to further narrow down the alternatives and measures that would undergo a full evaluation, including modeling and preliminary design in order to identify the Final Array. To provide the additional information and data to screen the Focused Array, the PDT undertook these tasks:

- Rough order of magnitude (ROM) cost estimates were developed for the Focused Array. The screening for the Initial Array used cost estimates from previous studies and reports and those costs were updated and or escalated costs to provide a more recent cost estimate. Cost estimates for compensatory mitigation resulting from for direct impacts to marsh and BLH habitat were also estimated and included in the total revised costs for the Focused Array of Alternatives.
- Potential benefit and inducement areas (subsections) for each remaining structural measure were delineated. These areas identify where potential flood risk reduction or inducement might occur with the implementation of the measure within the alternative. These approximate benefit areas represented rough estimation of potential flood risk reduction and were used to identify structures that would likely benefit from implementation of each measure. Both reduction and inducement estimates were formulated using a combination of existing model documentation and best engineering judgement. Literature sources and prior studies estimated benefits were also used. Below is a summary of assumptions applied to the delineated areas for calculating preliminary benefits when estimated lowerings from prior studies were not available. It should be noted that any lowering given in a range resulted in a median value, which was applied during the economic analysis.
    - Shoreline Protection: Range of water surface elevation (WSE) reduction due to shoreline protection is 0 -0.5 foot.
    - Marsh Creation: Range of surge attenuation rates from measured data is approximately3 feet per 14,000 feet- 200,000 feet to per.
    - CSRM Levees or Floodwalls: All structures in benefit area predicted to be protected up to the 100-year storm surge event.
    - FRM Levees or Floodwalls: Reduce damages by 90 percent for rainfall/riverine flood damages for events up to and including the 200 year. No reductions assumed for more extreme events (500 year).
    - Detention Pond: 0.3-2 feet reduction in the 10-year profile.
    - Channel Improvements: Range of estimated WSE reduction is 0.1 foot-0.9 foot for 10-year event and can be applied to other frequencies.
    - Diversion Channel: No damage reduction up to and including the 25-year rainfall event. 50 year and less-frequent events, water levels would equal the 25-year event.
- The EAD values for the structures within the potential benefit areas were calculated to estimate the maximum potential benefits that could accrue to each measure within an alternative. The EAD totals were then converted to a maximum cost supported by dividing by the capital recovery factor. These maximum cost

supported estimates were then further refined by developing an estimated flood lowering for each of the measures and using that value to adjust the potential maximum cost supported for each measure within an alternative.

- The PDT then compared the maximum cost supported estimate for each measure to the ROM cost estimates to screen out measures and alternatives that would likely not be economically justified.
- Nature based measures were also further evaluated. Research was conducted using published literature to determine the potential range of surge attenuation rates estimated to be reduced in St. Tammany Parish based on the acreage of marsh creation and shoreline protection proposed in the area. Potential lowerings of WSE were calculated for both marsh creation and shoreline protection using these statistics:
    - Marsh Creation: WSE reduction of approximately 3 feet per 200,000 feet to 3 feet per 14,000 feet. (Wamsley, T.V. 2010)
    - Shoreline Protection: WSE reduction of 0 feet-0.5 foot of reduction within the extents of the benefit area. (Naryan, S. 2017)

The analysis of the NB measures showed that the expected costs outweighed the storm surge reduction benefits. Additionally, to maximize benefits, the marsh creation feature was expected to have high Operation and Maintenance (O&M) costs to maintain the design elevation required to attenuate surge effectively.

*TableB:2-4. Summary of Focused Array Screening**

	Focused Array of Alternatives	Screening Notes
1	No Action	MF to the final array
2	Nonstructural	MF: NS- 08, NS- 09, NS- 10 and NS- 11.
3	Lake Pontchartrain Surge Reduction	Screened Alternative. Screened Measures: NB-24, NB-30, NB-31. The creation and shoreline protection measure were screened due to the low efficiency with which they would be able to reduce storm surge impacts. The marsh creation was also expected to have high O&M costs in order to maintain the marsh at a certain elevation over time due to subsidence and sea level rise.
4	Lacombe	MF: S-028, S-120. The Lacombe levee was moved forward to the final array. Screened Measures: NB-15, NB-16. The nature-based shoreline protection and marsh creation measures were screened due to effectiveness in reducing flood damages.

	Focused Array of Alternatives	Screening Notes
5	Bayou Liberty/ Bayou Vincent/Bayou Bonfouca	MF: S-004, S-010, S-080, S-081. Screened Measures: S-13, S-17. The Upper Watershed Detention Pond and Bayou Vincent Channel improvements were screened based on the estimated implementation costs exceeding the potential damages avoided. Screened Measures: NB-03. The marsh creation and shoreline protection were screened based on the low efficiency with which they would be able to reduce storm surge impacts.
6	South Slidell	MF: S-070, S-074, S-075, S-076 and S-077. Screened Measures: NB-33. The shoreline protection nature-based measures were screened based on the low efficiency with which they would be able to reduce storm surge impacts.
7	Eastern Slidell	MF: S-060, S-069, S-072, S-073, and S-119. Screened Measures: S 061 The Pearl River Levee Alignment E was screened based on the estimated Implementation costs exceeding the potential damages avoided. Screened Measures: S-071, S-078, S-079, and S-115. W-15 Detention Pond, Diversion Canal, French Branch Channel Improvements, and the W-15 Detention Pond were removed from consideration since they are under construction by the St Tammany Parish Government. Screened Measures. NB-34 The marsh creation nature-based measure was screened based on the low efficiency with which it would be able to reduce storm surge impacts.
8	Upper Tchefuncte/ Covington	MF: S-057, S-106 and S-121. Screened Measures: S-101 and S-105. Detention Pond and Diversion measure were screened based on the estimated Implementation costs exceeding the potential damages avoided.
9	Mandeville Lakefront	MF: S-046, S-047, S-048 and S-118.
11	Abita Channel Improvements	Screened Alternative Screened Measures: S-101. The estimated Implementation costs exceed the potential damages avoided.

*This tables presents the screening of the Focused Array of Alternatives to the Final Array of Alternatives. Please note previously screened measures and alternatives during the Initial Array screening are not duplicated here.

There were 2 alternatives and 18 additional measures that were screened from the Focused Array to the Final Array. All nature-based measures were screened out based on the estimated low efficiency with which they would be able to reduce storm surge impacts. Additionally, measures related to the W-15 in Alternative 7 were removed due to progress made by the St. Tammany Parish Government regarding their construction. Additional measures screened from the alternatives were due to the implementation costs exceeding estimated benefits included: Alternative 4 detention pond; Alternative 5 Bayou Liberty detention pond, and channel improvements along Bayou Vincent; and a detention pond and the diversions from the Tchefuncte and Abita south to Lake Pontchartrain to reduce riverine

flooding from Alternative 8 and 11. Nonstructural alternatives were moved forward in the sub basins and areas where structural and nature based measure were screened.

2.3 FINAL ARRAY OF ALTERNATIVES

The Final Array of Alternatives carried forward for H&H modeling, preliminary engineering and design, development of full cost estimates, and environmental and resource analysis, included 8 alternatives made up of 27 measures include:

- Alternative 1: No Action Alternative
- Alternative 2: Nonstructural (NS-008, NS-009, NS-010, NS-011)
- Alternative 4: Lacombe
  - 4a Lacombe Levee (S-028)
  - 4a.1 Lacombe Levee Short (S-028)
  - 4b Lacombe Levee Combined with West Slidell Levee (S-120)
- Alternative 5: Bayou Liberty/Bayou Vincent/Bayou Bonfouca
  - West Slidell Levee (S-081)
  - Bayou Bonfouca Detention Pond (S-004)
  - Bayou Liberty Channel Improvements (S-010)
  - Bayou Patassat Channel Improvements- Clearing and Snagging (S-080)
- Alternative 6: South Slidell
  - 6a South Slidell Levee and Floodwall System (S-074, S-075, S-076, S-077)
  - 6b South Slidell Levee and Floodwall System with Eden Isle (S-070, S-074, S-075, S-076, S- 077)
  - 6c South Slidell and West Slidell Levee and Floodwall System (S-074, S-075, S-076, S-077, S-081)
- Alternative 7: Eastern Slidell
  - Pearl River Levee (S-060)
  - Doubloon Bayou Channel Improvements-Dredging (S-069)
  - Poor Boy Canal Channel Improvements- Dredging (S-073)
  - Gum Bayou Diversion- Channel Improvements (S-072)
- Alternative 8: Upper Tchefuncte/Covington
  - Mile Branch Channel Improvements (S-057)
  - Lateral A Channel Improvements (S-121)
  -
- Alternative 9: Mandeville Lakefront
  - 9a Mandeville Lakefront-Seawall Passive Drainage (S-046, S-047, S-118)
  - 9b Mandeville Lakefront-Seawall and Pump Stations (S-046, S-048, S-118)
  - 9c Mandeville Lakefront-18 ft (S-046, S-048, S-118, S-122)

This included the 25 measures remaining from the Focused Array plus additional measures that were developed during the iterative process as new information became available. New measures included in the final array include, S-120 and S-122 (Table B:2-5). S-120 Lacombe Levee Combined with West Slidell Levee was added as a potential variation to have a complete levee system from Slidell to Lacombe and measure S-122 Mandeville

Lakefront-18 ft was added to evaluate a 100 year level of protection in Mandeville after the 7.3 ft system proposed being evaluated at the request of local stakeholders under Alternative 9 (S-046, S-047 and S-048) was shown to have limited flood reduction benefits.

Figure B:2-24 presents an overview of the Final Array of Alternatives. Maps depicting the Final Array of Alternatives are presented in Figure B:2-25 to Figure B:2-30. Refer to Appendix D: Engineering for detailed descriptions of the Final Array, including measure specific to each alternative.

Screening, evaluation, and comparison of the Final Array to determine the TSP is provided in Section 4 of the Report.

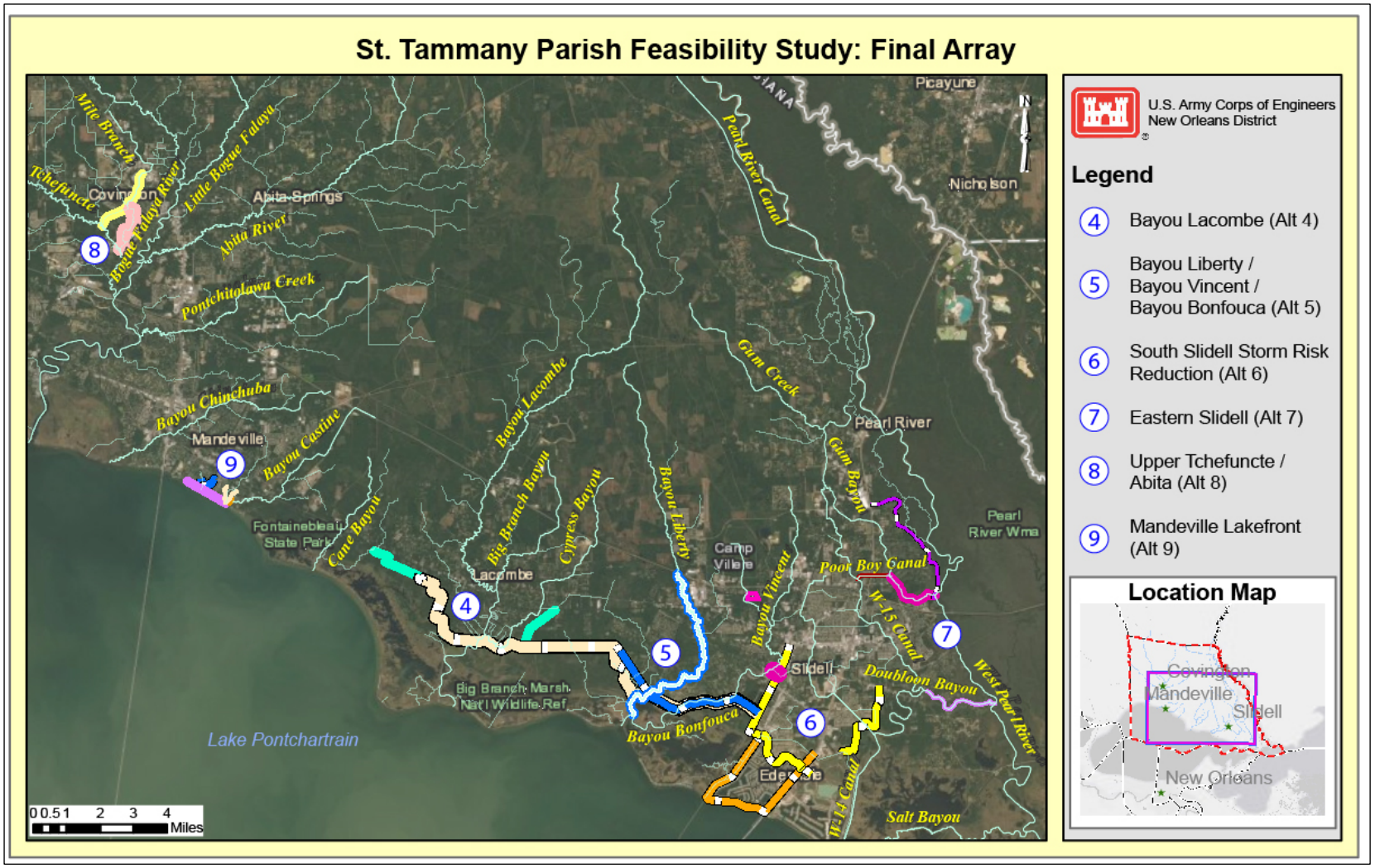

Figure B:2-24. Final Array of Alternatives

Table B:2-5. Final Array of Alternatives (Bolded superscript denotes subbasins with expected flood risk reduction)

	Alternative Name	**Measures**							
		Detention ponds	Channel improvements	Pump stations	Levee, floodwall, seawall	Flood gates	Shoreline protection breakwaters	Marsh creation	Nonstructural
		FRM	FRM/ CSRM	FRM/ CSRM	FRM/ CSRM	CSRM	CSRM	CSRM	
1	No Action								
2	Nonstructural **1, 2, 5, 6, 8, 10, 13, 14, 17, 22, 23, 24, 26, 30, 31, 35, 36**								NS-008, NS-009, NS-010, NS-011
4	4a Lacombe **18**			S-028	S-028	S-028			NS-008, NS-009, NS-010, NS-011
	4a.1 Lacombe Levee Short **18**			S-028	S-028	S-028			NS-008, NS-009, NS-010, NS-011
	4.b Lacombe Levee Combined with West Slidell Levee **18**			S-120	S-120	S-120			NS-008, NS-009, NS-010, NS-011
5	Bayou Liberty/ Bayou Vincent/ Bayou Bonfouca **1 & 35**	S-004	S-010, S-080	S-81, S-120	S-81, S-120	S-81, S-120			NS-008, NS-009, NS-010, NS-011
6	6a South Slidell **1 & 23**			S-074, S-075, S-077	S-075, S-076	S-075, S-076			NS-008, NS-009, NS-010, NS-011

	Alternative Name	Measures							
		Detention ponds	Channel improvements	Pump stations	Levee, floodwall, seawall	Flood gates	Shoreline protection breakwaters	Marsh creation	Nonstructural
	6b South Slidell with Eden Isle [1 & 23]			S-74, S-075, S-077	S-70, S-075, S-076	S-70, S-075, S-076			NS-008, NS-009, NS-010, NS-011
	6c South Slidell with West Slidell* [1 & 23]			S-74, S-075, S-076, S-077, S-81	S-075, S-076, S-81	S-075, S-076, S-81			NS-008, NS-009, NS-010, NS-011
7	Eastern Slidell [1, 13, 17, 23]		S-069, S-072 S-073	S-060	S-060	S-060			NS-008, NS-009, NS-010, NS-011
8	Upper Tchefuncte/Covington [2, 10, 31]		S-057, S-121						NS-008, NS-009, NS-010, NS-011
9	9a. Mandeville Lakefront-Seawall Passive Drainage [8]				S-046, S-118,	S-047			NS-008, NS-009, NS-010, NS-011
	9b. Mandeville Lakefront-Seawall and Pump Stations [8]			S-048	S-046, S-118,				NS-008, NS-009, NS-010, NS-011
	9c. Mandeville Lakefront-18 ft [8]			S-048	S-046, S-118, S-122				NS-008, NS-009, NS-010, NS-011

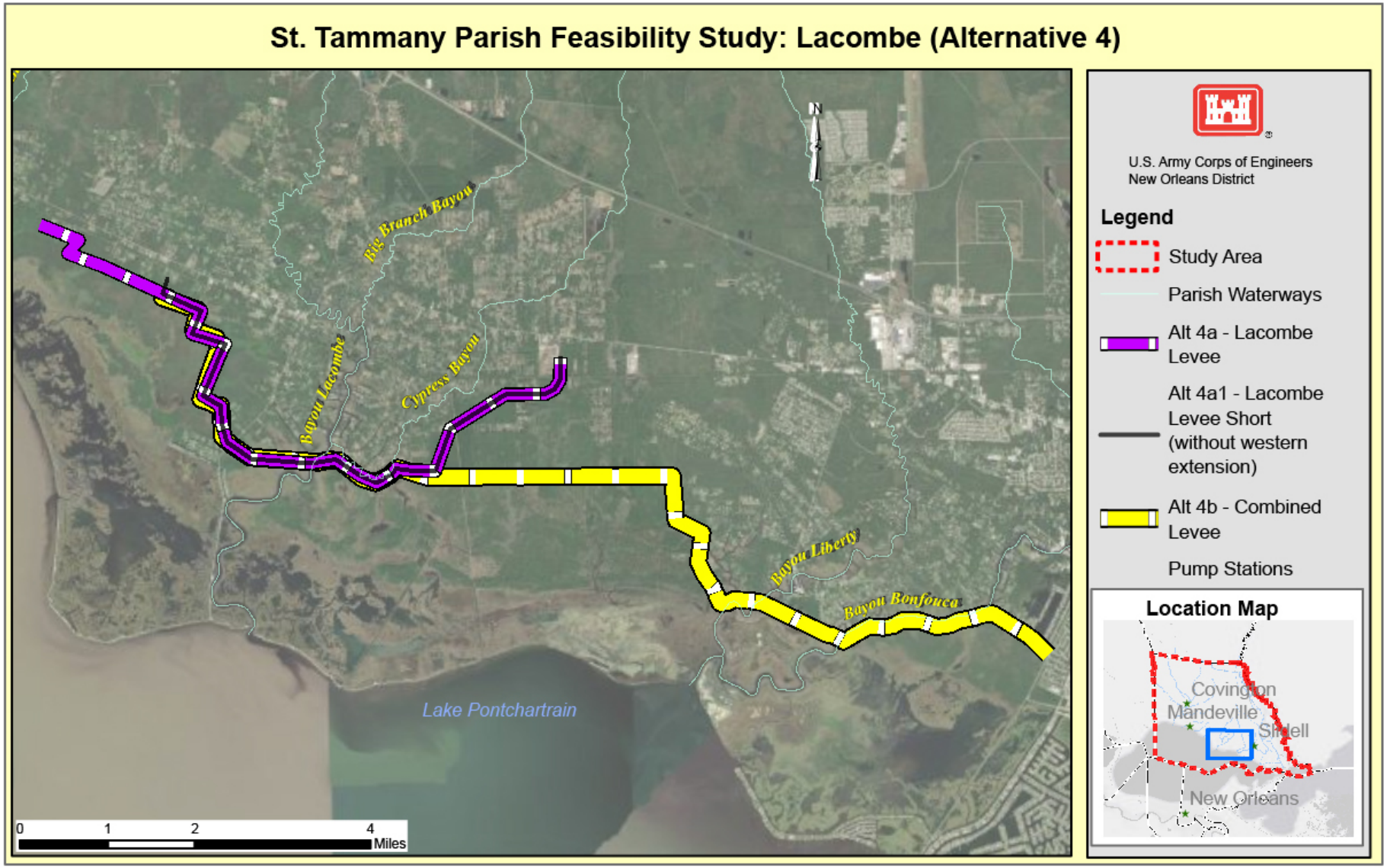

Figure B:2-25. Alternative 4- Lacombe

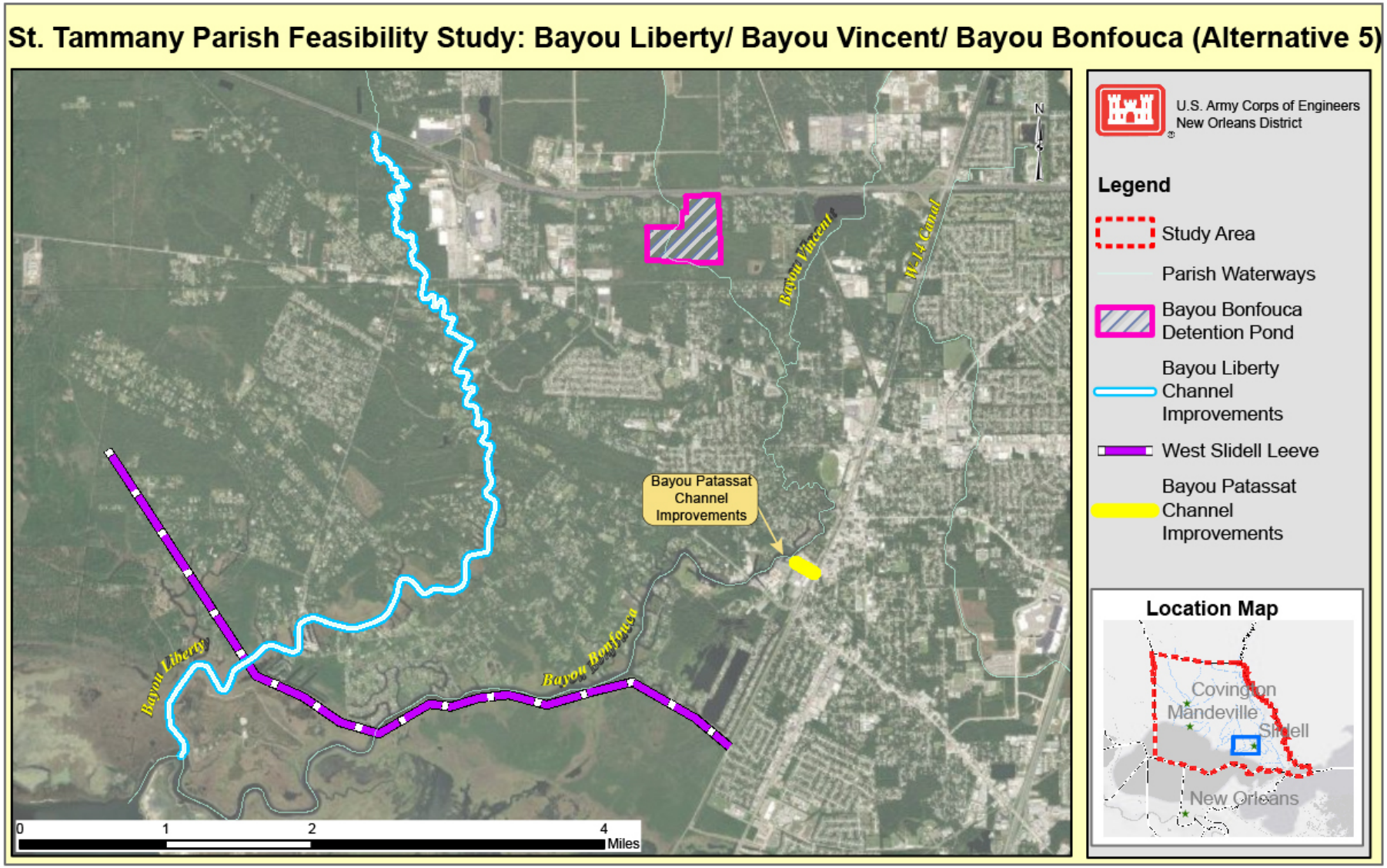

Figure B:2-26. Alternative 5- Bayou Liberty/ Bayou Vincent/ Bayou Bonfouca

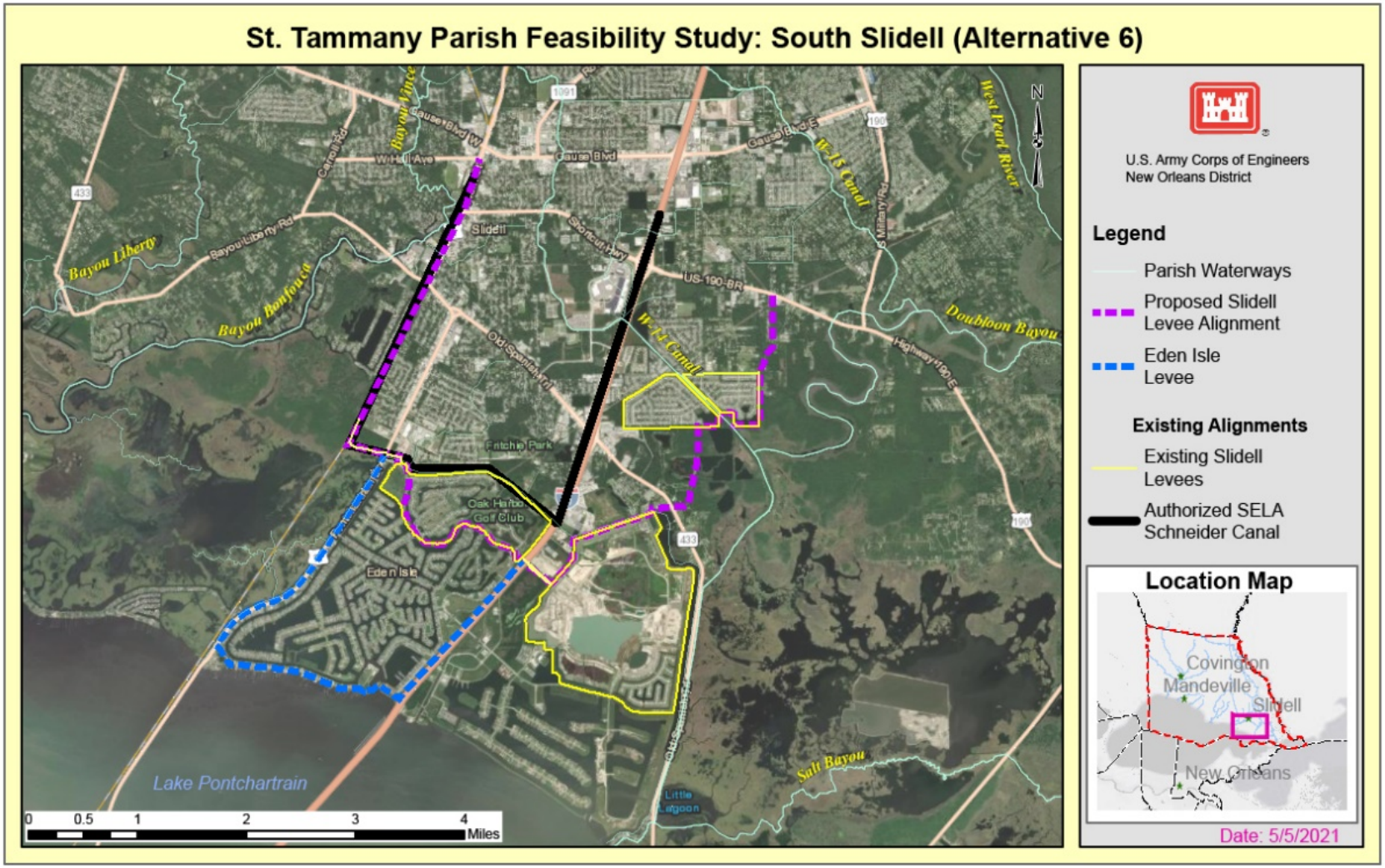

Figure B:2-27. Alternative 6- South Slidell

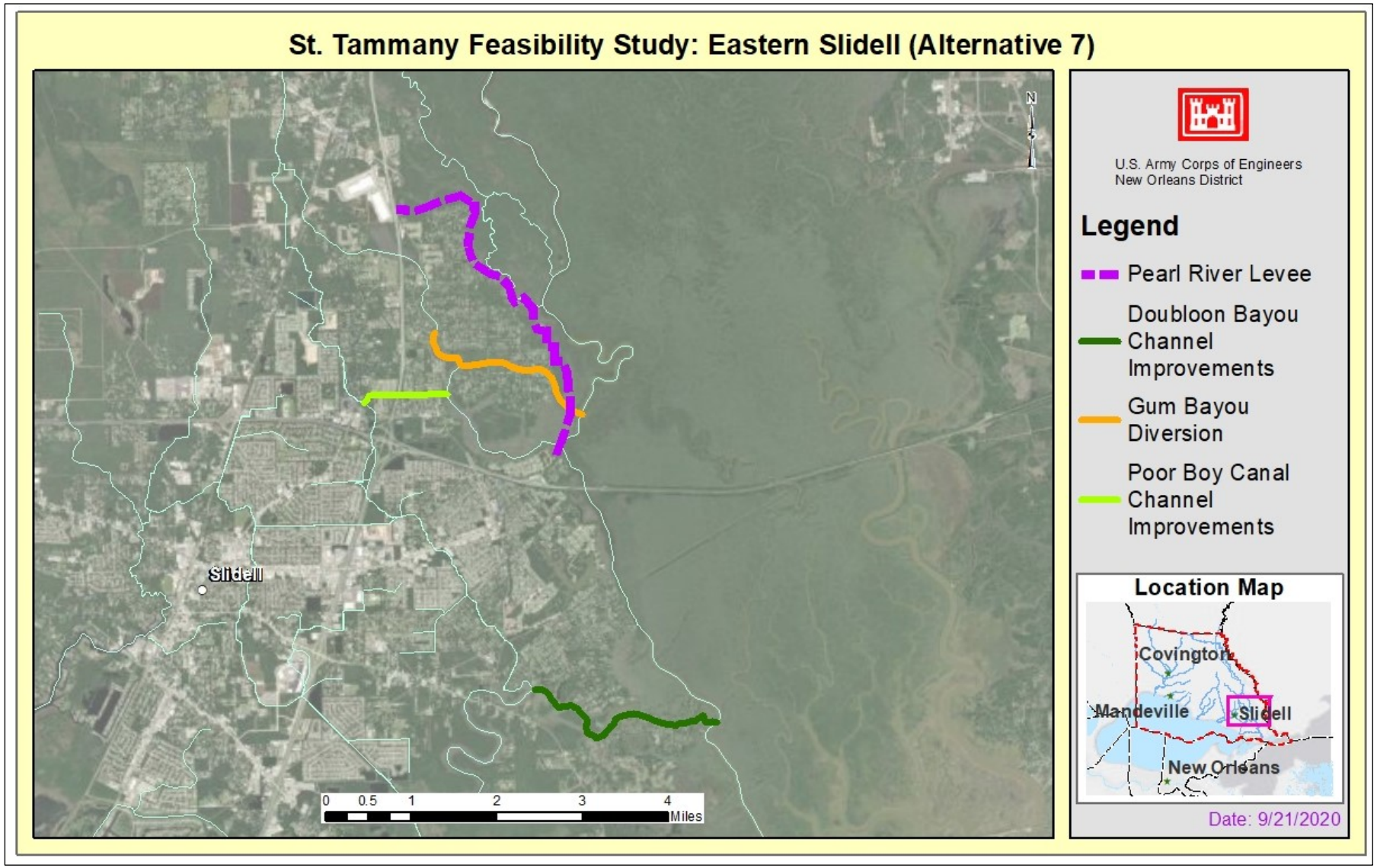

Figure B:2-28. Alternative 7- Eastern Slidell

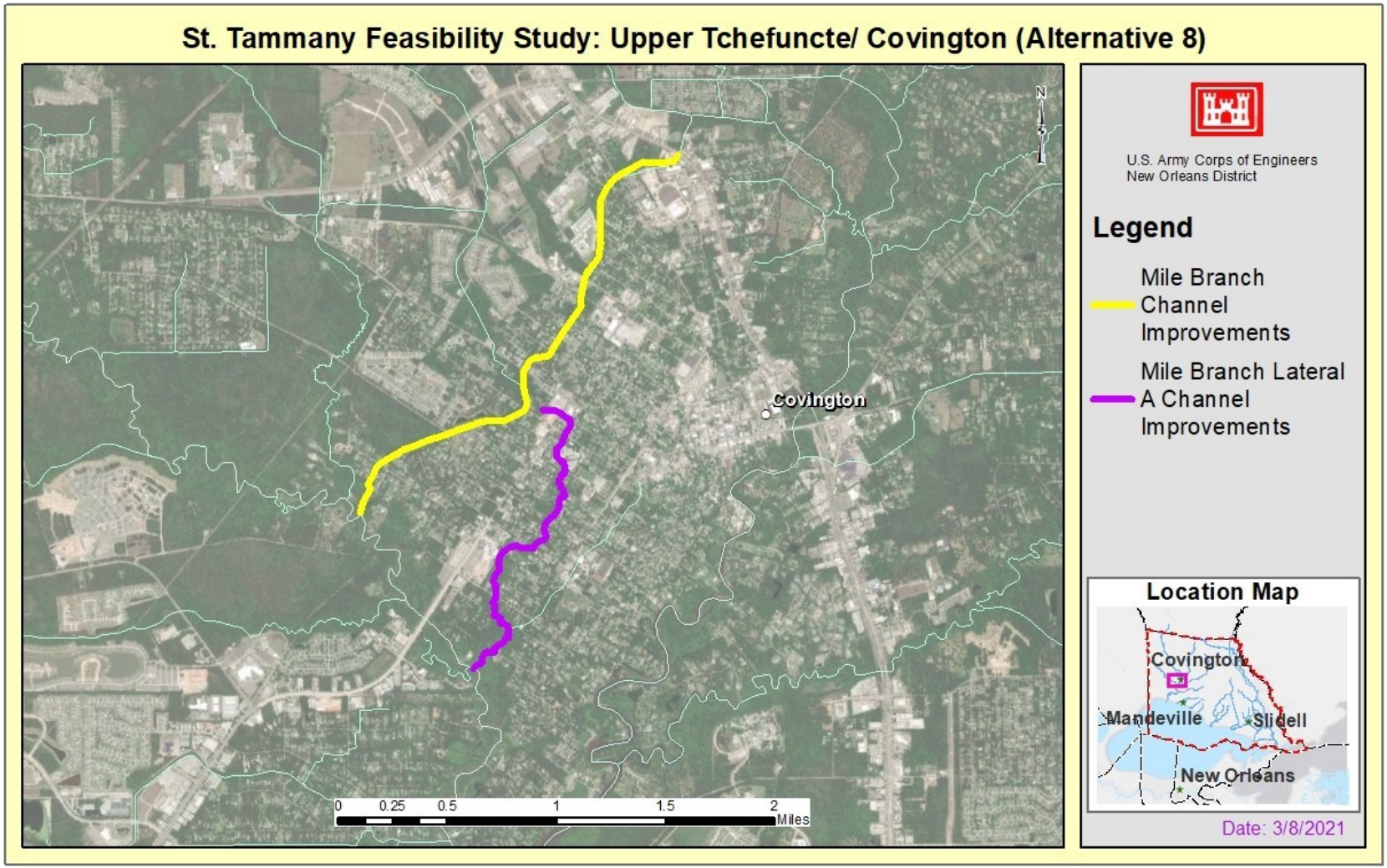

Figure B:2-29. Alternative 8- Upper Tchefuncte/ Covington

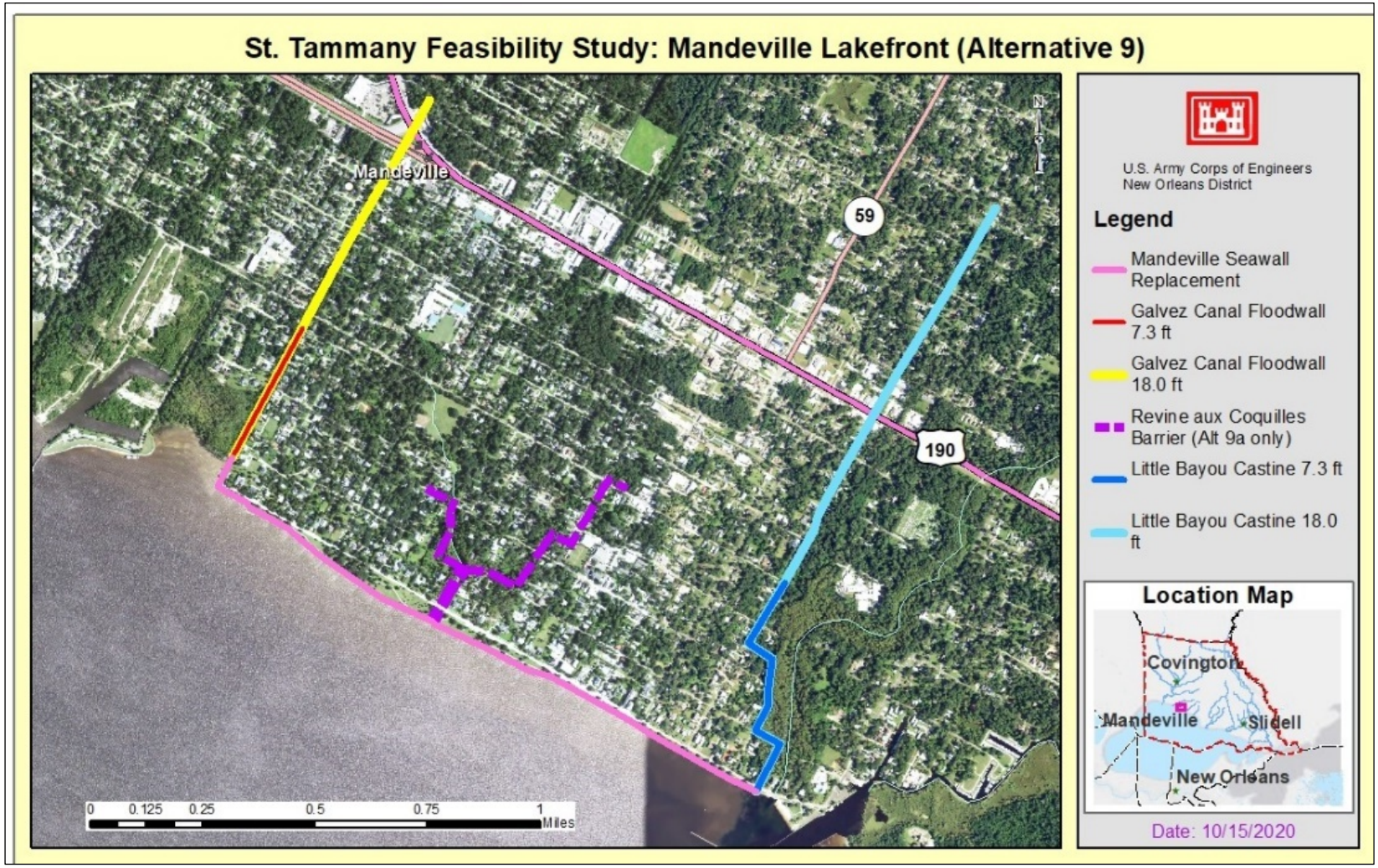

Figure B:2-30. Alternative 9- Mandeville Lakefront

Section 3

LOCAL FLOOD POLICIES AND MANAGEMENT

There are a variety of activities that are being conducted at the State, Parish and/or municipality level to reduce and or mitigate flood risk. While the TSP proposed, provides a suite of measures to reduce flood risk management and coastal storm risk in the study area, the plan would not solve all of flooding problems within St. Tammany Parish, Louisiana. Due to the large scale, complexity, and multiple sources of flooding in St Tammany Parish, risk reduction would require multiple management strategies at numerous levels. This section provides a brief summary of the flood reduction or mitigation policies and activities in place within St. Tammany Parish that were considered during the plan formulation process including: comprehensive planning, hazard mitigation planning, zoning and land use, local ordinances and the National Flood Insurance Program, Community Rating System (CRS) participation and Coastal Zone Management.

It should be noted that a floodplain management plan prepared by the NFS will be required prior to implementation in accordance with WRDA Section 402(c) of WRDA 1986 and Section 209, to ensure that the level of risk reduction of the project is preserved.

Table B:3-1 Summary of Flood Management Planning Efforts and Policies Applicable to the Study Area

Planning Efforts		
CPRA	2012, 2017 and 2023 Louisiana Coastal Master Plan	Include protection and restoration goals of reducing coastal flood risk, promoting sustainable ecosystems, providing habitats for a variety of commercial and recreational activities coast wide, strengthening communities, and supporting regionally and nationally important business and industry. https://coastal.la.gov/our-plan/2017-coastal-master-plan/
St Tammany Parish	Coastal Master Plan	Holistic watershed approach to address water quality, riverine flooding, and coastal erosion. http://www.stpgov.org/files/Departments/Grants/STP-Coastal-Mast-Plan-2017-BLUE-PLAN4.pdf
St Tammany Parish	New Directions 2025 – St. Tammany Parish Comprehensive Plan (2003)	Addresses community facilities, critical and sensitive areas, economic development, essential community design, housing, land use, natural hazards, transportation, and implementation. http://www.stpgov.org/new-directions-2025

St Tammany Parish	Storm Water Management Plan (2017)	St. Tammany Parish Stormwater Management Plan (SWMP)
City of Covington	Flood Response Plan-2018	https://thewaterinstitute.org/assets/docs/reports/Covington-Flood-Response-Plan-29-Oct-2018.pdf
City of Slidell	Master Plan	
Hazard Mitigation Plans-Hazard mitigation plans are multi-disciplinary risk reduction plans required by the Federal Emergency Management Agency (FEMA) for states and parishes to receive mitigation grants. These local mitigation plans form the foundation for communities' comprehensive and long-term strategies to reduce disaster losses. They also create a framework for risk-based decision making to protect health and safety, reduce damage to property, and minimize disruptions to the economy and governmental operations from future disasters. (CPRA 2017)		
State Hazard Mitigation Plan	Louisiana State Hazard Mitigation Plan (SHMP).	Produced by LA Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP) produces the SHMP and analyzes a range of climatological, geological, and human-influenced hazards, and assesses the relative risk they pose at the parish level based on past events. Hazards incorporated in the SHMP include: coastal erosion, dam failure, drought, earthquake, extreme heat, flooding, levee failure, saltwater intrusion, sea level rise, sinkholes, storm surge, subsidence, thunderstorms (hail, high wind, and lighting), tornadoes, tropical cyclones, wildfires, and winter weather.
St Tammany Parish	St. Tammany Parish Hazard Mitigation Plan, updated in 2020	Comprehensive plan for disaster relief in St. Tammany Parish. This plan is multi-jurisdictional and includes the following jurisdictions: Unincorporated St. Tammany Parish, Town of Abita Springs, City of Covington, Village of Folsom, Town of Madisonville, City of Mandeville, Town of Pearl River, City of Slidell, and Village of Sun. This plan provides the process, identifies natural hazards and risks within the parish and identifies the parish's hazard mitigation, which is done to make the parish less vulnerable and more disaster resilient.
Regulatory Tools- Zoning, subdivision regulations, unified development codes, infrastructures standards and building codes, ordinances and other regulations are key tools that can help communities reduce their flood risk. These types of statutory rules are the conduits through which plans and policies are implemented and achieve on the ground results (CRPA 2017).		
St Tammany Parish	Building Codes	St. Tammany Parish has a published building code, which is available online through the Permits and Regulatory Department of the parish government as a separate document and as Appendix D of the Code of Ordinances. The building code applies to the unincorporated portions of the parish and operates within the context of the State of Louisiana Uniform Construction Code, which requires the enforcement of the current editions of the Family of International Building Codes. Division 5 (Provisions for Flood Hazard Reduction) of the Parish Code of Ordinances stipulates that the first floor of new or substantially improved residential, commercial, and industrial structures must be above the base flood elevation. (GEC 2012)
St Tammany Parish	Unified Development Code	Subdivision ordinances, much like zoning, offer a tool for shaping future and on-going development. Essentially these are ordinances that offer ability and flexibility to developers to allow them, through

	(including Subdivision Ordinances),	design and location, keep development within a subdivision isolated to those areas that have lower hazard exposure. These ordinances can also help ensure features like wetlands and greenways that can provide mitigation services through water retention for example, are maintained, enhanced, and perhaps even created. (Peacock et al 2009). St. Tammany has an officially adopted Uniform Development Code – Volume 1 (Zoning), which is available online through the Planning Department of the parish government and identifies the various zoning districts (residential, commercial, industrial, medical, public facilities, etc.). Officially adopted zoning maps are available online at the parish, regional, and ward level. The Unified Development Code continues to evolve with new classifications being added and the requirements for existing classifications modified. (GEC 2012) St. Tammany Parish Code of Ordinances
Town of Abita Springs	Codes and Ordinances	https://library.municode.com/la/abita_springs/codes/code_of_ordinances
Village of Folsom	Code and Ordinances	https://www.codepublishing.com/CA/Folsom/
Town of Madisonville	Codes and Ordinances	https://library.municode.com/la/madisonville/codes/code_of_ordinances
City of Mandeville	Codes and Ordinances	https://library.municode.com/la/mandeville/codes/code_of_ordinances
City of Covington	Codes and Ordinances	https://library.municode.com/la/covington/codes/code_of_ordinances
Town of Pearl River	Code and Ordinances	https://library.municode.com/la/pearl_river/codes/code_of_ordinances
City of Slidell	Codes and Ordinances	https://library.municode.com/la/slidell/codes/code_of_ordinances
National Flood Insurance Program (NFIP)- aims to reduce the impact of flood damages on communities through increased access to affordable flood insurance in exchange for community adoption of floodplain management standards and regulations. In order to provide communities with opportunities to reduce flood insurance costs in exchange for additional flood risk reduction actions and more stringent ordinances, NFIP also encourages participation in CRS. Communities that enroll in CRS receive additional reductions in flood insurance premiums for implementing activities supporting four main goals: 1) increasing access to information about flood risk and risk reduction options, 2) improving floodplain mapping and regulatory standards, 3) promoting flood damage reduction activities, and 4) promoting flood preparedness plans (CPRA 2017).		
St Tammany Parish	CRS Score 7	
Covington	CRS Score 10	
Mandeville	CRS Score 7	
Slidell	CRS Score 7	
DFIRM-While flood damage prevention ordinances that meet or exceed the minimum standards of NFIP are currently in place, not all communities have updated Digital Flood Insurance Rate Maps (DFIRMs) with final effective BFEs. As the Parish and communities adopt the latest DFIRMs and BFEs, new work will be required periodically to assure that the latest land elevations, benchmarks, storm surge modeling, and other		

relevant information about Louisiana's dynamic coast are incorporated (CPRA 2017). FEMA's flood insurance study for St. Tammany Parish covers Slidell, Covington, Mandeville, Madisonville, Abita Springs, Pearl River, Folsom, Sun, and the unincorporated areas and includes flooding from Lake Pontchartrain, with revisions completed in April 2008. (GEC 2012)		
FEMA available flood hazard data as of 11-30-2020 (FEMA)		Location of Data
ABITA SPRINGS, TOWN OF	Effective FIRM 5/17/1988	https://msc.fema.gov/portal/availabilitySearch?addcommunity=220199
COVINGTON, CITY OF	Effective FIRM 11/19/1980	https://msc.fema.gov/portal/availabilitySearch?addcommunity=220200
FOLSOM, VILLAGE OF	Effective FIRM 3/16/1982	https://msc.fema.gov/portal/availabilitySearch?addcommunity=220285
MADISONVILLE, TOWN OF	Effective FIRM 3/16/1983	https://msc.fema.gov/portal/availabilitySearch?addcommunity=220201
MANDEVILLE, CITY OF	Effective FIRM 5/16/2012	https://msc.fema.gov/portal/availabilitySearch?addcommunity=220202
PEARL RIVER, TOWN OF	Effective FIRM 5/4/1988	https://msc.fema.gov/portal/availabilitySearch?addcommunity=220203
SLIDELL, CITY OF	Effective FIRM 4/21/1999	https://msc.fema.gov/portal/availabilitySearch?addcommunity=220204
ST. TAMMANY PARISH*	Effective FIRM 4/21/1999	https://msc.fema.gov/portal/availabilitySearch?addcommunity=225205
SUN, VILLAGE OF	Effective FIRM 7/1/2013	https://msc.fema.gov/portal/availabilitySearch?addcommunity=220205
ABITA SPRINGS, TOWN OF	Preliminary 4/4/2008. Revised on 4/30/2008	FEMA MIP
COVINGTON, CITY OF	Preliminary 4/4/2008. Revised on 4/30/2008	FEMA MIP
FOLSOM, VILLAGE OF	Preliminary 4/4/2008. Revised on 4/30/2008	FEMA MIP
MADISONVILLE, TOWN OF	Preliminary 4/4/2008. Revised on 4/30/2008	FEMA MIP
PEARL RIVER,	Preliminary 4/4/2008.	FEMA MIP

TOWN OF	Revised on 4/30/2008	
SLIDELL, CITY OF	Preliminary 4/4/2008. Revised on 4/30/2008	FEMA MIP
ST. TAMMANY PARISH	Preliminary 4/4/2008. Revised on 4/30/2008	FEMA MIP
SUN, VILLAGE OF	Preliminary 4/4/2008. Revised on 4/30/2008	FEMA MIP
Coastal Zone Management Program-CZMP attempts to "balance conservation and resources, . resolve user conflicts, encourage coastal zone recreational values, and determine the future course of coastal development and conservation" (DNR, 2015, p. II-2). While the Program typically pertain to projects that have "direct and significant impacts on coastal waters," it also refers directly to minimizing the risk due to flood and storm hazards (CPRA 2017)		
State of Louisiana	Louisiana Coastal Resources Program (CRP). http://www.dnr.louisiana.gov/index.cfm/page/85	

Section 4

BORROW SITE INVESTIGATIONS

4.1 INTRODUCTION

The term “borrow” is used in the fields of construction and engineering to describe material that is dug in one location for use at another location. The term borrow material is used to describe soil or sediment taken from a site for use in structure construction, such as sandy sediment dredged and pumped to restore an eroded beach, or clay taken to build a levee or dike. The term borrow pit is used to describe the site remaining after borrow material has been removed (EM 1110-2-5026).

The intent of this initial investigation was to provide a level of detail sufficient to support the TSP decision, demonstrate that there are sufficient available options for borrow for the proposed TSP and provide NEPA clearance on selected potential borrow sites, STP-5, STP-6, STP-9, MS-1, and MS-2. These sites are detailed further in Table B4-1 and shown on Figure B4-1. The only measure of the TSP that require borrow material are West and South Slidell Levees and Floodwalls which would require approximately 1.5 Million cubic yards of suitable clay fill (See Section 6 of the main report and Appendix D for additional details regarding the selected TSP for borrow).

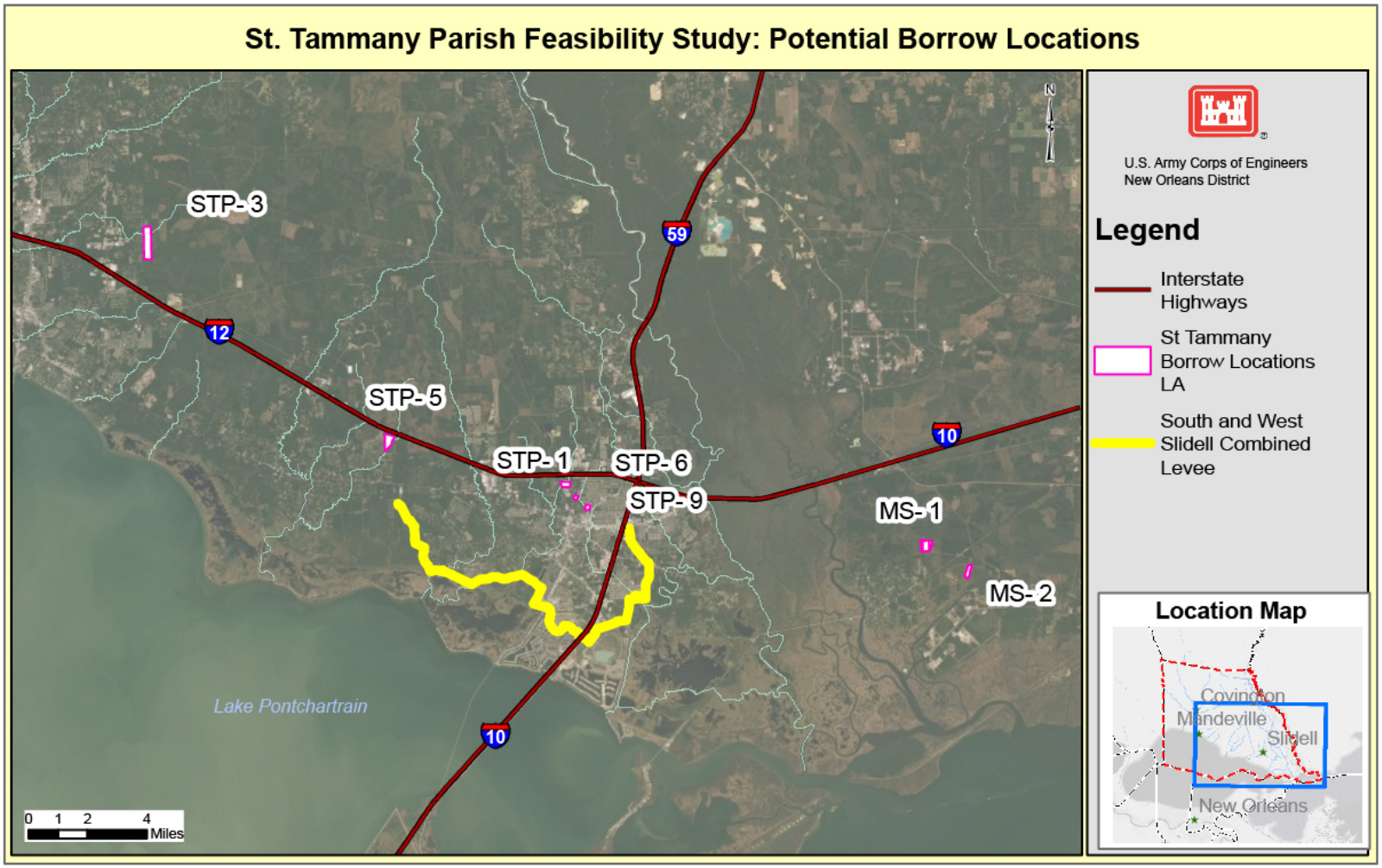

Figure B:4-1. Map of borrow sites. Sites STP-5, STP-6, STP-9, MS-1 and MS-2 retained for further consideration.

4.2 REFERENCES FOR THE ACQUISITION OF BORROW MATERIAL

The following regulations and authorities pertain to the acquisition of borrow material:

- EM 1110-2-1913, Chapter 4, Borrow Areas.
- MVD SOP 2009-01, Real Estate: Acquisition of Borrow Material.
- EO 11990, Protection of Wetlands.
- ER 200-2-2, Environmental Quality, Procedures for Implementing NEPA.
- ER 405-1-12, Section 12-9, Determining the Appropriate Interest to Acquire.
- ER 405-1-12, Section 12-10, Determining the Appropriate Estate.
- ER 405-1-12, Section 12-16, Real Estate Plan.
- ER 405-1-12, Section 12-18, Baseline Cost Estimate for Real Estate.
- ER 405-1-12, Section 12-29, LER and Relocations Required Relocations for Cost Shared Projects.
- ER 405-1-12, Section 12-34, Government Acquisition of LER and Performance of Relocations on Behalf of Nonfederal Sponsors.
- ER 1105-2-100, Planning Guidance Notebook, Appendix C, Environmental Evaluation and Compliance.
- ER 1165-2-132, Hazardous, Toxic and Radioactive Waste (HTRW) Guidance for Civil Work Projects.

4.3 IDENTIFICATION OF POTENTIAL BORROW SITES

The PDT initiated their investigations by identifying and ranking potential borrow sources in terms of the location, suitability and land use that best avoid and minimize adverse environmental impacts from the excavation, and haul distance. Throughout the process, the PDT coordinated with STPG, the NFS, stakeholders and other ongoing projects to identify potential borrow sources. In addition to identification of new borrow sites, the PDT investigated previous sites that were identified during the Hurricane Storm Damage Risk Reduction System (HSDRRS) borrow evaluation process https://www.mvn.usace.army.mil/Missions/Environmental/NEPA-Compliance-Documents/HSDRRS-Projects/) since some have readily available borrow materials and available site data. It was acknowledged that these sites may need additional investigations and their NEPA clearance updated prior to usage. Furthermore, the PDT used landowner parcel data, aerial maps, National Wetland Inventory datasets, United States Department of Agriculture (USDA) Soil Maps (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm) existing geology and geotechnical information to identify sites within St. Tammany Parish and nearby Hancock County, Mississippi with potentially suitable soil characteristics and suitable land characteristics. The PDT identified potential borrow sites along with the previously investigated HSDRRS sites that were evaluated and screened based on the estimated amount of borrow available and environmental risks. Through the investigation, a total of 34 sites were identified. Table B4-1 further details the screening and evaluation process and identifies the five sites the team moved forward.

Factors considered by the PDT in identifying and evaluating potential borrow sites:

1. **Environmentally sensitive areas**, including wetlands, BLH forest, were deemed critical areas to be avoided whenever practicable and possible.
2. **Section 404 of the Clean Water Act** regulates impacts to waters of the U.S., which could include streams, rivers, some lakes/ponds, and wetlands. Avoid and minimize impacts to "waters of the United States" and/or wetlands.
3. **Haul distances** should be minimized to reduce costs associated with material transportation; therefore, sites were identified near the TSP levee and floodwall system. Sites with suitable material and using the shortest possible access routes (i.e., shortest haul distance less than 15 miles) near Slidell, LA were identified. Distance from the work site was considered during the screening of borrow sites. Borrow sites must be accessible by equipment required to excavate and transport material to project location. (i.e. Excavators, dozers, scrapers, tractors and pans, over the road or off-road dump trucks).
4. **HTRW**. Soils exhibiting hazardous waste characteristics (40 CFR 261.21-261.24), even if naturally occurring, are not eligible as borrow material. Generally, soil with concentrations exceeding toxicity characteristic leaching procedure (TCLP) levels specified in 40 CFR 261.24 or significantly exceeding background levels are unsuitable as borrow material.
5. **Suitability of material**. The PDT used USDA Soil Survey Data (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm) and available engineering, geology and geotechnical information during this initial investigation to identify suitable clay sites.

    - Available geology and geotechnical information for Sites STP 1 thru 5: See Appendix D of the St. Tammany Parish Louisiana, DIFR for a preliminary geologic analysis of the five proposed sites in St. Tammany Parish (STP 1-5 from Table 1).
    - Available geology and geotechnical information for Sites MS-1 and MS-2: Individual Environmental Report (IER) 19 and IER 23 are incorporated by reference for the completed analysis of the HSDRRS approved Pearlington Dirt site (MS-1) and IER 31 for the geology and geotechnical information on the Port Bienville site (MS-2) in Hancock, Mississippi.
    - New Orleans District > Missions > Environmental > NEPA Compliance Documents > HSDRRS Projects (army.mil)

6. **Land uses** were evaluated in terms of borrow source locations that have the greatest ability to avoid and minimize environmental impacts. For example, areas to be avoided are those with BLH and wetlands. Preferred land uses include but are not limited to previously cleared land and prior-converted cropland.
7. **Parcel Data**. The PDT used landowner parcel data as a tool to identify potentially suitable clay sites that were in public ownership within St. Tammany Parish.

8. **Quantity**. Availability of sufficient quantities of suitable material were estimated for the identified sites. It was assumed that 10-15 feet of usable material could be found in these sites

4.4 SUMMARY

This evaluation of borrow for the TSP led to the identification of three sites in St. Tammany Parish and two sites in Hancock County, Mississippi as potential borrow sources See Figure B:4-2- B:4-6. These sites include land cleared of vegetation and previously investigated HSDRRS borrow sources. The three sites in St. Tammany Parish would be acquisition that would have no mitigation requirements. The two sites in Hancock County, Mississippi are recently active commercial sites that might be available for use subject to a Project Partnership Agreement (PPA) and normal USACE Real Estate acquisition processes.

Environmental resource assessments were performed on the five sites (ST-5, ST-6, ST-9, MS-1 and MS-2) in the DIFR/DEIS Chapter 5 to determine if significant impacts to potentially affected resources in the proposed borrow areas. The potentially affected resources included wetlands, uplands, prime and unique farmland, fisheries, wildlife, T&E species, cultural resources, recreational resources, noise, and aesthetics.

The proposed borrow sites avoid impacts to wetlands and are not expected to require compensatory mitigation. Any additional potential borrow sites besides the five included in the St. Tammany Parish Feasibility Study will require supplemental environmental evaluations in accordance with the NEPA.

This investigation supports the TSP decision and demonstrates a number of potential borrow site options within the vicinity of the TSP, containing approximately 27.3 Million cubic yards of borrow where only 1.5 Million cubic yards is estimated to be needed for construction of the TSP and follows environmental operating principles to reduce impacts. The final borrow sources are selected prior to acquisition and may include borrow material from all sites, from just one of the identified sites or a combination of sites depending on the suitability of the sites. The necessary right of entry and onsite surveys to get the additional information needed for site selection including geologic profiles, borings, and Cone Penetration Test (CPTs) would be obtained.

Transportation routes and mechanisms for the delivery of borrow material have been examined and can be achieved using highways including Interstate-10, Highway 190, Highway 433 and Highway 11. Sensitive areas such as schools and hospital would be avoided. These actions are expected to avoid and minimize transportation, noise and socioeconomic impacts. Staging areas and haul roads would be contained within the borrow site and construction footprints.

The borrow sites have been previously investigated and partially or fully cleared for Cultural Resources. See IER 19, 23 and 31 for sites MS-1 and MS-2 and SHPO report #'s 22-3725, 22-5346 and 22-3151 for the St Tammany sites. For additional information regarding environmental resource borrow evaluation see Section 5 of the DIFR/DEIS.

A Phase I Endangered Species Act (ESA) will be conducted by the New Orleans District (MVN) on proposed borrow sites.

The final borrow site(s) design would include slopes, depths, drainage, environmental design considerations. Best management practices would be developed and would address the installation of signage, construction fencing and gates, and erosion control. A stormwater pollution prevention plan (SWPPP) would be prepared in accordance with EPA and state regulations. The SWPPP will outline temporary erosion control measures, such as silt fences, retention ponds, and dikes. The construction contract will include permanent erosion control measures, such as turfing and placement of riprap or filter material.

Table B4-1- Potential Borrow Site Identification for the St. Tammany Parish Feasibility Study. Bolded highlighted sites were moved forward.

Site #	**Site Name**	**Location**	**Estimated Borrow Pit Acreage**	**Estimated Fill Volume (cubic yards)**	**Screening/Notes**	**Source**	**Haul Distance (Approximate distance in miles)**
STP-1	Ben Thomas	Slidell, LA	34	861,867	Screened- Adjacent to Ski Lake Task Force Guardian pit that was used and filled as pond, risk -potential impacts to BLH.	STPG HSDRRS	3.5
	Levis	Slidell, LA	51	1,282,470	Screened-North section developed for borrow; residential development is south section	Approved IER-31 (2010)	2.5
STP-3	Maritime	Mandeville, LA	176	4,384,100	Screened- potential impacts to BLH, if determined to be needed to meet fill requirements the site would need mitigation	STPG HSDRRS	12
	Murphy TFG	Pearl River, LA	194.055	4,832,480	Screened- potential impacts to BLH, approval declined during HSDRRS process	STPG HSDRRS	9
	Ski Lake TFG	Slidell, LA	56	1,416,790	Screened-Developed; retention pond on site	STPG HSDRRS	3.5
	Tammany Holding Company	Slidell, LA	332	8,291,880	Screened-Developed; retention pond on site	Approved IER-29 (2008)	1
	Site 1- Tax Free Nature Conservancy	St. Tammany Parish	0.001	0	Screened- Available quantity	PDT-NRCS Soil layer and public property	22
	Site 2- Tax Free	St. Tammany Parish	803	0	Screened-Environmental Impacts Within Big Branch Marsh NWR; available quantity	PDT-NRCS Soil layer and public property	1.5
	Site 3- Tax Free	St. Tammany Parish	0.009	0	Screened-Available quantity/too small	PDT-NRCS Soil layer and public	3
	Site 4- Tax Free	St. Tammany Parish	100	2,509,671	Screened-Environmental Impacts Within Big Branch Marsh National Wildlife Refuge(NWR)	PDT-NRCS Soil layer and public property	5.5
	Site 5- Tax Free	St. Tammany Parish	33	825,360	Screened-Environmental Impacts Within Big Branch Marsh NWR	PDT-NRCS Soil layer and public property	5

	Site 6- Tax Free	St. Tammany Parish	1.7	42,603	Screened- Available quantity/ too small	PDT-NRCS Soil layer and public	3
	Site 7- Tax Free	St. Tammany Parish	1.6	39,416	Screened- Available quantity/ too small	PDT-NRCS Soil layer and public	3
	Site 8- Tax Free 3101E Causeway	Mandeville, LA	1.5	38,072	Screened- Available quantity/ too small	PDT-NRCS Soil layer and public property	14
	Site 9 - Tax Free	St. Tammany Parish	1.4	34,237	Screened- Available quantity/ too small	PDT-NRCS Soil layer and public	3
	Site 10- Tax Free Nature Conservancy	Lacombe, LA	367	9,144,798	Screened-Wetland Impacts	PDT-NRCS Soil layer and public property	20
	Site 11- Tax Free	Mandeville, LA	0.041	1,020	Screened- Available quantity/ too small	PDT-NRCS Soil layer and public	14.5
	Site 12- Tax Free	Mandeville, LA	3.4	84,585	Screened-Environmental Impacts BLH and on Scenic River (Bayou Chinchuba)	PDT-NRCS Soil layer and public property	14.5
	Site 13- Tax Free-Weldon Park	Mandeville, LA	12.4	309,606	Screened-Environmental Impacts BLH and on Scenic River (Bayou Chinchuba)	PDT-NRCS Soil layer and public property	14.5
	Site 14- Tax Free-1923 Jefferson Street	Mandeville, LA	19.7	490,330	Screened-Environmental Impacts BLH and on Scenic River (Bayou Chinchuba)	PDT-NRCS Soil layer and public property	14.5
	Site 15- Tax Free	St. Tammany Parish	8.8	218,821	Screened-Environmental Impacts Within Big Branch Marsh NWR	PDT-NRCS Soil layer and public	5.5
	Site 16- Tax Free	St. Tammany Parish	8.7	216,306	Screened-Environmental Impacts Within Big Branch Marsh NWR	PDT-NRCS Soil layer and public	5
	Site 17- Tax Free	Mandeville, LA	0.24	5,976.00	Screened- Available quantity/ too small	PDT-NRCS Soil layer and public property	11.5
	Site 18- Tax Free 3010 Causeway Approach	Mandeville, LA	5.8	143,349	Screened-environmental impacts	PDT-NRCS Soil layer and public property	12
	Site 19- Tax Free	St. Tammany Parish	1.2	29,357	Screened- Available quantity/ too small	PDT-NRCS Soil layer and public	0.1
	Site 20- Tax Free – St Tammany Mitigation	St. Tammany Parish	88	2,180,916	Screened- Not available for use; mitigation bank	PDT-NRCS Soil layer and public property	14

	Site 21- Tax Free	St. Tammany Parish	1.7	41,433	Screened- Available quantity/ too small	PDT-NRCS Soil layer and public property	1.5
	Site 22- Tax Free	St. Tammany Parish	38.4	956,259	Screened-Impacts BLH, Bayou Castine and Fontainbleau State Park	PDT-NRCS Soil layer and public property	10
	Site 23- Tax Free	Mandeville, LA	1.0	24,775	Screened- Available quantity/ too small	PDT-NRCS Soil layer and public property	10.5
	Site 24- Tax Free	Mandeville, LA	1.3	33,366	Screened- Available quantity/ too small	PDT-NRCS Soil layer and public	11
STP-5	**Cleared Site 5**	**Lacombe, LA**	**73**	**1,817,700**	**Carried Forward- barren, land with no vegetation, existing retention pond- potential to increasing the retention capacity at this site-beneficial location, falls within defined soil/environmental parameters, and already has a similar land use**	**PDT identified based on previously cleared lands and available soil data**	**2**
STP-6	**Cleared Site 6**	**Slidell, LA**	**10**	**249,000**	**Carried Forward, cleared barren land with no vegetation**	**PDT identified based on previously cleared lands and available soil data**	**3.5**
STP-9	**Cleared Site 9**	**Slidell, LA**	**17**	**423,300**	**Carried Forward, previously cleared land with no vegetation**	**PDT-cleared lands**	**3**
MS-1	**Pearlington**	**Hancock County, MS**	**326**	**8,000,000**	**Carried forward- 3 potential sites at location (2 approved). Potential commercial site. Remaining borrow available at each needs to be determined. Pearlington Phase 3 site has wetlands but wetland areas would be avoided**	**HSDRRS IER 19 and IER 23 (2008)**	**9.5**
MS-2	**Port Bienville**	**Hancock County, MS**	**677**	**16,857,300**	**Carried Forward- HSDDRS approved site- Potential commercial site previously planted in pine for commercial harvesting, mixture of overgrown pine habitat and cleared areas. Remaining borrow available needs to be determined, potential commercial site**	**HSDRRS IER 31 (2010)**	**11**

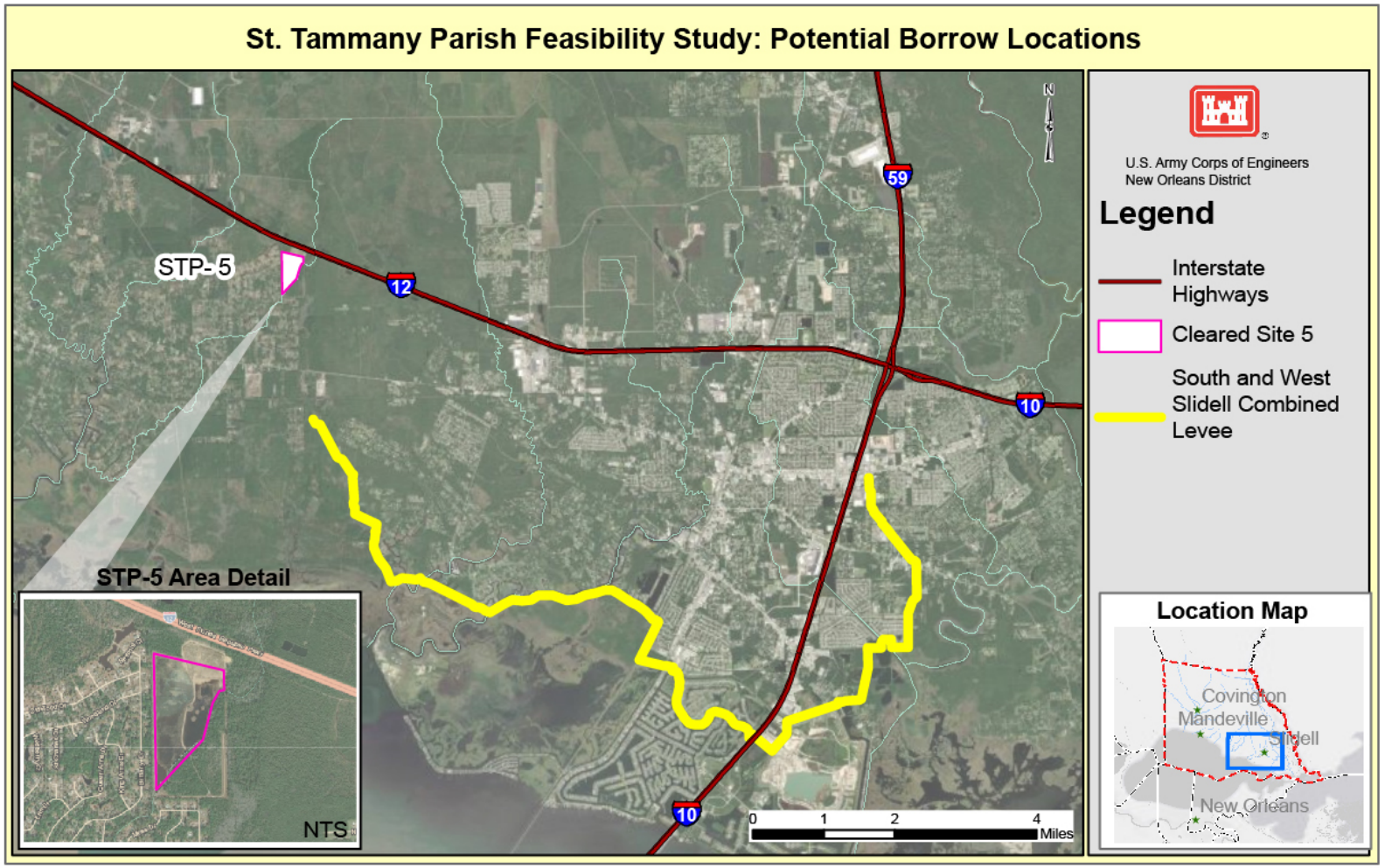

Figure B:4-2. Borrow Site STP - 5

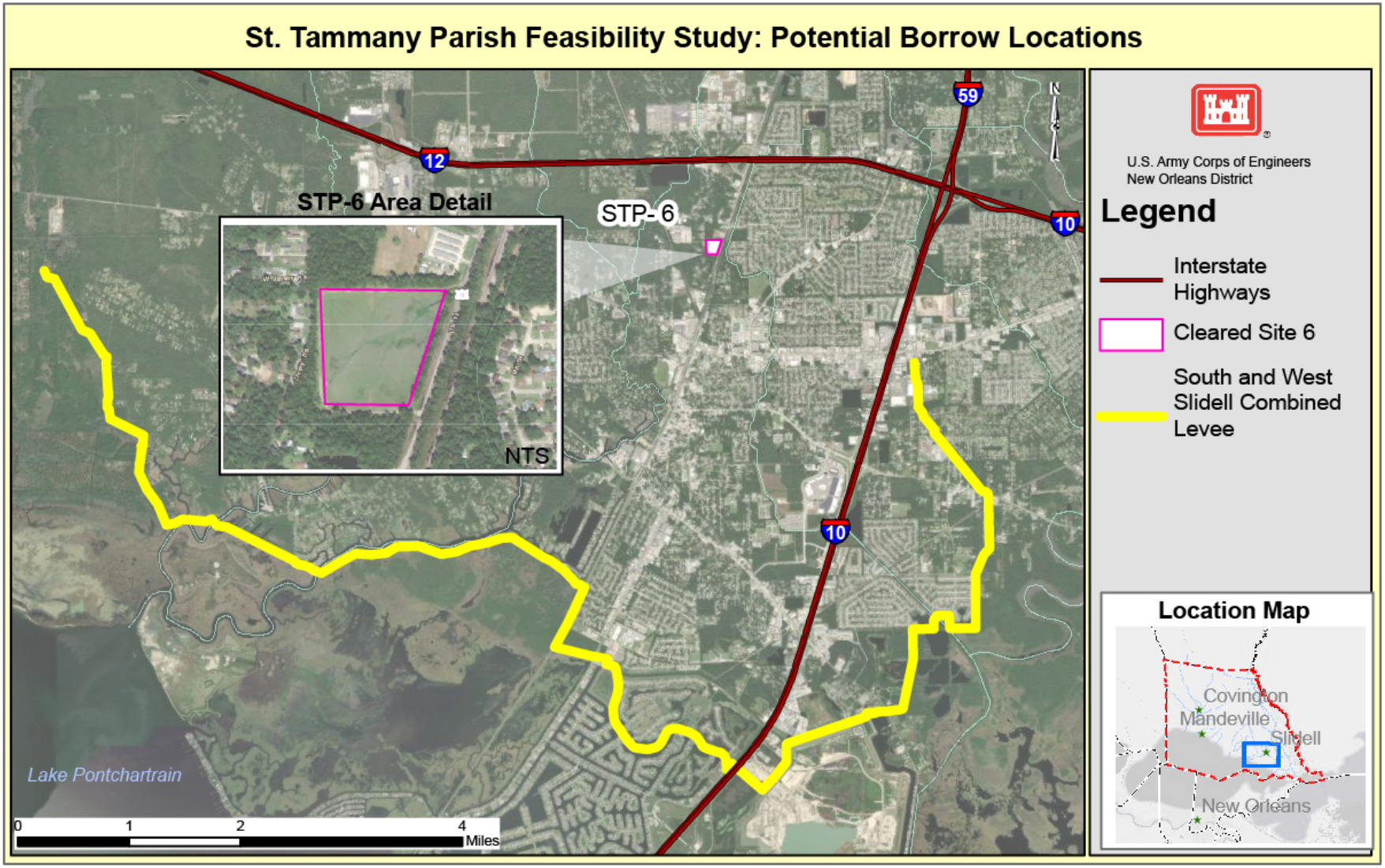

Figure B:4-3. Borrow Site STP-6

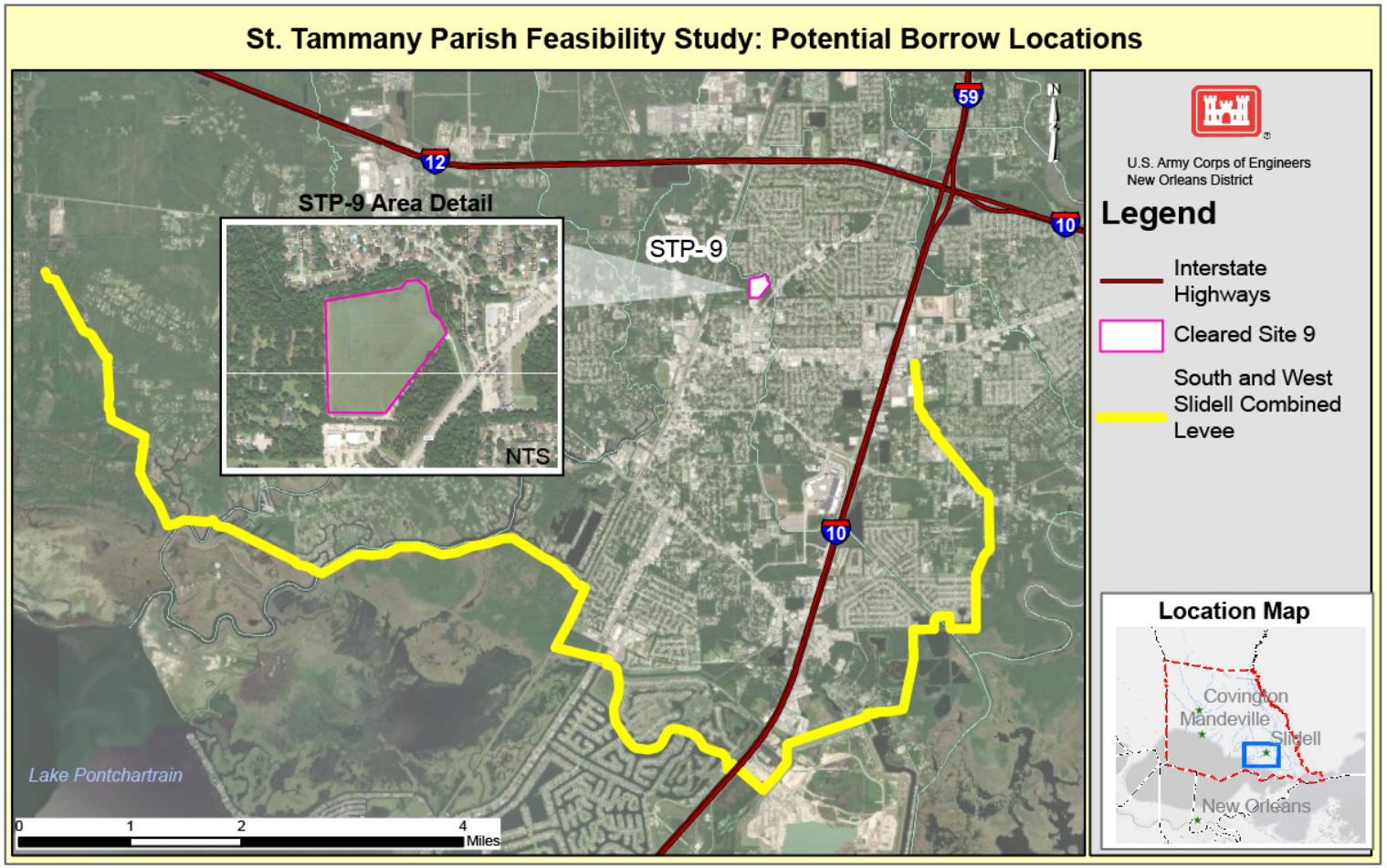

Figure B:4-4. Borrow Site STP-9

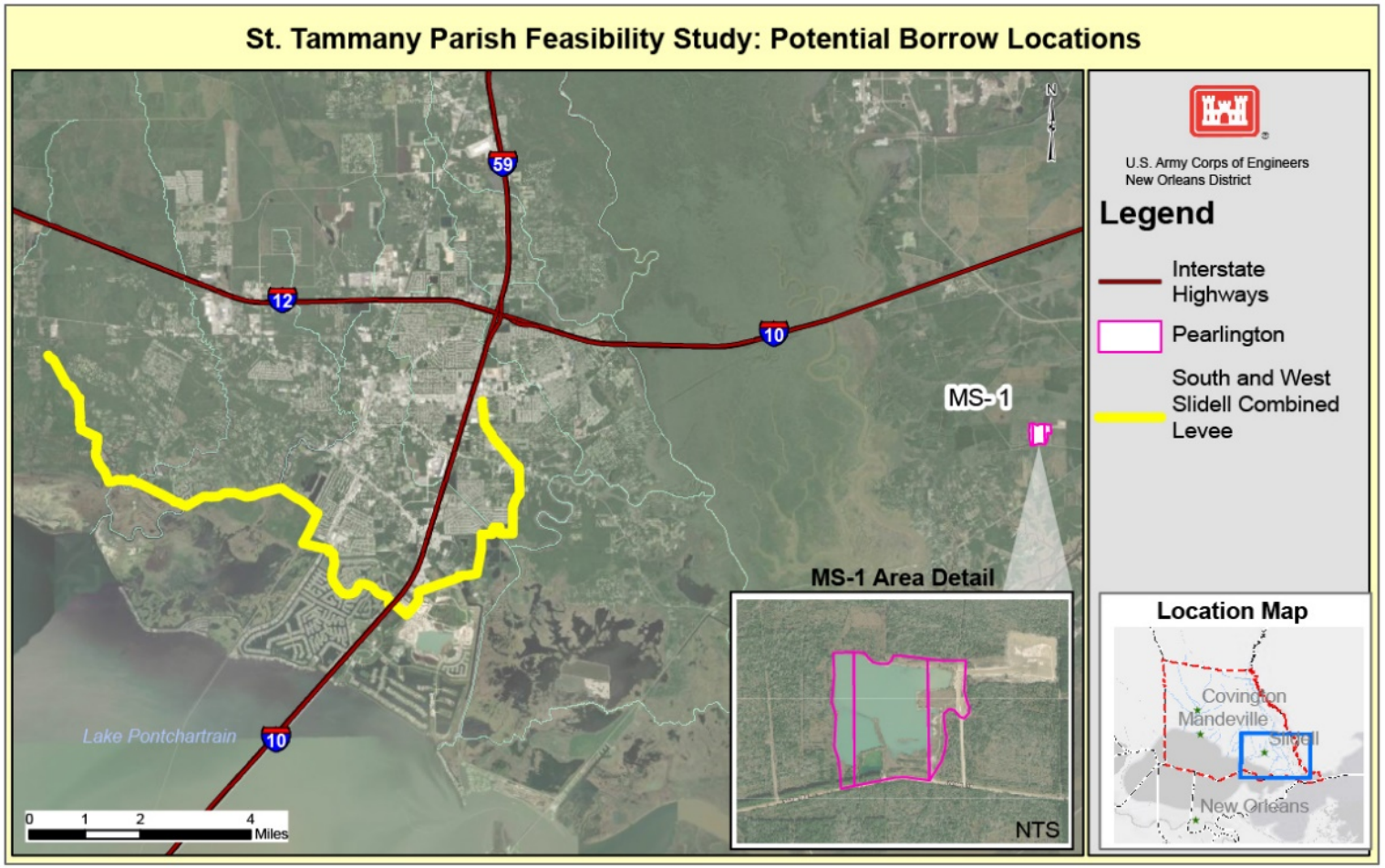

Figure B:4-5. Borrow Site MS-1

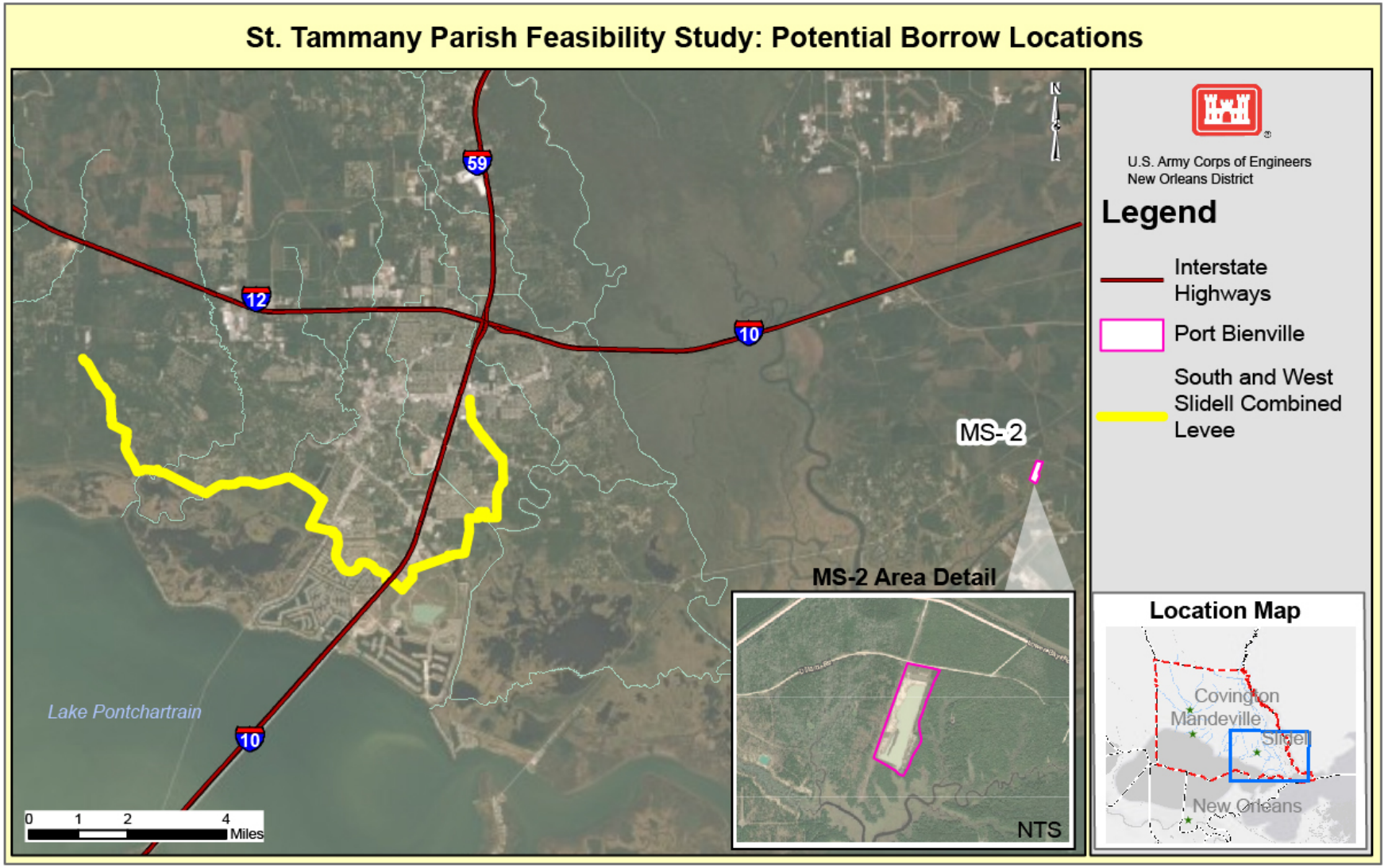

Figure B:4-6. Borrow Site MS-2

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List of Acronyms and Abbreviations

CDBG	Community Development Block Grant
BOEMRE	Bureau of Ocean Energy Management, Regulation, and Enforcement
CIAP	Coastal Impact Assistance Program
CPRA	Coastal Protection and Restoration Authority
CSRM	Coastal Storm Risk Management
CWPPRA	Coastal Wetlands Planning, Protection and Restoration Act
EFH	Essential Fish Habitat
EO	Executive Order
ER	Engineer Regulation
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FRM	Flood Risk Management
FWOP	Future Without-Project
HMGP	Hazard Mitigation Grant Program
HSDRRS	Hurricane Storm Damage Risk Reduction System
HUC	Hydrologic Unit Code
HUD	Housing and Urban Development
IER	Individual Environmental Report
MVN	New Orleans District
NB	Nature Based
NEPA	National Environmental Policy Act
NFS	Non-Federal Sponsor
NMFS	National Marine Fisheries Service
NRCS	National Resources Conservation Service

NS	Nonstructural
OCPR	Office of Coastal Protection and Restoration
PDT	Project Delivery Team
PPA	Project Partnership Agreement
S	Structural
SELA	Southeast Louisiana Urban Flood Control Damage Reduction Project
STPG	St Tammany Parish Government
TSP	Tentatively Selected Plan
USDA	United States Department of Agriculture
WBDHU12	U.S. Geological Survey Watershed Boundary Dataset (WBDHU12)
USACE	United States Army Corps of Engineers
USACE O&M	United States Army Corps of Engineers Operation and Maintenance Program