Mississippi Valley Division, Regional Planning and Environment Division South

St. Tammany Parish, Louisiana Feasibility Study

Appendix I - Mitigation Plan

July 2023

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SECTION 1
Introduction

This document details the compensatory mitigation plan for unavoidable habitat impacts associated with the St. Tammany Parish, Louisiana Feasibility Study project. This plan addresses only compensatory habitat mitigation and not the activities performed during project planning to avoid, minimize, rectify, or reduce habitat impacts from each project alternative (see Engineer Regulation (ER) 1105-2-100, Part C-3(b)(12)). Details on those actions are included in the plan formulation and environmental consequences sections (Sections 4 and 5 respectively) of the revised Draft Integrated Feasibility Report and Draft Environmental Impact Statement (DIFR and DEIS). Efforts taken to avoid, minimize, rectify and or reduce habitat impacts still resulted in unavoidable impacts to fish and wildlife resources that required development of a compensatory habitat mitigation plan. This document details the work performed, including coordination, plan formulation, and environmental compliance, to develop the compensatory habitat mitigation plan. An initial draft of the habitat mitigation plan was provided in the June 2021 DIFR and DEIS, this document replaces that original draft mitigation plan and updates the quantities and types of habitat impacts based on field survey and provides a selected plan to compensate for these impacts. The second draft of the mitigation plan will be released for concurrent public, agency, technical and policy review in July 2023. Comments received will be considered in development of the final plan.

SECTION 2
Requirements

The authority and requirements for compensatory habitat mitigation are founded in Federal laws and regulations. The legal foundation for habitat mitigation includes the Clean Water Act, various Water Resources Development Acts (WRDA), and other environmental laws. These laws are implemented and administered through rules, guidance, regulations, and policies issued by the agencies in the Executive Branch. The relevant laws and regulations specific to compensatory habitat mitigation planning for Corps of Engineers civil works projects are listed in Section 20 of this plan. The specific procedures followed to develop this compensatory habitat mitigation plan are found in Engineer Regulation 1105-2-100, Appendix C. Mitigation plans for other types of impacts, such as for cultural resources, environmental justice (Appendix C: Environmental) are also required for a project. Efforts to avoid, minimize, rectify, or reduce those impacts, their mitigation requirements and mitigation plans are not directly related to fish and wildlife habitat impacts and are not covered in this plan and are found in the appendices referenced.

Compensatory habitat mitigation is defined as “the restoration (re-establishment or rehabilitation), establishment, enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved” (see 40 CFR 230.92). Implementation guidance for Section 1163 of the WRDA of 2016 requires functional assessments be performed to define habitat impacts and to set mitigation requirements for impacted habitats.

SECTION 3
Coordination and Collaboration

3.1 ER 1105-2-100, APPENDIX C, SECTION C-2(A) AND SECTION C-3(B)

Development of this plan involved extensive coordination and collaboration with the project's non-federal sponsor (NFS), state and federal agencies. An interagency team comprised of state and federal resource agencies contributed expertise and information toward the identification of habitat impacts and the development of a comprehensive compensatory mitigation plan. The United States Amy Corps of Engineers (USACE) New Orleans District (CEMVN) will continue to coordinate and seek input from these organizations during the design and implementation phases in executing the mitigation plan upon authorization and funding of the St. Tammany Parish, Louisiana Feasibility Study.

The cooperating and participating agencies for the St. Tammany Parish, Louisiana Feasibility Study are listed below. An early interagency coordination meeting with the NFS, resource agencies and local officials was held on 15 January 2020 to comply with the provisions of Section 1005 of the Water Resources Reform and Development Act of 2014. The meeting afforded agencies an opportunity to learn about the St. Tammany Parish Feasibility Study and to provide input into the study. Cooperating agencies were invited to participate in the study and became members of the PDT. Regular meetings were held with the interagency team to provide project updates and offer opportunities to provide feedback into the project planning and development. A smaller habitat evaluation team (HET) consisting of MVN, USFWS and NMFS biologists was established to conduct the habitat analysis.

- Louisiana Coastal Protection and Restoration Authority
- St. Tammany Parish Government St. Tammany Parish Levee, Drainage and Conservation District
- City of Mandeville, La*
- City of Slidell, La*
- Louisiana State Historic Preservation Office*
- Louisiana Department of Wildlife and Fisheries (LDWF)*
- Choctaw Nation of Oklahoma*
- United States Fish and Wildlife Service (USFWS)*
- National Marine Fisheries Service (NMFS)*
- Environmental Protection Agency (EPA)

*Indicates an agency formally serving as a cooperating agency under 40 CFR 1508.5.

A cooperating agency has jurisdiction by law or special expertise with respect to any environmental impact involved in a major Federal action (or a reasonable alternative) for legislation significantly affecting the quality of the human environment. These agencies may

identify specific mitigation measures it considers necessary to allow the agency to grant or approve an applicable permit, license, or related requirements or concurrences. In those instances, the cooperating agency shall cite the applicable statutory authority for the requirements. See 40 CFR 1500.3(b)(2). Although the project NEPA document will discuss which plans were adopted and which were not, the compensatory mitigation plan should include the adopted agency plans. When another agency's mitigation is adopted, the applicable statutory authority should be cited (see 40 CFR 1503.3(e)). Specific agency mitigation measures, or plans are described in detail in Table I:3-1.

Table I:3-1. Agency Submitted Mitigation Plans

Agency	Mitigation Recommendation	Applicable Law	Adopted by Corps of Engineers?
USFWS	Avoid in-stream work during fish migration seasons. Repair riparian habitat damage after construction is completed.	Endangered Species Act (PL 93-205)	Yes – will be part of design if a construction project is recommended.
NMFS	Use a single point for site access. Repair habitat damage in the access corridor after project construction is completed.	Magnuson – Stevens Fishery Conservation and Management Act (PL 94-265)	Yes – will be part of design if a construction project is recommended.

A Habitat Evaluation Team (HET) was developed to assess impacts to the natural environment and develop a compensatory mitigation plan to restore the lost functions and services of the impacted habitat. Members of the HET include the USACE, EPA, USFWS, NMFS and LDWF.

The DIFR and DEIS were released in June 2021 for agency and public comment. Comments from the public related to habitat impacts and mitigation included a request for rock breakwaters to be placed off the shoreline of Lake Pontchartrain. This information helped develop opportunities for potential mitigation work in these areas.

SECTION 4
Inventory and Categorize Ecological Resources

4.1 ER 1105-2-100, APPENDIX C, SECTION C-4(G)(1)

The St. Tammany Parish, Louisiana Feasibility Study project is located in the Lake Pontchartrain Basin within St. Tammany Parish.

St. Tammany Parish is approximately 854 square miles and lies just north of Lake Pontchartrain. The Parish is comprised of 10 major watersheds which include the Pearl River, Gum Bayou, W-14/W-15 basin, Bayou Bonfouca, Bayou Lacombe, Bayou Liberty, Bayou Cane, Bayou Castine, Little Bayou Castine, Bayou Chinchuba and the Tchefuncte River. Land use of the region is both rural and urban and is the most densely populated region in Louisiana. Lake Pontchartrain, an estuary, is located within one of the largest estuarine systems in the Gulf of Mexico containing over 22 essential habitats. Of the 22 vegetative habitat types identified, 15 are classified as wetlands, of which all are in a state of decline. The majority of St. Tammany Parish is located within the Southern Coastal Plains, Gulf Coast Flatwoods ecoregion with a small portion of the most southern boundary of the Parish being located within the Mississippi Alluvial Plain, Deltaic Coastal Marshes and Barrier Islands ecoregion. More than 30 endangered and threatened species are found in the study area.

The Gulf Coast Flatwoods is a narrow region of nearly level terraces and alluvial and deltaic deposits composed of Quaternary-age sands and clays. Soils are a mix of poorly to moderately well drained Entisols, Alfisols, and Ultisols with silty and fine sandy loam surfaces. Historically, longleaf pine dominated the broad flats and low ridges, forming more densely stocked flatwoods and open savannas. A high natural fire frequency was typical, often sparked by lightning and fueled by grasses, and maintained the open pine flatwoods and savannas. While most of the longleaf pine savannas have been lost, remnant savannas are centers of biodiversity supporting a variety of grasses, sedges, rushes, and an array of wildflowers: red lilies, orange milkweeds, yellow pitcher plants, white, orange, and pink orchids, lavender butterworts, and purple sundews. Much of the landscape is now in mixed forest or pine plantations, while some better-drained land has been cleared for pasture or crops. Dominant land uses include woodland, wildlife habitat, and urban.

The HET investigated the habitat resources found in the project area using existing available information and data collected during field surveys completed for the required functional habitat assessments, the Wetlands Value Assessment (WVA) and Habitat Evaluation Procedures (HEP). Sources of existing available information included those obtained from resource agencies, published reports, agency records, and pre-existing field investigations. Table I:4-1 describes how each data source was utilized in developing the mitigation plan.

Table I:4-1. Data Sources

Year	Source of Information	Information	Use in Mitigation Planning
1984	USFWS	The Ecology of Delta Marshes of Coastal Louisiana	Identification of habitat types and locations in the study area.
2005	USACE, Engineer Research and Development Center	Louisiana Coastal Area – Ecosystem Restoration Study – Appendix C Hydrodynamic and Ecological Modeling	Conceptual ecological model of study area wetlands.
2007	USGS and Clemson University	Ecology of Tidal Freshwater Forested Wetlands in the Southeastern U.S.	Characterize significance and scarcity of habitat resource.
2008	USACE, New Orleans District	Amite River Diversion Canal Modification, Louisiana Coastal Area	Source of some mitigation strategies, measures, and alternative plans.
2011	Lake Pontchartrain Basin Foundation	Lake Pontchartrain's Northshore: Recommendations for Restoration and Conservation	background information, source of potential mitigation sites
2013	USACE, New Orleans District	Lake Pontchartrain Vicinity Hurricane Protection Project Mitigation	Source of potential mitigation sites
2014	USACE, New Orleans District	West Shore of Lake Pontchartrain – Feasibility Study – Appendix K – Mitigation & Monitoring & Adaptive Management Plan	Source of mitigation measures and alternatives. Monitoring and adaptive management protocols and ecological success criteria.
2016	USFWS/NatureServe	Rapid Assessment Metrics to Enhance Wildlife Habitat and Diversity within Southern Pine Ecosystems, Volume 1 (draft)	Characterize significance and scarcity of habitat resources
2018	Interagency Team (USACE, federal & state resource agencies)	Interagency field visit report	Inventory and forecast mitigation site resources and conditions. Data for habitat models.
2019	USACE, New Orleans District	Amite Draft Mitigation Plan	Source of potential mitigation sites
2020	USACE, New Orleans District	Environmental Assessment 576	Mitigation Plan
2022	USACE, New Orleans District	Maurepas Supplemental Environmental Impact Statement (SEIS)	Mitigation plan, Conceptual model, Adaptive Management Plan
2022	USACE, New Orleans District	Guste Island Fresh Intermediate Marsh Mitigation, St Tammany Parish	Mitigation plan, Conceptual model, Adaptive Management Plan

Table I:4-2 shows the habitat resources in the project area, the quantity of the resource and

the type of impact to the resource.

Table I:4-2. Impacted Ecological Resources

Habitat	Quantity Impacted	Type of Impact
Pine Savanna	440 acres Direct Non Refuge Direct = 171 Refuge Direct = 21 21 acres of direct impact on BBWNR require land exchange and would need to be mitigated off refuge Indirect Non Refuge = 202.6acres Refuge = 36 acres indirect impacts that require mitigation on Refuge	Direct removal; indirectly by altered hydrology
Fresh/intermediate wetland marsh	123 acres total Direct 123 acres total which includes 77 acres of impact on Big Branch Marsh National Wildlife Refuge (BBMWNR) that require land exchange and would need to be mitigated off refuge Indirect 0 acres There are no marsh impacts to be mitigated on current refuge lands.	Direct removal
Riparian	35 acres total Direct 35 acres Non refuge land Indirect 0	Direct impact; deepening and widening channel; removal of riparian habitat
Stream waterbottoms	Direct 3 acres Indirect 0	Direct impact; deepening and widening channel

4.2 MILE BRANCH RIPARIAN AND STREAM HABITAT

The Tchefuncte River drains into Lake Pontchartrain in Louisiana in the United States. Part of the western boundaries of the lower Tchefuncte River runs along the Washington - St. Tammany Parish boundaries before turning southeastward into St. Tammany Parish, where it passes the City of Covington and the Town of Madisonville. The Tchefuncte River is a designated "Natural and Scenic River" under Louisiana's Natural and Scenic River Act. Mile Branch is a tributary to the Tchefuncte River and thereby is part of the natural and scenic river system. The proposed work on Mile Branch is approximately 2.15 river miles long. It is a highly incised stream with steep banks. The riparian habitat consists predominantly of bottomland hardwood species with an understory of privet, smilax, cottonwood, water oak species. There are approximately 35 acres of riparian habitat, within the mile branch right of way that exists on both sides of the stream, shown in Figure I:4-1. A residential neighborhood exists immediately adjacent to and in some instances on the banks of Mile Branch and the riparian corridor. Riparian habitat is a significant natural resource and are the zones along water bodies that serve as interfaces between terrestrial and aquatic ecosystems. Riparian ecosystems are more structurally diverse and more productive in plant and animal biomass than adjacent upland areas. They are distinctly different from the surrounding lands because of their unique soil and vegetation characteristics that are strongly influenced by free or unbound water in the soil. These areas supply food, cover, and water for a large diversity of animals, and serve as migration routes and connectors between habitats for a variety of wildlife. The Mile Branch provides in-stream habitat for a variety of feeder fish, amphibians, and reptiles. Other wildlife, including mammals, birds, and reptiles, use the stream for watering and foraging.

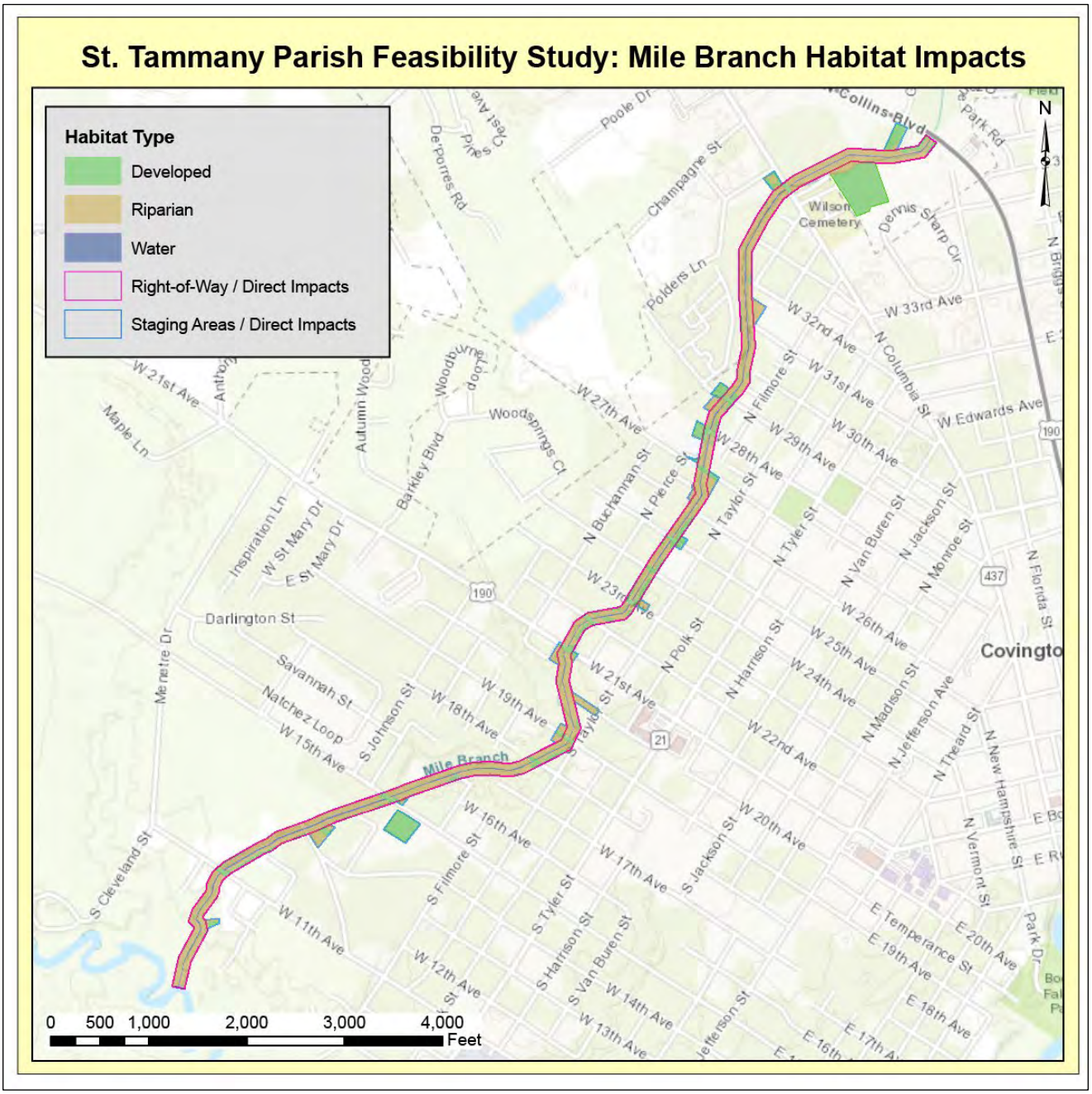

Figure I: 4-1. Habitat in the Mile Branch Project Area

4.3 WEST AND SOUTH SLIDELL

The proposed levee alignment crosses through pine flatwood/savanna forest, fresh/intermediate marsh and commercial/residential development, shown in Figures I:4-2 and I:4-3. The topography of the area is generally flat and low lying. Bayous traversing the

area and flowing into Lake Pontchartrain include Bayous Paquet, Liberty, and Bonfouca. The Pearl River is on the eastern boundaries of the study area, but is not within the proposed project area.

The southeast boundaries of St. Tammany Parish transitions from uplands occurring on gradual sloping to flat topography to wet forested habitat consisting of pine flatwoods toward a fresh/intermediate estuary as it flows into the open waters of Lake Pontchartrain. There are approximately 123 acres of fresh/intermediate marsh and 192 acres of pine flatwood/savanna in the levee footprint. The BBMNWR is located within this project area and contains over 18,000 acres of marsh, offshore grass beds, hardwood hammocks, and pine flatwood/savanna forests. The area is home to the threatened gopher tortoise, red-cockaded woodpecker as well as other important shorebirds, waterfowl and neotropical songbirds. The project area lies within the important Mississippi Flyway providing important resting and foraging habitat for a diverse array of migratory birds.

Pine savannas are found naturally on broad “flats” in an intertwined mosaic with dry-mesic (non-wetland) longleaf pine flatwoods, savannas occupying the poorly drained and seasonally saturated/flooded depressional areas and low flats. Pine savannas are subject to a highly fluctuating water table, from surface saturation/shallow flooding in late fall/winter/early spring to growing-season droughts. These communities naturally experienced frequent fairly low intensity surface fires and with such conditions have a dense herb layer, a very high herb species diversity and an open to sparse pine canopy. In the absence of fire the canopy becomes denser, shrubs invade and herb diversity drops (Schafale and Weakley 1990). There are many rare plants associated with this community type.

Daily tidal fluctuations influence the hydrology of the habitat. Seasonal rainfall flooding also plays a role in habitat composition associated with tolerance of rapid rises and short duration high flows across the landscape. Hurricanes and tropical storms occasionally impact the area with high winds, heavy rainfall, and storm surge flooding. Pine savanna habitat connects downstream lower estuary tidal marshes to upper estuary bottomland forests

Tidal freshwater marsh occurs along the southern and southeastern reaches of the study area where it transitions into intermediate marsh and the open waters of Lake Pontchartrain. These wetlands host a diverse community of vegetation including grasses, sedges, and rushes along with patches of submerged aquatic vegetation. The area provides high value avian foraging habitat particularly for wading birds. These marshes are essential estuarine fishery habitat supporting various life stages of important fish and shellfish. The proposed project would directly remove 123 acres of marsh habitat as part of the structural features of the project.

The proposed project would alter the hydrology of the wetlands and pine savanna habitat. Threats to this habitat include changes to the surrounding landscape that increase or decrease surface water draining into savannas, changes to ground-water hydrologic patterns, increased commercial and residential development and lack of appropriate frequent burning during the proper season among other things.

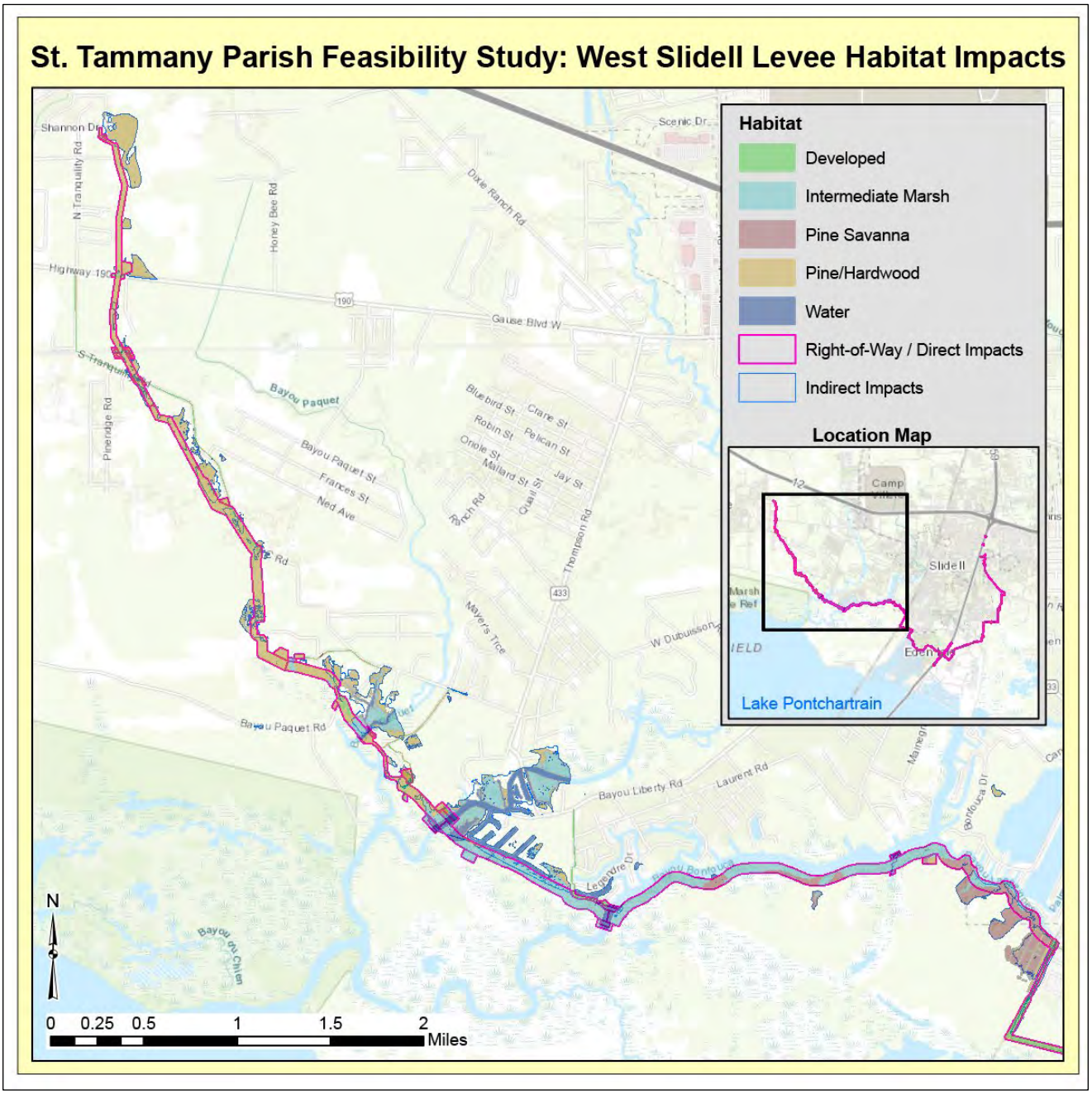

Figure I: 4-2. Habitat in the West and South Slidell Project Area (West Portion of the Alignment)

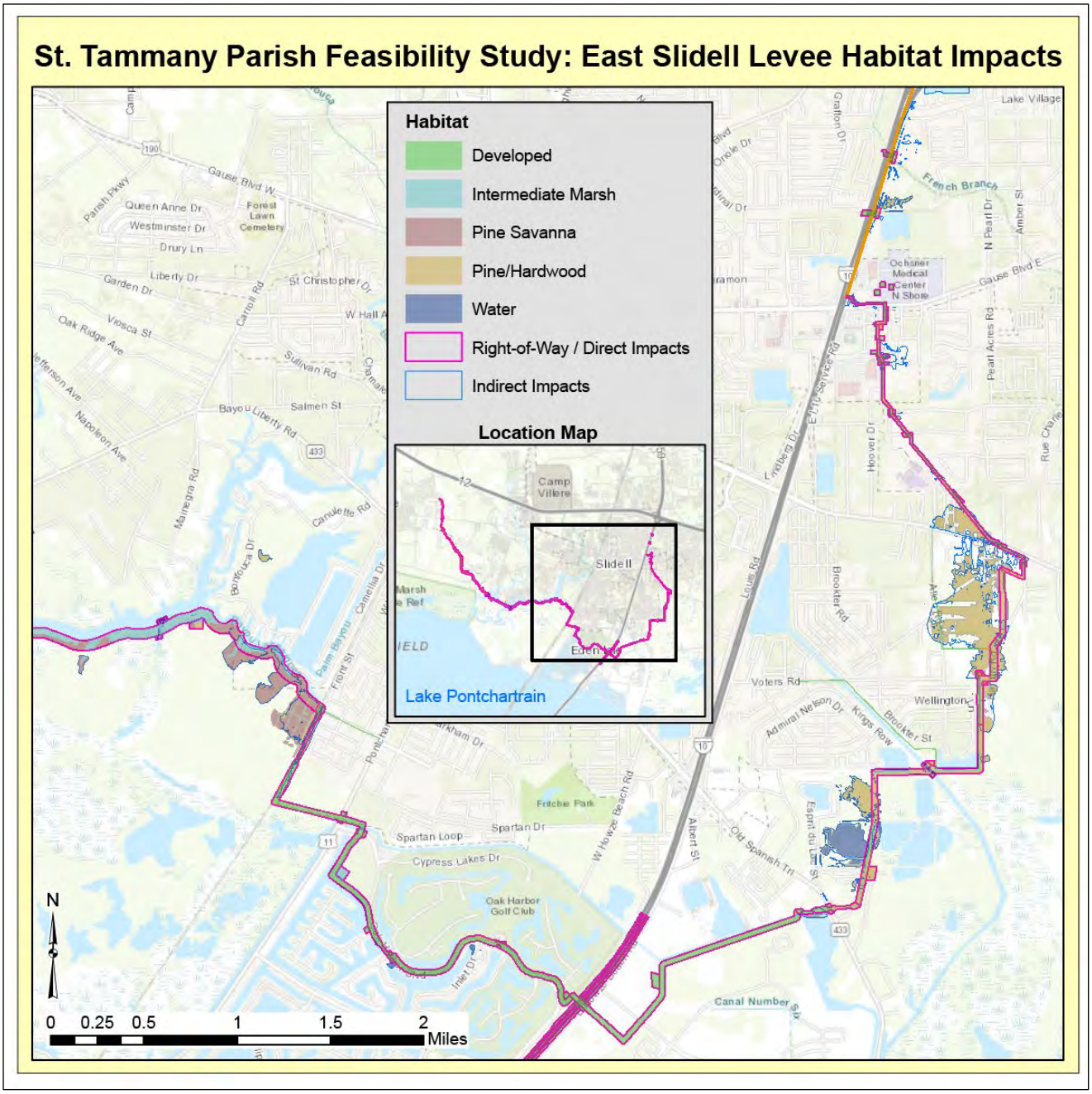

Figure I: 4-3. Habitat in the West and South Slidell Project Area (East Portion of the Alignment)

SECTION 5
Determine Significant Net Losses

5.1 ER 1105-2-100, APP C, PART C-4(G)(2)

A significance assessment was conducted to determine what significant resources were being impacted by the project. This assessment assists teams in understanding the ecosystem impacts of the parent project and the linkages of the resources to other parts of the system or watershed. The impacted resources are recognized as significant across institutional, public, and technical perspectives. The main feasibility report Sections 3 and Section 5 discusses these three significance factors in detail.

Table I:5-1 presents additional information characterizing the significance of the resources from a national, regional, and state perspective. This determination is based upon the factors of significance and the magnitude of unavoidable project impacts.

Table I:5-1. Ecological Resource Significance

Habitat Type	Significance of Resource	Significance – Is the Resource Scarce or Unique at Various Levels?		
		National	Regional	State
Pine Savanna	High diversity plant, mammal, reptile, amphibian, and avian habitat	Longleaf pine once occupied over 90 million acres in the southern U.S. and are now considered globally imperiled. Pine habitat has been reduced to less than 3% of their historic range due to development, fire suppression, forest conversion and logging.	Longleaf pine habitats are scarce and unique for Louisiana.	Rarity rank S1G1 (imperiled in state; critically imperiled globally) assigned by LDWF.
Freshwater/Intermediate wetlands	High value avian foraging habitat.	Overall, various estuarine wetlands makeup only 5% of the total amount of wetlands in the U.S. This makes the resource scarce on a national scale. Freshwater riparian wetlands in coastal watersheds are scarce accounting for less than 2% of the total wetlands in the U.S. (USFWS 2011).	In the south and along the Gulf coast these types of wetlands are significant overwintering habitat for waterfowl and other migratory birds that use the Mississippi River flyway. Transcontinental neo-tropical migratory species may use these areas as stopover habitat for resting and feeding.	Rarity rank S2 (Imperiled) assigned by LDWF. Freshwater marsh has undergone the largest reduction in acreage of any marsh type in 20 years. Pre-settlement acreage was estimated at 1 to 2 million acres but has been reduced by 25-50%.
Riparian Habitat	Transition zones between aquatic and upland habitats.	In the U.S. alone, riparian systems provide habitat for up to one-third of plant species and 60% of vertebrate species. In addition, 70% of threatened and endangered species in the U.S. depend on riparian systems to survive.	Riparian habitat is important regionally and suffers from the same national threats. They are important stopover habitat for migratory birds, travel corridors for wildlife and many protected and T&E species.	The Riparian habitat in the study area is a mix of loblolly pine and hardwoods. It is classified as a S4 indicating that it is secure with many occurrences.
Riverine Streambed	Streams carry sediment, nutrients and other materials into rivers, lakes, estuaries, and oceans. They Support aquatic organisms, insects, and warm water fisheries by providing habitat; provides places for spawning; serve as recharge for groundwater and exchange of nutrients	Healthy functioning stream ecosystems provide society with many benefits, including drinking water and water purification, flood control, nutrient recycling, waste decomposition, fisheries, aesthetics and recreation. Nonpoint source pollution, trash, climate change, herbicides/pesticides, urbanization all threaten the integrity of natural stream functions.	Streams are equally regionally important as they are nationally to the purity of the freshwater, groundwater recharge, nutrient cycling and habitat for aquatic organisms, fisheries, and wildlife. Continued development and	Streams in Louisiana are important part of the ecosystem and provide a number of services such as flood control, sediment retention, wildlife habitat and recreation

Habitat Type	Significance of Resource	Significance – Is the Resource Scarce or Unique at Various Levels?		
		National	Regional	State
	and organisms with surrounding aquifers.		degradation affects the area regionally.	

From a planning perspective the ecological significance of the habitats is useful in defining the goals and objectives of the compensatory mitigation plan.

A conceptual ecological model (CEM) was developed for Pine Savanna habitat to identify the major stressors and drivers affecting in-kind compensatory mitigation project in St Tammany Parish and the broader watershed (Figure I:5-1). The information to populate the model is based off the information provided in the 2006 Lake Pontchartrain Basin (LPB) Comprehensive Management Plan, the 2012 Northshore Flood Protection Plan and the SEIS Section 3. Existing conceptual models for marsh (Table I:5-2), riparian and stream (Table I:5-3) habitats are incorporated by reference. The conceptual models do not explain all possible relationships between the factors influencing a potential mitigation site. The models present the most relevant relationships and factors affecting the ability of a mitigation project to produce the required number of habitat units. Coupled with strategies (presented in Section 7), the models were used to identifying measures to address habitat needs in the potential mitigation sites.

The study area is composed primarily of flat lands that slope southward. The higher elevations are 130 feet and the lowest elevation is zero at the edge of Lake Pontchartrain. The lake edge in St. Tammany is occupied by a band of marsh for most of its extent, decreasing in size from east to west and giving way to a bald cypress-tupelo swamp on the western end. This swamp is the east portion of the Maurepas Swamp that occupies the southern end of Tangipahoa Parish.

The Maurepas Swamp, originally a virgin cypress forest, experienced intensive logging between 1890 to 1925. The streams in the area are relatively clear and quick flowing in the hill country, becoming deeper, cloudier, and more sluggish in the flat lands, and are subject to overflow from heavy rains in the spring and late fall. The streams run from north to south, beginning in the hill country within Louisiana or to the north in Mississippi. Most of the streams flow into Lake Pontchartrain. However, there are some notable exceptions. The Pearl River, which forms the eastern boundary of St. Tammany Parish and is the major stream in the area, flows into Lake Borgne. The Bogue Chitto River, in the northeastern corner of St. Tammany Parish, flows into the Pearl River. The hill lands and the flat lands in both parishes were formerly occupied by virgin longleaf and yellow pine forests that were logged from 1890 to 1940 and have been replaced by cultivated loblolly pines, farmland, pasture, open land, and urban development.

The hydrologic character of the Pontchartrain Basin is variable. The western and southern boundary of the Pontchartrain Basin is dominated by the man-made levees of the Mississippi River, which prevent the river's natural overbank flow except for the spillway opening for river flood control or along the most southern un-leveed reach of the River south

of Pointe a la Hache. A controlled river diversion at Caernarvon, Louisiana diverts Mississippi River water seasonally through the flood control levee into the local estuary. The northeastern boundary is the Pearl River watershed. The southeastern boundary is the Gulf of Mexico, which has tidal, wind connection within the basin. The Pontchartrain Basin habitats range from pine flatwoods to estuarine to marine. The basin has undergone many anthropogenic alterations that have affected its hydrology. However, the basin is still characterized as an upland watershed coupled with a tidal estuary. The Upland areas above Interstate12 are non-tidal, whereas the rest of the subbasins are tidally influenced portions of the estuary.

Although a wide variety of ecologically important native forest types once occupied the upland areas of the LPB and the Study area, the longleaf pine flatwoods stand out as the most ecologically significant. The ecological value of pine habitat is derived from its:

- Biological diversity – represented by a huge diversity of herbaceous plants (including grasses, sedges, insectivorous plants, lilies, orchids and numerous others), and associated fauna (including, among others, insects, reptiles, amphibians and grassland birds) many of which are declining and are restricted to fire-driven longleaf pine habitats.
- Aesthetic value – These forests were found to be naturally “park like” with many open vistas through tall stands of majestic pines.
- Rarity: Longleaf pine forests were logged ubiquitously throughout their range in the Southeast U.S., to the point that these habitats are now considered threatened ecosystems.

The historic range of the longleaf pine once extended from southeastern Virginia to Florida, west through Louisiana to east Texas. Today the trees are only found within small patches of this range. Longleaf pines can survive in a range of habitats, but they prefer sandy, dry, acidic soils ranging in elevation from sea level to 2,300 feet. Only relatively small, highly fragmented patches of this ecosystem remain in the region and Louisiana. Longleaf pine savannas are among the most diverse and most threatened habitats in North America, with only 1 to 5 percent of the original acreage estimated to remain.

Due to intense commercial logging, the Pontchartrain Basin uplands are currently dominated by a highly altered habitat comprised of young, scattered pine forests. For a variety of reasons, among them the absence of regular fire, these forests do not support the kinds and diversity of plant and animal species that were supported by the historic pine forests. Additionally, further loss and degradation of remaining habitats is occurring due to rapidly expanding residential development. Longleaf pines are more resilient to the negative impacts of climate change than other southeastern pines. They can withstand severe windstorms, resist pests, tolerate wildfires and drought, and capture carbon pollution from the atmosphere.

Approximately half the Nation’s original wetland habitats have been lost over the past 200 years. In part, this has been a result of natural evolutionary processes, but human activities, such as dredging wetlands for canals or draining and filling for agriculture, grazing, or

development, share a large part of the responsibility for marsh habitat alteration and destruction. Louisiana's wetlands today represent about 40 percent of the wetlands of the continental United States, but about 80 percent of the losses (USGS). The Pontchartrain Basin has had a significant loss in the areal extent of wetlands. Most of this loss was induced by human activities occurring during the period from 1932 to 1983 when industrialization of the Louisiana coast occurred. Some of the drivers for loss are the effects of an extensive network of canals, impoundments, relative sea-level rise, loss of overbank flow of the Mississippi River and others.

The wetlands adjacent to Lake Pontchartrain are co-dependent with the Lake. The wetlands provide detritus, cover, and diversity. Lake Pontchartrain allows tidal exchange and provides aquatic access to migrating species into the wetlands. The north shore wetlands are important because of their extent and their support to the streams and bayous of the north shore. The north shore wetlands also have some unique wetland characteristics pine flatwoods gently grade into coastal marshes, producing a highly diverse assemblage of wetland plants that is unique on the north shore.

There are numerous streams within the area including the Louisiana designated scenic rivers Tchefuncte River and by extension Mile Branch and Bayou Liberty. Approximately 3,000 miles of water are currently designated as Scenic Rivers in Louisiana, including a great diversity of waterbody types, habitats, and geographic areas throughout the state. Streams provide many upstream and downstream benefits. They protect against floods, filter pollutants, recycle potentially harmful nutrients, and provide food and habitat for many types of fish. These streams also play a critical role in maintaining the quality and supply of our drinking water, ensure a continual flow of water to surface waters, and help recharge underground aquifers. Streams play an important role in the economy particularly in fishing, hunting, agriculture and recreation.

Riparian systems provide habitat for a wildlife species as well as a threatened and endangered species that often depend on riparian systems to survive. The Riparian habitat in the study area is a mix of loblolly pine and hardwoods. The habitat is important to wildlife species as a travel corridor between adjacent larger habitat sources. Within Louisiana the habitat is classified as a S4 indicating that it is secure with many occurrences.

5.2 BIG BRANCH MARSH NATIONAL WILDLIFE REFUGE

The St. Tammany Feasibility Study project includes features that would impact part of the BBMNWR. As a result, a Compatible Use Determination will be required. The National Wildlife Refuge (NWR) System Improvement Act of 1997 authorized that no new or expanded use of a refuge may be allowed unless it is first determined to be compatible. A compatibility determination is a written determination signed and dated by the Refuge Manager and Regional Refuge Chief, that determines whether a proposed action is either compatible with the existing use of the NWR or is not a compatible use. A compatible use is defined as a proposed or existing wildlife-dependent recreational use or any other use of a NWR that, based on sound professional judgement, will not materially interfere with or detract from the fulfillment of the NWR System mission or purposes of the NWR.

Compatibility determinations will include a public review and comment before issuing a final determination. It is highly unlikely that a major levee and associated structures will be found compatible with the purposes of BBMNWR. Without a positive compatibility determination, ROE to BBMNWR for construction would not be granted. The compatibility determination will occur in PED.

The Final Policy on the NWR System and Compensatory Mitigation Under the Section 10/404 Program (federal register notice (64 FR 49229) for mitigation on refuge lands: https://www.govinfo.gov/content/pkg/FR-1999-09-10/html/99-23627.htm) stipulates that the Service will not allow compensatory mitigation for off-refuge habitat losses authorized through the Section 10/404 program to be implemented on lands and waters within the NWR System, except under limited and exceptional circumstances. At this time, the Refuge does not support pursuing waivers to the mitigation policy for the St. Tammany Feasibility Study. A land exchange would be required for any direct impacts associated with the project that occur on refuge lands. In other words, the NFS would be required to purchase land in the refuge acquisition boundary and exchange and donate those properties to the refuge to offset the direct impacts on refuge associated with the proposed project. The NFS would then own the direct project impact areas and would be required to mitigate habitat impacts in those areas as off refuge impacts. In a refuge land exchange, land is not swapped on an acre for acre basis, but rather value for value based on the appraised value so, tracts of land larger or smaller than the acres impacted may be exchanged. USFWS may accept or require exchange lands that could out of kind (i.e., marsh for pine savanna, etc.), but lands must be within the approved refuge acquisition boundary. Any indirect impacts on the Refuge associated with the project would be mitigated for on refuge property.

Based on the impacts described in Table I:4-2. Ninety-eight acres with direct marsh and pine savanna impacts on the Refuge would need to be exchanged for an equivalent land value within the Refuge acquisition boundary. Additionally, indirect on-Refuge impacts for 36 acres of pine savanna habitat would be mitigated for on the Refuge.

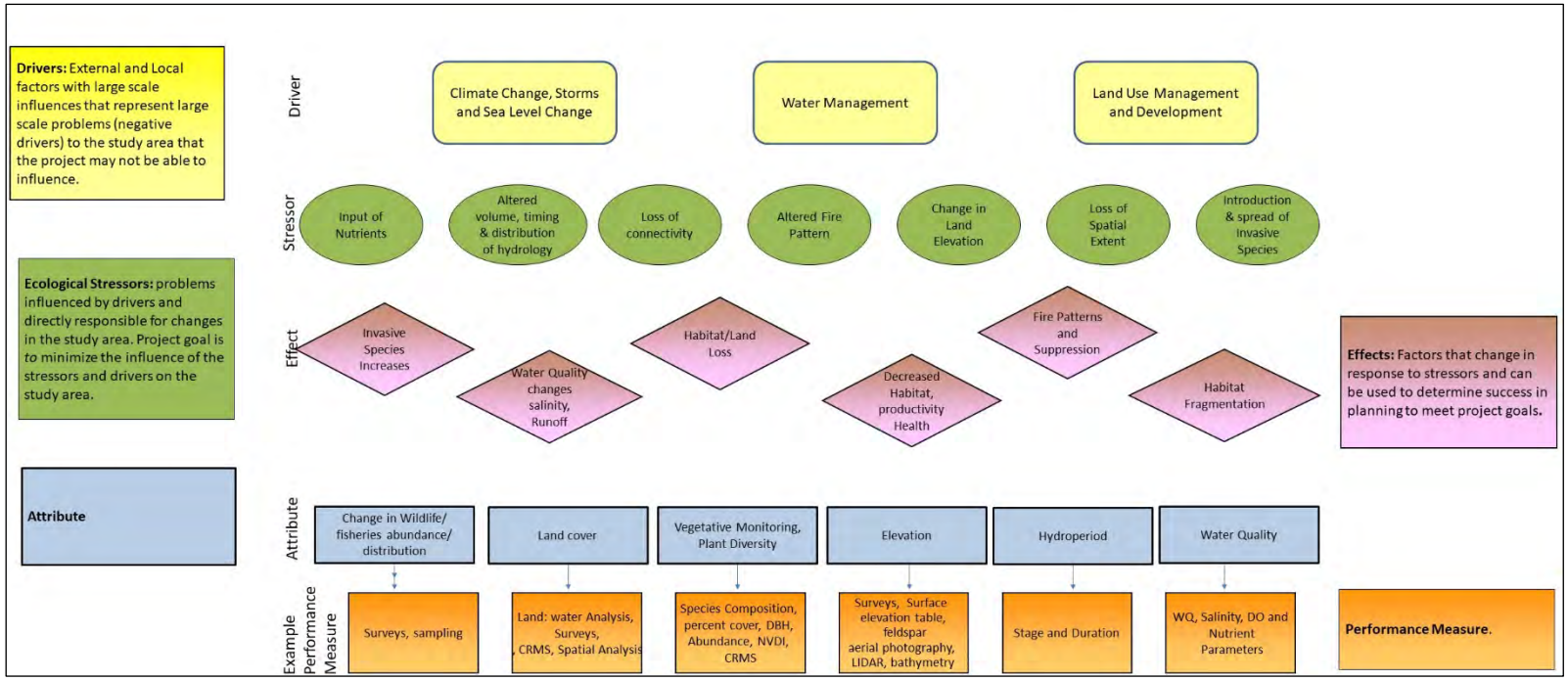

Figure I:5-1. Conceptual Model St. Tammany Parish Pine Savanna Habitat

Table I:5-2. St Tammany Fresh Intermediate Marsh Conceptual Ecological Model (USACE 2023 Maurepas SEIS Appendix G)

Alternatives/Issues/Drivers	Fresh/Intermediate Marsh
Subsidence	-
Sea Level Rise	-
Runoff	-
Storm Induced	+/-
Salinity Impacts	+/-
Wave Action	-
Storm Surge	-
Vegetative Invasive Species	-
Herbivory	-
Hydrology (water table; wet/dry days; soil inundation)	+/-
Topography (elevation)	+/-

Key to Cell Codes: - = Negative Impact/Decrease

+ = Positive Impact/Increase

+/- = Duration Dependent

Table I:5-3. Stream Conceptual Ecological Model (adapted from ERDC/EL Sr-20-6)

Alternatives/Issues/Drivers	Mile Branch and Backwater Habitat
Channel Stability-Cross Section	+
Hydrologic Alteration	+
Riparian Zone	+
Bank Stability	+
Fish Cover	+
Nutrient Enrichment	N/A
Pools	+
Canopy	+
Embeddedness (substrate)	+
Hydrology (water table; wet/dry days; soil inundation)	+
Topography (elevation)	+

Key to Cell Codes: - = Negative Impact/Decrease
+ = Positive Impact/Increase
+/- = Duration Dependent

Based upon the types of habitats in the project area the HET determined that the WVA model and the HEPs were appropriate tools to assess the St. Tammany Parish, Louisiana Feasibility Study's impacts on fish and wildlife habitat. The WVA model is certified for use by the USACE Ecosystem Restoration National Planning Center of Expertise (ECO-PCX) for marsh and BLH riparian habitat. The HEP Habitat Suitability Index (HSI) being used for the pine habitat has been coordinated with the ECO-PCX and submitted for approval. Model outputs measure habitat value in average annual habitat units (AAHU). The WVA model is the standard tool utilized for assessing mitigation potential at various alternative mitigation sites throughout the watershed. The HEP models used to assess impacts to the Pine Savanna habitat were red-cockaded woodpecker (RCW) and pine warbler (PW). The PW HEP was previously certified.

Table I:5-4 displays the model output results for each of the impacted habitat types. The impacts are quantified using AAHUs. Additional details on the use of the model and the results of the analysis are presented in Section 5 of the integrated feasibility report and environmental impact statement and Appendix C: Environmental. In consultation with USFWS it was determined that due to the small number of acres impacted for stream habitat impacted along with the fact that the stream has previously been impacted and is in a degraded state that an acre for acre impact would be used. Acres of like habitat was used as the determined measurement unit this habitat in accordance with ER 1105-2-100 Appendix C-4, Section G. 4. The focus for stream water bottoms was to restore the affected environment along Mile Branch.

Table I:5-4. Results for the Impacted Habitat Types

Refuge Impacts*	Direct *			Indirect			Total Net Acres
	Acre Impacts	Net Acres	AAHU	Acre Impact	Net Acres	AAHU	
Fresh/Intermediate Marsh	77	28.8	33.13	0	0	0	28.8
Pine Savanna/flatwood	21	1.19	RCW 9.7	36	0.25	RCW 7	1.44
			PW 2.53			PW 2	
Private Impacts	**Direct**			**Indirect**			**Total Net Acres**
	Acre Impacts	**Net Acres**	**AAHU**	**Acre Impact**	**Net Acres**	**AAHU**	
Fresh/Intermediate Marsh	45.5	11	14.4	0	0	0	11
Pine Savanna/flatwood	171	145	RCW 0	202	0	PS RCW 0	148
			PW 42.5		3	PS PW 10.5	
						RCW 0	
						PW 1.5	
Riparian Habitat	35	35	22.9	0	0	0	35
Stream Habitat	3	3	N/A	N/A	N/A	N/A	3

*Notes:

-PS = protected side impacts

-Net acres are the difference between FWP (year 50 with the project) and FWOP (year 50 without the project) or FWP-FWOP at the end of the project life. AAHUs represent changes in habitat quality and/or quantity which are annualized over the 50-year period of analysis.

-Direct impacts on current refuge land require a land exchange prior to construction. The NFS would then own the direct project impact areas and would be required to mitigate habitat impacts in those areas as off refuge impacts .See section 5.2.

SECTION 6
Mitigation Planning Objectives

6.1 ER 1105-2-100, APPENDIX C, PART C-4(G)(3)

Planning for the St. Tammany Parish, Louisiana Feasibility Study included steps to avoid, minimize, rectify, and reduce/eliminate habitat impacts for each alternative. The need for compensatory habitat mitigation is driven by the remaining unavoidable impacts to significant fish and wildlife habitat. The goal of this mitigation plan is to fully compensate for the unavoidable impacts to significant fish and wildlife habitat resources that would occur with St. Tammany Parish, Louisiana Feasibility Study implementation. The objectives of the mitigation plan are defined by the results of the habitat impact assessment model using quantified units. The same habitat assessment model was used to estimate potential St. Tammany Parish, Louisiana Feasibility Study impacts and potential mitigation project outputs.

- Compensate for the loss of 48 average annual habitat units of fresh and intermediate marsh wetland habitat in the Mississippi Alluvial Plain, Deltaic Coastal Marshes and Barrier Islands ecoregion within Louisiana.
- Compensate for the loss of 55 average annual habitat units (10 red-cockaded woodpecker AAHU; 45 pine warbler AAHU) of Pine Savanna habitat in the Lake Pontchartrain Watershed.
- Compensate for the loss of 23 average annual habitat units of Riparian habitat in the Lake Pontchartrain Watershed.
- Compensate for the loss of 9 average annual habitat units (7 red-cockaded woodpecker AAHU; 2 pine warbler AAHU) of Pine Savanna habitat on refuge land within BBMNWR or on within other USFWS within the Lake Pontchartrain Watershed.
- Compensate for the loss of 3 acres of Stream water bottoms within the Mile Branch impact area.

There are other factors that were also considered that influence the mitigation planning objectives and the development of strategies, measures, and alternative plans. Some of these factors are based on legal requirements and policies and others are derived from scientific or technical standards. For example, mitigation work is required to be carried out before or concurrently with project construction (see 33 U.S.C. 2283). This introduces an implementation time factor to consider during alternative evaluation and selection. Another example is a preference for larger contiguous tracts of land to take advantage of greater ecological output and cost efficiencies during construction and operation and maintenance (O&M) compared to dispersed smaller tracts.

SECTION 7
Identify and Assess Potential Mitigation Strategies

7.1 ER 1105-2-100, APPENDIX C, SECTION C-4(E)(3)

Planning strategies are different means employed to develop a plan to achieve a project goal. The use of one or more strategies helps planning teams focus on an approach to developing a plan. For mitigation planning work, strategies may range from the purchase of mitigation bank credits to the construction of a project or projects to achieve the objectives and compensate for unavoidable impacts to habitat. While implementation guidance for the WRDA of 2016, Section 1163 requires to the USACE to consider mitigation bank credits or in-lieu fee programs where appropriate, strategies for Corps construction projects may involve different approaches to site selection such as the use of public lands or identifying contiguous sites that would potentially enhance wildlife corridors or expand wildlife pockets. The strategies considered for planning the St. Tammany mitigation plan are described below. The strategies were considered for each habitat impacted and for BBMNWR impacts separately. Together, the mitigation projects for each habitat impacted and the BBMNWR impacts make up the St. Tammany mitigation plan.

- Purchase of mitigation bank credits. Commercial mitigation banks sell credits for mitigation work performed at an approved mitigation site. The banks are approved and legally bound through banking instruments that hold the bank owners to certain standards of performance and reporting. The use of mitigation banks for a project may offer advantages to the government and non-federal sponsor by reducing performance risk and eliminating project specific requirements for operations and maintenance work and development of monitoring and adaptive management plans.
- Purchase of in-lieu fee program credits. In-lieu fee programs are established by state or local natural resource management agencies, and approved by the Corps and EPA, to accept funds for future mitigation work. The programs are approved for implementation of either specific or general wetland or other aquatic resource development projects. In-lieu-fee programs must meet the requirements that apply to an offsite mitigation effort and provide adequate assurances of success and timely implementation. A formal agreement between the in-lieu-fee program sponsor and the agencies, like a banking instrument, defines the conditions under which the use of the program is considered appropriate. Using an in-lieu-fee program for a project’s mitigation needs may offer advantages to the government and non-federal sponsor by reducing performance risk and eliminating project specific requirements for operations and maintenance work and development of monitoring and adaptive management plans.

- Construction of a mitigation project. The government and non-federal sponsor may choose to construct a mitigation project themselves. This construction strategy offers some potential advantages in tailoring a project to specific needs or locations. In addition, the partners may bring special expertise to the project gained from previous work on similar projects in the area.
- Non-structural mitigation methods. Various non-structural approaches may be available for accomplishing mitigation objectives. These approaches generally do not involve major construction work and therefore potentially reduce some associated environmental impacts. These actions may include land preservation, invasive species control, controlled burns, environmental flows, or other management actions that produce ecosystem benefits. As a strategy reducing environmental impacts may be more appropriate and complimentary in sensitive or protected areas.
- Combination of mitigation bank credit purchases, non-structural and/or construction of a project. One potential strategy is to combine multiple approaches - together to achieve the mitigation objectives. This strategy allows for a tailored plan address to the needs of multiple habitats.
- Partnership opportunities. Many organizations have missions or goals that align with Corps of Engineers mitigation planning needs. In these cases, opportunities may exist to collaborate in planning to develop a project or projects that meet the goals of the mitigation plan and the watershed goals of one or more partners. This strategy offers an opportunity to benefit from the strengths of organizations outside of government and may leverage existing information or offer unique local insight. There may be opportunities to perform habitat mitigation work on lands managed by partners.

SECTION 8
Identify Measures

8.1 ENGINEER REGULATION 1105-2-100, PART 2-3(C)(1) AND 40 CFR 1503.3(E)

Mitigation measures and alternatives were developed and evaluated separately for the following impact types:

- fresh and intermediate marsh non refuge
-
- Pine Savanna non refuge
- Pine Savanna refuge
- Riparian Habitat non refuge
- Stream water bottoms

Management measures are actions or activities that work towards accomplishing the mitigation planning objectives. Each measure is linked to one or more stressors or drivers in the conceptual ecological model (example the management measures for the use of dredged material to create habitat addresses the stressors related to change in land elevation and loss of spatial extent identified in the CEM). Identified management measures are outlined in Table I:8-1. In some cases management measures could be applied to more than one habitat type.

A qualitative analysis of the potential effectiveness of each measure towards achieving the mitigation planning objectives for each habitat type was performed. A summary of the results of the initial screening of potential mitigation measures is included in Table I:8-1. Measures were screened out if they could not achieve planning objectives or if there were more effective or efficient measures available. Even though each measure was evaluated against its ability to accomplish the project objectives, no measure was eliminated if a specific objective was not achieved. Consideration was given to those measures which failed to achieve any of the stated objectives, but could be combined with other measures in a beneficial manner, to achieve the project objectives. The effectiveness of each measure was considered to ensure that the objectives would be adequately met.

After the measure screening the team retained 14 measures for further consideration and potential combinability into alternative plans.

Each measure was further assessed to determine the potential for combining it with other measures for each habitat type to form alternative plans. This assessment determined if a measure could stand alone as a plan and whether the measure had any restrictions that would prevent its combination with other measures. Results of the assessment are shown in the table below. The information on combinability is also included in Table I:8-1.

The applicable management measures were then attributed to each of the remaining sites identified Section 10 to develop specific alternatives under each habitat type.

The recommended mitigation alternative will be identified from within each habitat type and the mitigation alternatives by habitat type will be combined like building blocks to form the tentatively selected mitigation plan TSP. The TSP will compensate for impacts across all habitat types.

Based on the identified sites per habitat type, the remaining measures were developed into mitigation alternative (MA) plans aligned with the mitigation planning strategies and the combinability of measures.

Table I:8-1 Measures

Management Measure Number	Mitigation Strategy	Management Measures	Applicable Impact						Combinability	Screening Results
Number	Strategy	Measure	Non Refuge Marsh	Refuge Marsh	Non Refuge Pine Savanna	Refuge Pine Savanna	Riparian Stream	Stream		
0	no action	no action								Retained for final array
1	Purchase of mitigation credits	Purchase of mitigation credits	x		x		x	x	Standalone Comb- S, NS Retained for nonrefuge impacts	Retained for nonrefuge impacts
2	Purchase of in-lieu fee program credits	Purchase of in-lieu fee program credits	x				x	x	Standalone Comb- S, NS Screened due to insufficient	screened due to insufficient credits
3	Construction of a mitigation project	create habitat / beneficial use	x	x			x		Standalone Comb- S, NS	retained
4	Construction of a mitigation project	Restore hydrology to create habitat	x	x			x	x	Standalone Comb- S, NS	retained
5	Construction of a mitigation project	change topography to restore habitat	x	x	x	x	x	x	Standalone Comb- S, NS	retained
6	Nonstructural mitigation	preservation-control wave action-boat restrictions etc.	x	x					Comb- S, NS	screened as standalone measure
7	Construction of a mitigation project	Plantings	x	x	x	x	x	x	Standalone Comb- S, NS	retained
8	Nonstructural mitigation	enhancement through management (controlled burns, thinning, hardwood removal)			x	x			Standalone Comb- S, NS	retained
9	Construction of a mitigation project	Diversion	x	x					Standalone Comb- S, NS	retained

10	Nonstructural mitigation	Invasive Species control-enhancement through management	x	x	x	x	x	x	Comb- S, NS	screened as standalone measure
11	Nonstructural mitigation	preservation			x	x			Standalone Comb- S, NS	retained only for pine habitat
12	Construction of a mitigation project	Living Shoreline	x	x			x	x	Comb- S, NS	screened as standalone measure
13	Construction of a mitigation project	terracing	x	x					Comb- S, NS	screened as standalone measure
14	Construction of a mitigation project	breakwater-enhancement through manage-ment	x	x					Comb- S, NS	screened as standalone measure
15	Construction of a mitigation project	retore degraded habitat to create ripples, pools, backwater upwater,					x	x	Standalone Comb- S, NS	retained
16	Construction of a mitigation project	restore degraded habitat upstream to more natural conditions					x	x	Standalone Comb- S, NS	retained
17	Construction of a mitigation project	add buffer on side of stream					x	x	Standalone Comb- S, NS	retained
28	Construction of a mitigation project	remediation of sand and gravel mine site					x	x	Standalone Comb- S, NS	retained
19	Partnership Opportunities	Partnership Opportunities	x	x	x	x	x	x	Standalone Comb- S, NS	retained
20		Combination of mitigation bank credits, non-structural and or construction of a project	x		x		x	x	Standalone	retained

SECTION 9
Land Considerations and Site Identification

9.1 ER 1105-2-100, APPENDIX C, PART C-4(E)(3)

Parcels within St Tammany Parish, Lake Pontchartrain Basin watershed, the deltaic plain and the ecoregion capable of supporting mitigation projects for the types of habitats impacted by the St. Tammany Parish, Louisiana Feasibility Study were identified. Available national, county, and municipal geospatial data was utilized to identify parcels, property lines, watershed boundaries, ownership, land designations, managed areas, existing projects, soil, etc.

- Aerial based Geographic Information Systems (GIS) analysis of St. Tammany Parish was completed to identify potential mitigation. Public lands, Trust Lands, Federal and private lands that had the potential for mitigation were documented. This included cleared or lands with poor quality habitat of sufficient size to meet mitigation needs. Some of the habitats on these parcels have been previously impacted by prior activities including farming, development or other construction. These sites contain degraded habitat and have the potential for use as compensatory mitigation lands for marsh, riparian and pine savanna habitat. Additionally, for pine savanna with mature stands of pine habitat were considered for preservation and enhancement.
- Nature based measures previously identified through the St Tammany Feasibility Study (Appendix B Table B:1-3) that were screened as standalone measures during the feasibility study were reevaluated as potential mitigation sites. Outside of St. Tammany Parish previously identified sites through the Lake Pontchartrain and Vicinity General Re-evaluation Report, EA #576, Amite River and Tributaries - East of the Mississippi River, LA Feasibility Study Environmental Impact Statement (EIS), Comite River Final Environmental Assessment mitigation efforts were reviewed and reconsidered for applicability to this mitigation plan. Potential marsh fresh and intermediate marsh, pine, bottom land hardwood (BLH), riparian and stream sites identified and considered these various planning efforts were reviewed. BLH sites were considered and were examined to determine if they could be used for pine or riparian restoration. Sites with known real estate concerns were not considered.
- Land within the BBMNWR acquisition boundary-USFWS provided information regarding land sites within the existing acquisition boundary of BBMNWR. Marsh and pine sites that met acreage requirements or sites that could be combined with nearby parcels to meet mitigation need were considered. Sites with known real estate concerns were not considered.

- Mine Sites-Louisiana Department of Environmental Quality's Electronic Document Management System site was used to identify mine sites in the parish. 16 sites were identified.
- Mitigation Banks within the watershed were identified for marsh fresh and intermediate marsh, pine, bottom land hardwood, riparian and stream sites

To be considered for inclusion sites were required to:

- Be within Basin for marsh
- Be within watershed for pine, riparian
- Be within Mile Branch impact area for stream waterbottom sites
- Not be developed
- Marsh impacts must be mitigated by replacing the same habitat type as was originally impacted () (33 CFR 332).
- Be upland sites that were above the 5-ft contour for pine habitat.. In additional identification of at least 30 acres of Pine Savanna refuge impacts within BBMNWR were required (or within the acquisition boundary).
- Sites could not covert existing wetlands to uplands (No net loss of wetlands. WRDA 1990, Section 307)
- At the time of initial site identification, the AAHUs for all habitat types had not been completed. Impact acres and the intent to create larger contiguous tracts of land (greater ecological output and cost efficiencies during construction and O&M phases) were used for site identification.

    - Marsh- Sites were required to be 200 acres in size (123 total assumed initial impact with a contingency).
    - Pine Savanna- (assumed 350 initial impact acres with contingency) 100 acres was determined to be the minimize sized considered based on the documented foraging areas of RCW, and the Size of Contiguous Forest Habitat documented for similar forested habitat (Size of V5 Size of Contiguous Forested Habitat,)
    - Riparian - 50 acres (assumed 35 acre impact plus contingency)
    - Stream waterbottom-5 acres (assumed 3 acre impact plus contingency)

- Sites were required to be easily scaled to meet final mitigation AAHU requirements since initial identification was based on acres not AAHUs.
- Smaller sites that were touching each other or closely separated by features that do not significantly fragment the sites from each other were grouped to generate a larger site.
- Duplicate sites were removed.
- Proposed sites could not be part of the Future Without Project condition.
- Have independent utility and not be dependent on implementation or modification of other projects

SECTION 10
Site Screening

An initial list of 177 sites were identified (53 marsh, 68 pine savanna, 5 pine savanna refuge, 38 riparian and 13 stream water bottoms). The initial site screening was aimed to identify those sites with most potential for mitigation. A total of 15 sites (4 marsh, 5 pine savanna, 1 refuge pine savanna, 4 riparian, and 1 stream) were retained and combined with management measures (retained after screening) for alternative development. The retained sites were considered alongside mitigation banks for each habitat type to develop the final array for each habitat type. Each habitat was evaluated individually. The criteria and the screening results are presented in Sections 9.1- 9.4.

10.1 MARSH HABITAT SITE SCREENING

Fifty three sites were pulled from other USACE projects, resources agencies, the NFS, and nature based and borrow sites identified during this study. The team identified criteria to use in the screening process which included the size and if the site met the required potential restoration acreage of 200 acres. Other screening criteria included the mitigation potential, technically viable, proximity to existing stream or wetland, proximity to an existing managed natural area, potential to address multiple habitat type or needs and real estate risk. The team walked through each site and the screening criteria and noted whether the potential site met the criteria. This resulted in the screening of 49 marsh sites and retaining 4 marsh sites. The following sites retained were used for alternative development:

- M1-Milton Island
- M2-East Fountain Bleu
- M4-Felix Bopp
- M6-Eastern Fritchie

10.2 PINE SAVANNA SITE SCREENING

Sixty eight sites were developed by the mitigation planning team and pulled from other USACE projects, resources agencies, the NFS, and nature based and borrow sites identified during this study. The team identified criteria to use in the screening process which included the size and if the site met the required potential restoration acreage of 400 acres. Other screening criteria included the mitigation type, technically viability, if the site was within RCW range large contagious tracts, within 150 feet of a stream or river, distance from impact, within 500 year floodplain, proximity to an existing managed area, and if the site creates a contiguous riparian corridor to waterway. The team walked through each site and the screening criteria and noted whether the potential site met the criteria. This resulted in the screening of 63 pine savanna sites and retaining 5 pine savanna sites. The following sites retained were used for alternative development:

- RS 28-Creek Southwest Lake Ramsey
- RS 27-West Airport

- RS 29-East Airport
- RS 30-West Tchefuncte

10.3 REFUGE PINE SAVANNA SITE SCREENING

A total of five sites were identified for on BBNWR refuge pine savanna mitigation. Three sites were provided by the USFWS and two sites were developed by the PDT using a GIS evaluation of the potential sites within the BBNWR. The potential pine savanna sites were evaluated based on screening criteria identified by the team. The criteria included the size and if the site met the required potential restoration acreage of 50 acres, mitigation type, and technically viable including available soils and elevation. The team walked through each site and the screening criteria and noted whether the potential site met the criteria. This resulted in the screening of the two sites developed by the PDT and screening 2 sites provided by USFWS. The one remaining site (Fritchie PSR-1) was retained for alternative development.

- PSR-1 Fritchie

10.4 RIPARIAN SITE SCREENING

Thirty eight sites were identified from the methods described in Section 9. The potential riparian sites were evaluated based on the following criteria identified by the team, the size and if the site met the required potential restoration acreage of 45 acres. Other screening criteria included the mitigation type, technically viability, if the site was within RCW range large contagious tracts, within 150 feet of a stream or river, and proximity to an existing managed area. The team walked through each site and the s criteria and noted whether the potential site met the criteria. This resulted in the screening of 35 riparian sites and retaining 4 riparian sites. The following sites retained were used for alternative development:

- RS 28-Creek Southwest Lake Ramsey
- RS 27-West Airport
- RS 29-East Airport
- RS 30-West Tchefuncte

10.5 STREAM SCREENING

Thirteen Sites were identified from the methods described in Section 9. Sites investigated along Mile Branch included adjacent wet areas such as existing ponds, water retention ponds, open cleared land and beneficially using staging areas that would be used for construction purposes. The potential stream sites were first evaluated based on the size and if the site met the required potential restoration acreage of 3acres. The other screening criteria included technical viability and ability to create mud bottom and or reconnect Mile Branch flow, risk for inducing flooding and or risk to the bank structure of Mile Branch.

The HET worked in conjunction with CEMVN ED to determine the best potential location for stream restoration along Mile Branch. This feature was also discussed and considered as a nature based feature along Mile Branch as the restoration of stream bottoms was expected to provide flood reduction benefits with additional overbank storage.

The evaluation led to the identification of a site (M-12a) that was already going to be used as a staging area for construction during Mile Branch and that could be beneficially used for stream mud bottom creation. The furthermore the site was identified was expected to have minimal additional real estate costs since the land was owned by the City of Covington and would already be purchased as part of the Mile Branch channel improvements project.

Site M-12a was retained for the final array.

SECTION 11
Alternative Development

The measures identified in Table I:11-1 in the previous section to form alternative plans for each site were combined within each habitat type. Additionally various scales of the constructed mitigation project were identified in combination with mitigation banks for consideration the no action alternative. The no action alternative is included as a basis for comparison as well as meeting the requirements of the National Environmental Policy Act. Each developed Mitigation Alternative (MA) is described below and shown in Figures I:11-1 through I:11-5.

11.1 MARSH ALTERNATIVES

- MA 1- No Action Alternative. Under this scenario no mitigation work would be performed, and the structure, functions and values of St. Tammany Parish, Louisiana Feasibility Study impacted habitats would be lost. The alternative is retained for purposes of a baseline comparison against other action alternatives.

- MA 2-1 Nonrefuge Fresh and Intermediate Marsh – Purchase mitigation bank credits (FIM-MB). Mitigation bank credits purchased would be selected through a solicitation process, through which any mitigation bank meeting eligibility requirements and having the appropriate resource type of credits could submit a proposal to sell credits. If appropriate and cost-effective, the Corps may choose to purchase mitigation bank credits from more than one bank to fulfill the compensatory mitigation requirements for a particular habitat type (Management Measure #1). This alternative would provide mitigation for 123 acres of impacts which includes 77 acres of impacts on BBNWR that require a land exchange and need to be mitigation off refuge.

- MA 2-2 Nonrefuge Fresh and Intermediate Marsh - Milton Island Marsh (Site M1) Restoration Expansion. This alternative includes a 200 acre measure restoration site in St Tammany Parish. This site is adjacent to recent mitigation projects conducted under the LPV project at Milton Island. Measures include perimeter retention dikes, dredged material placement, interior terraces, pump and fill to require elevation, 1 year after dewatering bringing down dikes, should naturally vegetate, external borrow if possible (Management Measure #3 and #10). There are 1,364 acres available. This site provides 47 AAHUS. This alternative would provide mitigation for 123 acres of impacts which includes 77 acres of impacts on BBNWR that require a land exchange and need to be mitigation off refuge.

- MA 2-3 Nonrefuge Fresh and Intermediate Marsh - East Fontainebleau (Site M2), This alternative includes a 221 acre measure restoration site in St. Tammany Parish. The site is within the acquisition boundary of the BBMNWR but is currently

under private ownership. There is a proposed CWPPRA project (Bayou Cane Marsh Creation #PO181 adjacent to this site. Measures include perimeter retention dikes, dredged material placement, interior terraces, pump and fill to require elevation, 1 year after dewatering bringing down dikes, should naturally vegetate, external borrow if possible (Management Measure #3 and #10). There are 299 acres available. This site provides 47 AAHUS. This alternative would provide mitigation for 123 acres of impacts which includes 77 acres of impacts on BBNWR that require a land exchange and need to be mitigation off refuge.

- MA 2-4 Nonrefuge Fresh and Intermediate Marsh e - Felix Bopp (Site M4). This alternative includes a 215 acre measure restoration site in St. Tammany Parish. The site is within the acquisition boundary of the BBMNWR but is currently under private ownership. Measures include perimeter retention dikes, dredged material placement, interior terraces, pump and fill to require elevation, 1 year after dewatering brining down dikes, should naturally vegetate, external borrow if possible (Management Measure #3 and #10). There are 206 acres available. This site provides 47 AAHUS. This alternative would provide mitigation for 123 acres of impacts which includes 77 acres of impacts on BBNWR that require a land exchange and need to be mitigation off refuge.

- MA 2-5 Nonrefuge Fresh and Intermediate Marsh - Eastern Fritchie (Site M6). This alternative includes a 221 acre measure restoration site in St Tammany Parish. This site overlaps with a CWPPRA project (Fritchie Marsh Creation #PO173). Measures include perimeter retention dikes, dredged material placement, interior terraces, pump and fill to require elevation, 1 year after dewatering brining down dikes, should naturally vegetate, external borrow if possible (Management Measure #3 and #10). There are 214 acres available. This site provides 47 AAHUS. This alternative would provide mitigation for 123 acres of impacts which includes 77 acres of impacts on BBNWR that require a land exchange and need to be mitigation off refuge.

- MA 2-6- through 2-17 are a combination of mitigation bank purchase and the constructed mitigation sites presented in MA 2-2, MA 2-3, MA 2-4 and MA 2-5. All combined alternatives provide 47 AHHUs. See Table I:11-1. This alternative would provide mitigation for 123 acres of impacts which includes 77 acres of impacts on BBNWR that require a land exchange and need to be mitigation off refuge.

Table I:11-1. Summary of the Final Array of Marsh Alternatives

Alternative Number	Mitigation Alternative	Description
2/1	Mitigation Bank (MB)	100% Marsh mitigation Bank
2/2	Constructed M1-Milton Island	100% constructed M1
2/3	Constructed M2-East Fountain Bleu	100% constructed M2
2/4	Constructed M4-Felix Bopp	100% constructed M4
2/5	Constructed M6-Eastern Fritchie	100% constructed M6
2/6	Combination MB/M1	25% bank 75% constructed
2/7	Combination MB/M1	50% bank 50% constructed
2/8	Combination MB/M1	75% bank 25% constructed
2-9	Combination MB/M2	25% bank 75% constructed
2-10	Combination MB/M2	50% bank 50% constructed
2-11	Combination MB/M2	75% bank 25% constructed
2-12	Combination MB/M4	25% bank 75% constructed
2-13	Combination MB/M4	50% bank 50% constructed
2-14	Combination MB/M4	75% bank 25% constructed
2-15	Combination MB/M6	25% bank 75% constructed
2-16	Combination MB/M6	50% bank 50% constructed
2-17	Combination MB/M6	75% bank 25% constructed

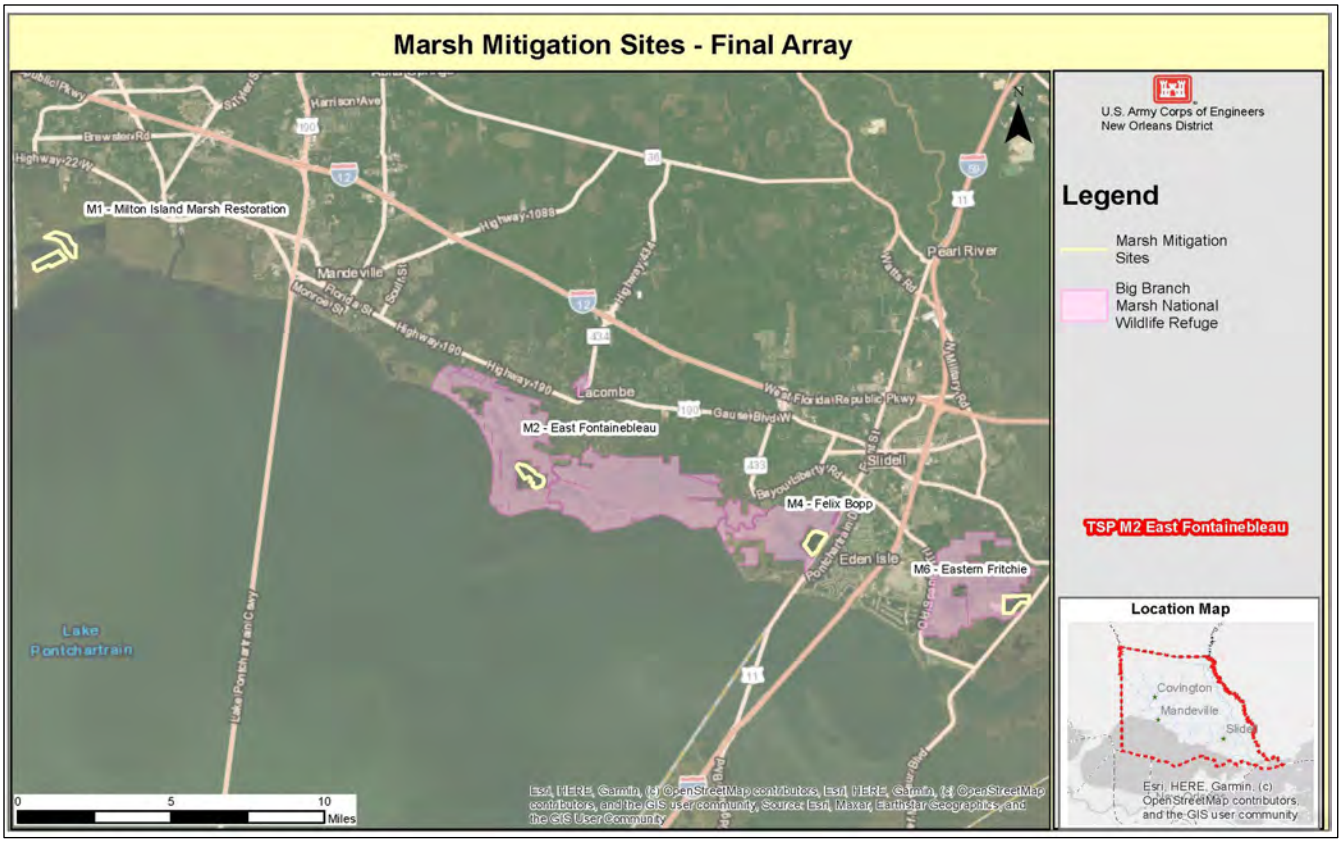

Figure I:11-1. Final Array of Marsh Constructed Marsh Mitigation Sites

11.2 RIPARIAN ALTERNATIVES

- MA 3-1 Nonrefuge Riparian BLH – Purchase mitigation bank credits (RS-MB). Mitigation bank credits purchased would be selected through a solicitation process, through which any mitigation bank meeting eligibility requirements and having the appropriate resource type of credits could submit a proposal to sell credits. If appropriate and cost-effective, the Corps may choose to purchase mitigation bank credits from more than one bank to fulfill the compensatory mitigation requirements for a particular habitat type (Management Measure #1). This alternative provides 24 AAHUS.

- MA 3-2 Nonrefuge Riparian BLH – Creek Southwest Lake Ramsey – Tchefuncte (RS28). This alternative includes a 41 acre measure restoration site in St. Tammany Parish. Measures include plantings dec-march, invasive species control (Management Measure #5 and #7). There is 41 acres available. This site provides 24 AAHUS.

- MA 3-3 Nonrefuge Riparian BLH – West Airport (RS27). This alternative includes a 38 acre measure restoration site in St. Tammany Parish. Measures include

plantings dec-march, invasive species control (Management Measure #5 and #7). There is 54 acres available. This site provides 24 AAHUS.

- MA 3-4 Nonrefuge Riparian BLH – East Airport (RS29). This alternative includes a 43 acre measure restoration site in St Tammany Parish. Measures include plantings dec-march, invasive species control (Management Measure #5 and #7). There is 43 acres available. This site provides 24 AAHUS.
- MA 3-5 Nonrefuge Riparian BLH – West Tchefuncte (RS30). This alternative includes a 42 acre measure restoration site in St Tammany Parish. Measures include plantings dec-march, invasive species control (Management Measure #5 and #7). There is 57 acres available. This site provides 24 AAHUS.
- MA 3-6- through 3-17 are a combination of mitigation bank purchase and the constructed mitigation sites presented in MA 3-2, MA 3-3, MA 3-4, and MA 3-5. All combined alternatives provide 24 AHHUs. See Table I:11-2.

Table I:11-2 Summary of the final array of Riparian BLH Alternatives

Alternative #	Alternative Name	Description
3-1	100% Mitigation Bank (MB)	100% Mitigation Bank (MB)
3-2	100% constructed RS 28-Creek Southwest Lake Ramsey	100% constructed RS 28
3-3	100% constructed RS 27-West Airport	100% constructed RS 27
3-4	100% constructed RS 29-East Airport	100% constructed RS 29
3-5	100% constructed RS 30-West Tchefuncte	100% constructed RS 30
3-6	Combination MB/ RS 28	25% bank 75% constructed-RS-14
3-7	Combination MB/ RS 28	50% bank 50% constructed-RS-14
3-8	Combination MB/ RS 28	75% bank 25% constructed-RS-14
3-9	Combination MB/ RS7	25% bank 75% constructed-RS-14
3-10	Combination MB/ RS7	50% bank 50% constructed-RS-14
3-11	Combination MB/ RS7	75% bank 25% constructed-RS-14
3-12	Combination MB/ RS 29	25% bank 75% constructed-RS-14
3-13	Combination MB/ RS 29	50% bank 50% constructed-RS-14
3-14	Combination MB/ RS 29	75% bank 25% constructed-RS-14
3-15	Combination MB/ RS 30	25% bank 75% constructed-RS-14
3-16	Combination MB/ RS 30	50% bank 50% constructed-RS-14
3-17	Combination MB/ RS 30	75% bank 25% constructed-RS-14

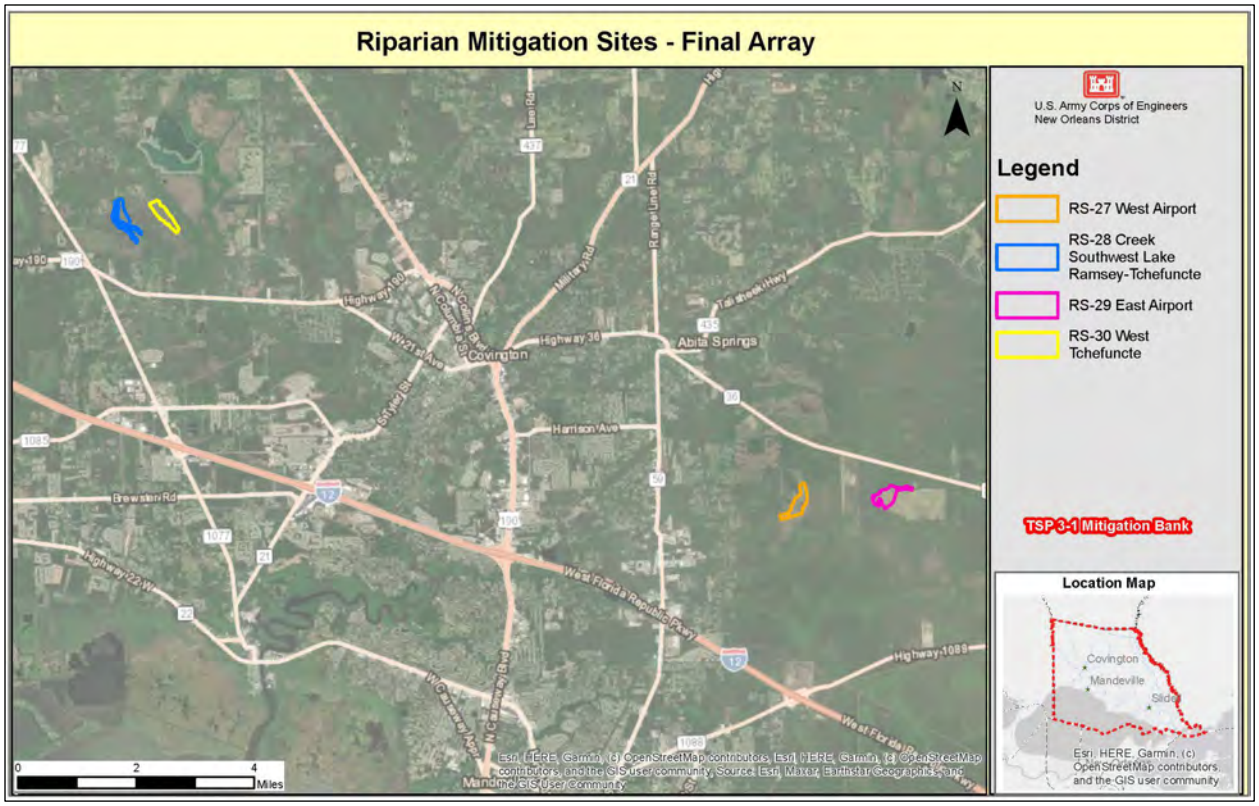

Figure I:11-2. Final Array of Riparian Constructed Marsh Mitigation Sites

11.3 PINE SAVANNA ALTERNATIVES

- MA 4-1 Nonrefuge Pine Savanna – Purchase mitigation bank credits (PS-MB). Mitigation bank credits purchased would be selected through a solicitation process, through which any mitigation bank meeting eligibility requirements and having the appropriate resource type of credits could submit a proposal to sell credits. If appropriate and cost-effective, the Corps may choose to purchase mitigation bank credits from more than one bank to fulfill the compensatory mitigation requirements for a particular habitat type (Management Measure #1). This alternative provides 67 AAHUS.

- MA 4-2 Nonrefuge Pine Savanna – Old Whispering Pines (PS25). This alternative includes a 357 acre measure restoration site in Tangipahoa Parish. Measures include controlled burns, plantings, invasive species control, look at drainage, rest same as BLH (Management Measure #7). There are 441 acres available. This site provides 67 AAHUS.

- MA 4-3 Nonrefuge Pine Savanna – Near Talisheek (PS6). This alternative includes a 307 acre measure restoration site in St Tammany Parish. Measures include controlled burns, plantings, invasive species control, look at drainage, rest same as BLH (Management Measure #7). There are 424 acres available. This site provides 67 AAHUS.

- MA 4-4 Nonrefuge Pine Savanna – Reed Brake (PS7). This alternative includes a 307 acre measure restoration site in St Tammany Parish. Measures include controlled burns, plantings, invasive species control, look at drainage, rest same as BLH (Management Measure #7). There are 432 acres available. This site provides 67 AAHUS.

- MA 4-5 Nonrefuge Pine Savanna – Old Military Road Red Oak Fork (PS19). This alternative includes a 382 acre measure restoration site in St Tammany Parish. Measures include controlled burns, plantings, invasive species control, look at drainage, rest same as BLH (Management Measure #7). There are 500 acres available. This site provides 67 AAHUS.

- MA 4-6 Nonrefuge Pine Savanna – Mentab (PS26). This alternative includes a 300 acre measure restoration site in St. Tammany Parish, requested for consideration by the USFWS. The site is not located in the BBMNRW acquisition boundary but is just above the BBMNWR. Measures include controlled burns, plantings, invasive species control, look at drainage, rest same as BLH (Management Measure #7). There is 300 acres available. This site provides 67 AAHUS.
- MA 4-6- through 4-21 are a combination of mitigation bank purchase and the constructed mitigation sites presented in MA 4-2, MA 4-3, MA 4-4,MA 4-5 and MA 4-6. All combined alternatives provide 67 AHHUs. See Table I:11-3.

Table I:11-3 Summary of the Final Array of Pine Savanna Alternatives

Alternative #	Alternative	Description
4-1	100% Mitigation Bank (MB)	100% PS
4-2	100% constructed PS 25-Camp Whispering Pines	100% constructed PS 25
4-3	100% constructed PS 6- Talisheek	100% constructed PS 6
4-4	100% constructed PS 7-Reed Break	100% constructed PS 7
4-5	100% constructed PS 19 Old Military Road-Red Oak Fork	100% constructed PS 19
4-6	100% constructed PS 26-Mentab	100% constructed PS 26
4-7	Combination MB/PS-25	25% bank 75% constructed
4-8	Combination MB/PS-25	50% bank 50% constructed
4-9	Combination MB/PS-25	75% bank 25% constructed
4-10	Combination MB/PS-6	25% bank 75% constructed
4-11	Combination MB/PS-6	50% bank 50% constructed
4-12	Combination MB/PS-6	75% bank 25% constructed
4-13	Combination MB/PS-7	25% bank 75% constructed
4-14	Combination MB/PS-7	50% bank 50% constructed
4-15	Combination MB/PS-7	75% bank 25% constructed
4-16	Combination MB/PS-19	25% bank 75% constructed
4-17	Combination MB/PS-19	50% bank 50% constructed
4-18	Combination MB/PS-19	75% bank 25% constructed
4-19	Combination MB/PS-26	25% bank 75% constructed
4-20	Combination MB/PS-26	50% bank 50% constructed
4-21	Combination MB/PS-26	75% bank 25% constructed

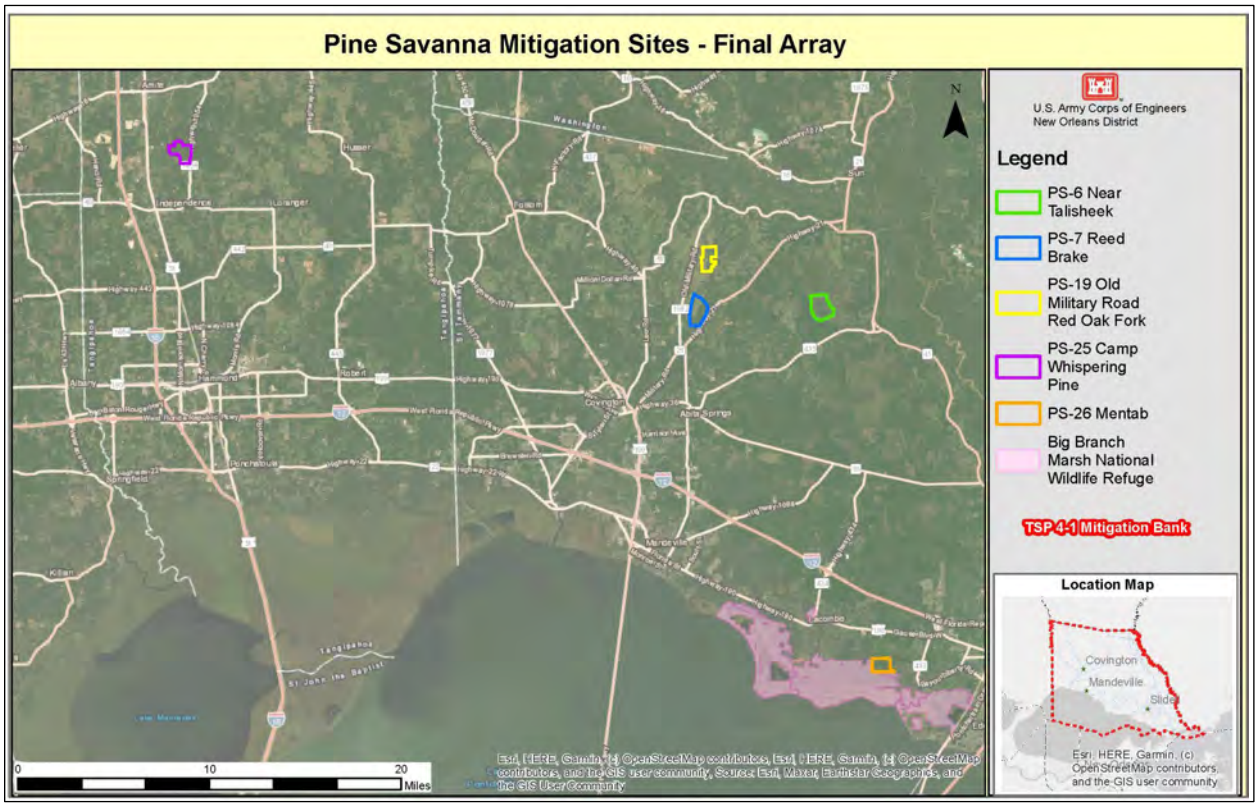

Figure I:11-3. Final Array of Pine Savanna Mitigation Sites

11.4 REFUGE PINE SAVANNA

- MA 5-1 Refuge Pine Savanna – Site Bayou Bonfouca (PSR-1). This alternative includes a 50 acre site in St Tammany Parish located in BBMNWR. There are 70 acres available. This site provides 9 AAHUS.

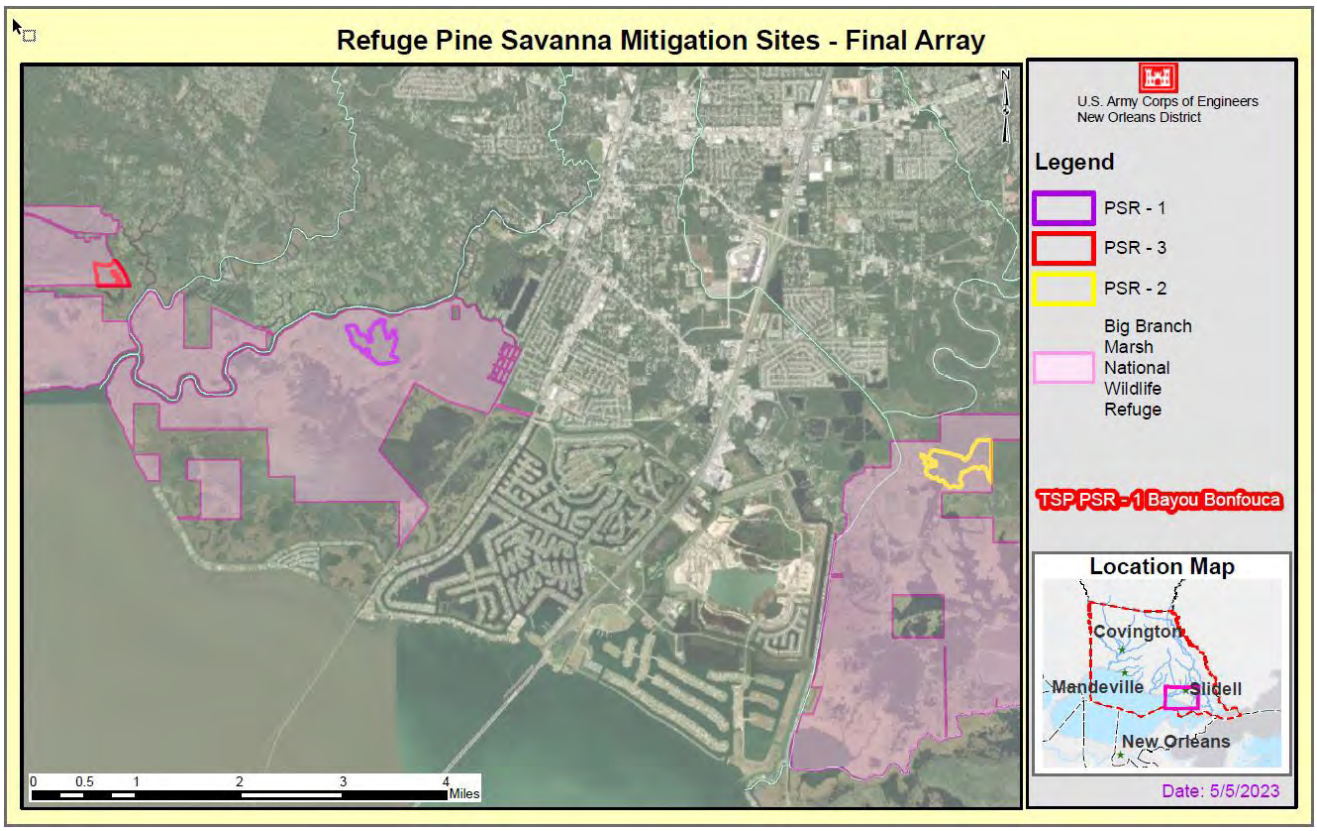

Figure I:11-4. Refuge Pine Savanna Mitigation Sites

11.5 STREAM WATERBOTTOMS

- MA 6-1- Mitigation Bank – Purchase mitigation bank credits. Mitigation bank credits purchased would be selected through a solicitation process, through which any mitigation bank meeting eligibility requirements and having the appropriate resource type of credits could submit a proposal to sell credits. If appropriate and cost-effective, the Corps may choose to purchase mitigation bank credits from more than one bank to fulfill the compensatory mitigation requirements for a particular habitat type (Management Measure #1). This alternative provides 3 acres.

- MA 6-2- Mile Branch Backwater Beneficial Use of Staging Area (M-12a) Create a backwater area off of Mile Branch that provides 3 acres of mud bottom as a project feature. Culverts would allows frequent water exchange between Mile Branch and the backwater area to avoid stagnation. The site would be excavated below the average stage to Mile Branch to achieve both deep-water and shallow water habitat. A buffer would be planted with bottomland hardwoods around the east, south, and west perimeter of the site. Some shallow areas should be provided for marsh or swamp vegetation growth.

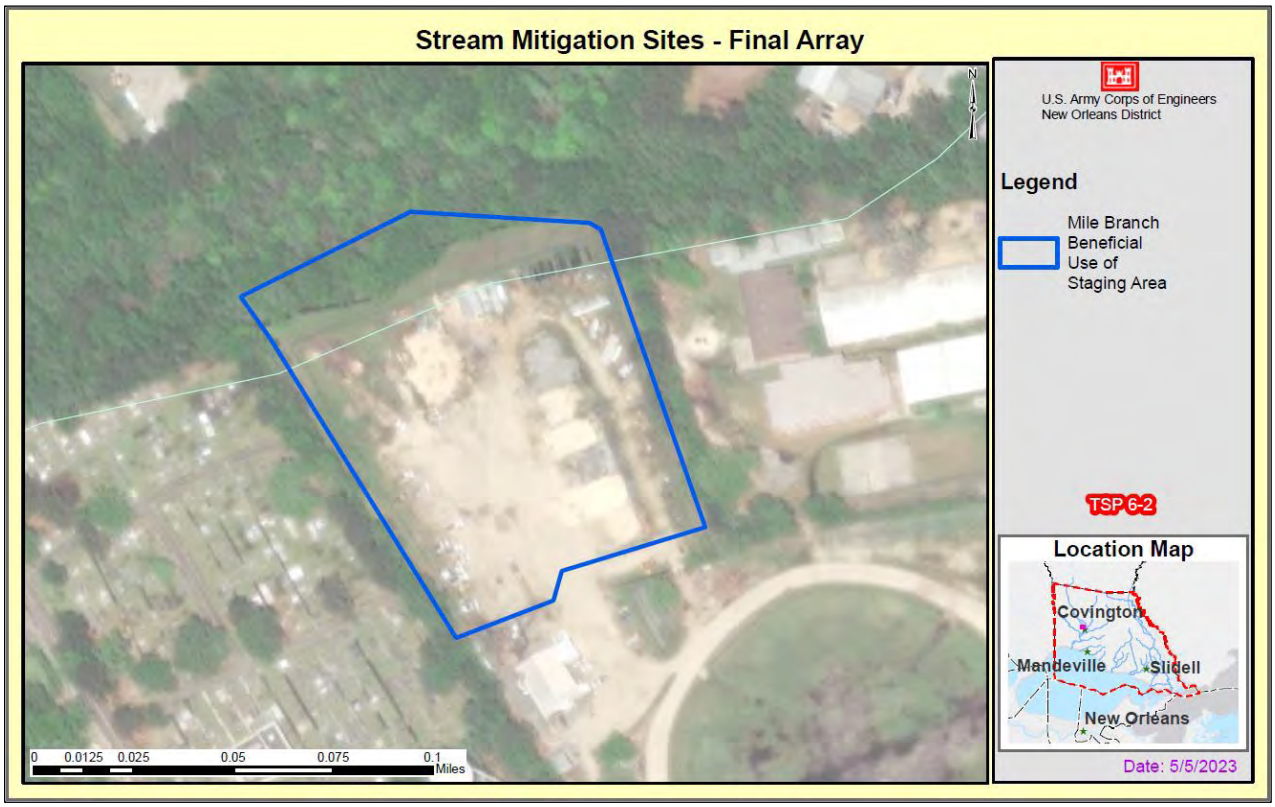

Figure I:11-5. Steam Water Bottom Mitigation Sites

SECTION 12
Evaluation and Comparison

12.1 ER 1105-2-100, APP C, PART C-2(B)

Multiple formulation and plan selection considerations may be relevant to identifying a recommended TSP alternative for the project. Factors considered include compliance with laws, regulations and policies, watershed and ecological site considerations, implementation timing, risk and reliability, environmental impacts and cost effectiveness. The least cost plan may not necessarily be the recommended plan when other selection factors or tradeoffs are considered. Table I:12-1 below systematically assesses each alternative plan by posing and answering questions that were considered to further evaluate the alternatives and aimed at discerning differences in alternatives beyond simply identifying the least cost plan. Law requires mitigation work to be performed before or concurrently with project construction. All alternatives can be implemented before construction. There are differences in risks between the alternatives. The alternatives scoring the highest for each question were denoted in green. Those with lowest evaluation for each question were denoted in orange. The resulting ranking of alternatives exclusive of costs for each habitat type are included below.

Marsh Alternative Ranking
- 2-1-Mitigation Bank
- 2-4-Felix Bopp
- 2-3- East Fontainebleau
- 2-2- Milton Island
- 2-5-Eastern Fritchie

Riparian Alternative Ranking
- 3-1- Mitigation Bank
- 3-2-Creek Southwest Lake Ramsey-Tchefuncte
- 3-5-West Tchefuncte
- 3-3-West Airport
- 3-4-East Airport

Pine Savanna Refuge (one acceptable site remained after evaluation)
- 5-1- Pine Savanna Refuge

Pine Savanna Alternative Ranking
- 4-2-Old Whispering Pines
- 4-1- Mitigation Bank
- 4-6-Mentab
- 4-3-Near Talisheek
- 4-4-Reed Brake
- 4-5-Old Military Road Red Oak Fork

Stream -(one acceptable site remained after evaluation)
- 6-2 Stream Backwater
- 6-1 Mitigation Bank (no available credits-screened)

Table I:12-1. Plan Selection Considerations

			Alternatives																		
		Evaluation Criteria	No Action	2-1-Mitigation Bank Marsh	2-2- Milton Island	2-3- East Fontainebleau	2-4-Felix Bopp	2-5-Eastern Fritchie	3-1-PMitigationBank Riparian	3-2-Creek Southwest Lake Ramsey-Tchefuncte	3-3-West Airport	3-4-East Airport	3-5-West Tchefuncte	4-1- Mitigation Bank Pine Savanna	4-2-Old Whispering Pines	4-3-Near Talisheek	4-4-Reed Brake	4-5-Old Military Road Red Oak Fork	4-6-Mentab	5-1- Pine Savanna Refuge-	6-1 Stream Mitigation Bank	6-2 Stream Backwater
Watershed Considerations and Significance in Watershed	Is the mitigation alternative located in the impact area?	0-not within basin 1-within basin 2- within Study Area (St Tammany Parish)	0	1	2	2	2	2	1	2	2	2	2	1	1	2	2	2	2	2	0	2
	Is the mitigation alternative contiguous with or within a resource managed area?	0-not within a managed area 1-non managed natural land 2-adjacent to or on	0	1	2	2	2	2	1	0	1	0	2	1	2	2	0	0	2	2	1	2
	Is the mitigation alternative documented within other, parish, state, regional or federal plans?	0 – not within other, parish, state, regional or federal plans 2 - within other, parish, state, regional or federal plans	0	0	2	0	2	2	0	0	0	0	0	0	2	2	0	0	2	2	0	0
Risk and Reliability	Does the mitigation alternative have lower implementation risks than other alternatives?	0-high 1-med 2-Low Risk	0	2	2	2	2	2	2	1	1	2	1	2	2	1	2	2	2	2	2	1
	Is their uncertainty relative to achieving ecological success?	0-Major Uncertainty 1-Medium 2-Low uncertainty	0	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Is the alterative sustainable against high sea level rise?	0-high risk 1-Med Risk 2-Low Risk	0	1	2	2	2	1	1	2	2	2	2	1	2	2	2	2	2	1	2	2

	Can the alternative be implemented before or concurrently with construction?	0- high risk 1-medium risk 2-low risk	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	1
	Does the mitigation alternative avoid operation risks for the government? Does it include difficult or extensive OMRR&R?	0 -extensive 1 – traditional amount 2- Minimum	N/A	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	2	1
Ecological Site Considerations	Is the mitigation alternative adjacent to existing habitat of the same kind for continuity and connectivity?	0-not adjacent of a larger area 2-contigous with larger area	0	0	2	2	2	2	0	0	2	2	2	0	2	2	2	0	2	2	0	2
P&G Criteria	Is the mitigation alternative cost effective? (P&G Efficient)	Yes No	Yes	No	No	Yes	No	No	Yes	No	No	No	No	Yes	No	No	No	No	No	N/A*	N/A*	N/A*
	Does the alternative have independent utility and not depend on another action? (not dependent on implementation of or modification to other projects)	Yes No	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
	Does the mitigation alternative meet acceptability criteria?	Yes No	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
	Does the mitigation alternative meet effectiveness criteria by meeting mitigation objectives?	Yes No	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*
Environmental Impacts	Does the mitigation alternative avoid adverse impacts to environmental resources?	*0-significant impacts* *1-Minimla or temporary* *2-No impacts*	*2*	*2*	*1*	*1*	*1*	*1*	*2*	*1*	*1*	*1*	*1*	*2*	*1*	*1*	*1*	*1*	*1*	*1*	*2*	*1*
	Does the mitigation alternative avoid HTRW concerns?	0-high risk 1-low risk 2-no risk identified	1	1	1	2	1	1	1	2	1	2	2	1	2	2	2	1	1	1	1	1
	Does the alternative avoid converting wetlands to uplands?	*Yes* *No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Implementation Risk	Can the alternative be easily scaled to meet changing mitigation acreage requirements?	Yes No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes

SECTION 13

Define and Estimate Costs of Final Array of Mitigation Plan Alternatives

13.1 ER 1105-2-100, APPENDIX C, PART C-4(F)(1) AND PART C-4(J)(3)(D)

Cost estimates were prepared for each alternative in the final array. The team used various sources of information to estimate the costs of the alternatives. Available information included records of recent mitigation bank credit sales in the area and details from recently completed nearby projects. The study team also considered other cost factors such as site access, fuel and equipment, and the availability of plant materials. Table I:13-1 displays the costs and outputs for each alternative plan. Because compensatory mitigation has a set objective, the outputs is the same for each alternative within a habitat type. Estimated costs include in construction, Operations and Maintenance, monitoring and adaptive management.

Table I:13-1. Estimated Costs of the Final Array of Alternative Plans

	Alternatives	Annual Cost	AAHU Needed	Total Cost	Plan Outputs
	No Action	$0	0	$0	0
Fresh Intermediate Marsh Non Refuge	Alternative 2-1 –Non Refuge Fresh and Intermediate Mash purchase mitigation bank credits	$954,938	47.5	**$26,751,905.00**	47.5 AAHU available
	Alternative 2-2 - Expand Milton Guste Island Expansion Marsh Restoration	$1,040,054	47.5	**$29,136,375.00**	47.5
	Alterative 2-3 -East Fontainebleau	$892,638	47.5	**$23,241,722.00**	47.5
	Alternative 2-4 -d-Felix Bopp	$1,243,133	47.5	**$34,573,364.00**	47.5
	Alternative 2-5 -- Eastern Fritchie	$1,438,826	47.5	**$40,307,692.00**	47.5
	Alternative 2-6 -- Combination of mitigation bank credits and MA 2-2 25% bank 75% constructed	$1,041,210	47.5	**$29,168,757.50**	47.5
	Alternative 2-7 -- Combination of mitigation bank credits and MA 2-2 50% bank 50% constructed	$1,042,366	47.5	**$29,201,140.00**	47.5
	Alternative 2-8 --	$1,043,522	47.5	**$29,233,522.50**	47.5

	Combination of mitigation bank credits and MA 2-2 75% bank 25% constructed				
	Alternative 2-9 - Combination of mitigation bank credits and MA 2-3 25% bank 75% constructed	$879,337	47.5	**$24,634,017.75**	47.5
	Alternative 2-10 - Combination of mitigation bank credits and MA 2-3 50% bank 50% constructed	$929,037	47.5	**$26,026,313.50**	47.5
	Alternative 2-1 1- Combination of mitigation bank credits and MA 2-3 75% bank 25% constructed	$978,736	47.5	**$27,418,609.25**	47.5
	Alternative 2-12 - Combination of mitigation bank credits and MA 2-4 25% bank 75% constructed	$1,197,067	47.5	**$33,534,999.25**	47.5
	Alternative 2-13 - Combination of mitigation bank credits and MA 2-4 50% bank 50% constructed	$1,160,002	47.5	**$32,496,634.50**	47.5
	Alternative 2-14 -	$1,122,936	47.5	**$31,458,269.75**	47.5

	Combination of mitigation bank credits and MA 2-4 75% bank 25% constructed				
	Alternative 2-15 - Combination of mitigation bank credits and MA 2-5 25% bank 75% constructed	$1,382,084	47.5	**$38,718,120.25**	47.5
	Alternative 2-16 - Combination of mitigation bank credits and MA 2-5 50% bank 50% constructed	$1,325,343	47.5	**$37,128,548.50**	47.5
	Alternative 2-17 - Combination of mitigation bank credits and MA 2-5 75% bank 25% constructed	$1,268,602	47.5	**$35,538,976.75**	47.5
Nonrefuge Riparian BLH	Alternative 3-1 –Riparian BLH purchase mitigation bank credits	$98,742	23.87	**$2,766,198.82**	23.87
	Alternative 3-2 – Creek Southwest Lake Ramsey - Tchefuncte	$133,617	23.87	**$4,453,358.01**	23.87
	Alternative 3-3 – West Airport	$133,847	23.87	**$4,043,738.01**	23.87
	Alternative 3-4 – East Airport	$134,078	23.87	**$3,743,180.51**	23.87

	Alternative 3-5 – West Tchefuncte	$134,308	23.87	**$3,918,428.01**	23.87
	Alternative 3-6 -- Combination of mitigation bank credits and MA 3-2 25% bank 75% constructed	$139,872	23.87	**$4,459,816.34**	23.87
	Alternative 3-7 -- Combination of mitigation bank credits and MA 3-2 50% bank 50% constructed	$140,103	23.87	**$4,466,274.67**	23.87
	Alternative 3-8 -- Combination of mitigation bank credits and MA 3-2 75% bank 25% constructed	$140,334	23.87	**$4,472,732.99**	23.87
	Alternative 3-9 - Combination of mitigation bank credits and MA 3-3 25% bank 75% constructed	$140,564	23.87	**$4,050,196.34**	23.87
	Alternative 3-10 - Combination of mitigation bank credits and MA 3-3 50% bank 50% constructed	$144,346	23.87	**$4,056,654.67**	23.87
	Alternative 3-11 - Combination of mitigation bank credits and MA 3-3 75%	$144,576	23.87	**$4,063,112.99**	23.87

	bank 25% constructed				
	Alternative 3-12 - Combination of mitigation bank credits and MA 3-4 25% bank 75% constructed	$144,807	23.87	**$3,749,638.84**	23.87
	Alternative 3-13 - Combination of mitigation bank credits and MA 3-4 50% bank 50% constructed	$145,037	23.87	**$3,756,097.17**	23.87
	Alternative 3-14 - Combination of mitigation bank credits and MA 3-4 75% bank 25% constructed	$158,967	23.87	**$3,762,555.49**	23.87
	Alternative 3-15 - Combination of mitigation bank credits and MA 3-5 25% bank 75% constructed	$159,198	23.87	**$3,924,886.34**	23.87
	Alternative 3-16 - Combination of mitigation bank credits and MA 3-5 50% bank 50% constructed	$159,428	23.87	**$3,931,344.67**	23.87
	Alternative 3-17 - Combination of mitigation bank credits and MA 3-5 75%	$159,659	23.87	**$3,937,802.99**	23.87

	bank 25% constructed				
Pine Savanna Non Refuge	Alternative 4-1 –Pine Savanna purchase mitigation bank credits	$417,181	66.79	**$6,175,937.72**	66.79
	MA 4-2 Nonrefuge Pine Savanna – Old Whispering Pines	$498,749	66.79	**$13,731,304.96**	66.79
	Alternative 4-3 – – Near Talisheek	$681,036	66.79	**$18,871,687.46**	66.79
	Alternative 4-4 – Reed Brake	$810,292	66.79	**$22,492,687.46**	66.79
	Alternative 4-5 – Old Military Road Red Oak Fork	$543,321	66.79	**$14,963,104.96**	66.79
	Alternative 4-6 – Mentab	$501,352	66.79	**$13,837,969.93**	66.79
	Alternative 4-7 -- Combination of mitigation bank credits and MA 4-2 25% bank 75% constructed	$531,473	66.79	**$13,330,463.15**	66.79
	Alternative 4-8 -- Combination of mitigation bank credits and MA 4-2 50% bank 50% constructed	$564,197	66.79	**$12,929,621.34**	66.79
	Alternative 4-9 -- Combination of mitigation bank credits and MA 4-2 75%	$596,920	66.79	**$12,528,779.53**	66.79

	bank 25% constructed				
	Alternative 4-10 - Combination of mitigation bank credits and MA 4-3 25% bank 75% constructed	$714,201	66.79	**$18,474,751.90**	66.79
	Alternative 4-11 - Combination of mitigation bank credits and MA 4-3 50% bank 50% constructed	$747,365	66.79	**$18,077,816.34**	66.79
	Alternative 4-12 - Combination of mitigation bank credits and MA 4-3 75% bank 25% constructed	$780,529	66.79	**$17,680,880.78**	66.79
	Alternative 4-13 - Combination of mitigation bank credits and MA 4-4 25% bank 75% constructed	$843,456	66.79	**$22,095,751.90**	66.79
	Alternative 4-14 - Combination of mitigation bank credits and MA 4-4 50% bank 50% constructed	$876,620	66.79	**$21,698,816.34**	66.79
	Alternative 4-15 - Combination of mitigation bank credits and MA 4-4 75%	$909,785	66.79	**$21,301,880.78**	66.79

	bank 25% constructed				
	Alternative 4-16 - Combination of mitigation bank credits and MA 4-5 25% bank 75% constructed	$575,825	66.79	**$14,560,310.03**	66.79
	Alternative 4-17 - Combination of mitigation bank credits and MA 4-5 50% bank 50% constructed	$608,328	66.79	**$14,157,515.09**	66.79
	Alternative 4-18 - Combination of mitigation bank credits and MA 4-5 75% bank 25% constructed	$640,832	66.79	**$13,754,720.16**	66.79
	Alternative 4-19 - Combination of mitigation bank credits and MA 4-6 25% bank 75% constructed	$516,604	66.79	**$12,939,211.87**	66.79
	Alternative 4-20 - Combination of mitigation bank credits and MA 4-6 50% bank 50% constructed	$531,855	66.79	**$12,040,453.82**	66.79
	Alternative 4-21 - Combination of mitigation bank credits and MA 4-6 75%	$547,106	66.79	**$11,141,695.77**	66.79

	bank 25% con-structed				
Refuge Pine Savanna	Alternative 5-1 Pine Savanna Refuge Bayou Bonfouca		21	$2,719,532.98	9
Stream	Alternative 6-2-Benefical Use Stream Backwater		3 acres	$4,062,000	3 acres

SECTION 14
Incremental Costs

14.1 ER 1105-2-100, APP C, PART C-4(D)

For environmental planning, where traditional benefit-cost analysis is not possible because costs and benefits are expressed in different units, two analytical methods are used to assist in the decision process. First, cost effectiveness (CE) analysis is conducted to ensure that the least cost solution is identified for each possible level of environmental output. Subsequent incremental cost analysis (ICA) of the cost effective solutions is conducted to reveal changes in costs for increasing levels of environmental outputs. In the absence of a common measurement unit for comparing the non-monetary benefits with the monetary costs of environmental plans, cost effectiveness and incremental cost analysis are valuable tools to assist in decision making.

Incremental cost analysis discovers and displays variations in costs of alternative plans with the intent to identify and describe the least cost plan. Incremental analysis is the investigation and documentation of the relationship between costs incurred to realize each unit of output associated with the implementation of each plan increment. Incremental cost is the increase in cost incurred when output is increased by one unit.

For mitigation planning the outputs of each alternative plan are the same. Each alternative plan in the final array was scaled to meet the mitigation planning objective which is equal to the amount of unavoidable habitat impacts expressed in units.

It is important to keep in mind that the most useful information developed by these two methods is what it tells decision makers about the relative relationships among solutions – that one will likely produce greater output than another, or one is likely to be more costly than another – rather than the specific numbers that are calculated. Furthermore, these analyses will usually not lead, and are not intended to lead, to a single best solution (as in economic cost-benefit analysis); however, they will improve the quality of decision making by ensuring that a rational, supportable approach is used in considering and selecting alternative methods to produce environmental outputs.

Institute for Water Resources IWR Planning Suite software was used to analyze and compare alternative plans. The software uses information about the measures and plans including combinability and exclusions, costs, and outputs. The team establishes the parameters and enters cost estimates and plan outputs into the software. The resulting information is used to evaluate alternatives and identify a suite of cost effective solutions or plans. The latest version (2.0.9.1) has been certified for use by USACE Headquarters, meaning that it has been reviewed and certified by the appropriate Planning Center of Expertise (PCX) and represents a corporate approval that the model is sound and functional. Please note that an CE/ICA were not conducted for Refuge Pine Savanna or Stream restoration since only site remained after alternative site evaluations.

14.1.1 Cost Effective Solutions (CE)

In cost effectiveness analysis, it is necessary to filter out plans that produce the same output level as another plan, but cost more; or cost the same amount or more than another plan, but produce less output. This CE analysis was performed by the IWR planning model.

Tables I:14-1 through I:14-3 display the expected environmental outputs (AAHUs) along with the first cost, interest during construction, and average annual cost for each of the restoration alternatives and no action plans for Marsh, Riparian, and Pine Savanna. In this instance alternatives 2-3, 3-1, and 4-1 are the only cost-effective plans for Marsh, Riparian, and Pine Savanna, respectively.

14.1.2 Cost Effective and Incrementally Justified (Best Buy Plans)

The final step in the analysis is to determine which subset of the cost effective solutions is also incrementally justified. These solutions, also known as Best Buy Plans or Best Buy Alternatives, are those plans that provide increases in benefits at the lowest average cost (per habitat unit). The IWR Planning model was run to make the necessary calculations producing the results shown in Table I:14-4. In this case, the cost-effective solutions 2-3, 3-1, and 4-1 are also the Best Buy Plans for Marsh, Riparian, and Pine Savanna, respectively.

Included in Table I:14-4 are the incremental costs per habitat unit for the Best Buy Plans. Incremental cost is calculated by dividing the difference between the solution's costs by the difference between the solution's outputs. Figures I:14-1 through I:14-3 show the full range of solutions and highlight the non-cost effective solutions and the incrementally justified (Best Buy) solutions for Marsh, Riparian, and Pine Savanna. Figures I:14-4 through I:14–6 show the incremental cost and output for the Best Buy plans for Marsh, Riparian, and Pine Savanna.

Table I:14-1 Summary of Outputs and Costs: Marsh

Name of Alternative	Mitigation Site Name	Types of Activities	First Cost	Interest During Construction	Average Annual Cost	AAHUs	Cost Effective
No Action	-	-	$ -	$ -	$ -	-	-
2-1	General Marsh Mitigation Bank	Purchase Mitigation Bank	$ 26,751,905	$ 332,335	$ 954,938	47.5	No
2-2	Milton Island Marsh Restoration	100% constructed M1	$ 29,136,375	$ 361,956	$ 1,040,054	47.5	No
2-3 TSP	**East Fontainebleau**	**100% constructed M2**	**$ 23,241,722**	**$ 288,728**	**$ 829,638**	**47.5**	**Yes**
2-4	Felix Bopp	100% constructed M4	$ 34,573,364	$ 429,499	$ 1,234,133	47.5	No
2-5	Eastern Fritchie	100% constructed M6	$ 40,307,692	$ 500,736	$ 1,438,826	47.5	No
2-6	Combination of mitigation bank credits and constructed mitigation	25% bank 75% constructed M1	$ 29,168,758	$ 362,359	$ 1,041,210	47.5	No

2-7	Combination of mitigation bank credits and constructed mitigation	50% bank 50% constructed M1	$ 29,201,140	$ 362,761	$ 1,042,366	47.5	No
2-8	Combination of mitigation bank credits and constructed mitigation	75% bank 25% constructed M1	$ 29,233,523	$ 363,163	$ 1,043,522	47.5	No
2-9	Combination of mitigation bank credits and constructed mitigation	25% bank 75% constructed M2	$ 24,634,018	$ 306,024	$ 879,337	47.5	No
2-10	Combination of mitigation bank credits and constructed mitigation	50% bank 50% constructed M2	$ 26,026,314	$ 323,321	$ 929,037	47.5	No
2-11	Combination of mitigation bank credits and constructed mitigation	75% bank 25% constructed M2	$ 27,418,609	$ 340,617	$ 978,736	47.5	No
2-12	Combination of mitigation bank credits and constructed mitigation	25% bank 75% constructed M4	$ 33,534,999	$ 416,600	$ 1,197,067	47.5	No
2-13	Combination of mitigation bank credits and constructed mitigation	50% bank 50% constructed M4	$ 32,496,635	$ 403,700	$ 1,160,002	47.5	No
2-14	Combination of mitigation bank credits and con-	75% bank 25% constructed M4	$ 31,458,270	$ 390,801	$ 1,122,936	47.5	No

	structed mitigation						
2-15	Combination of mitigation bank credits and constructed mitigation	25% bank 75% constructed M6	$ 38,718,120	$ 480,989	$ 1,382,084	47.5	No
2-16	Combination of mitigation bank credits and constructed mitigation	50% bank 50% constructed M6	$ 37,128,549	$ 461,242	$ 1,325,343	47.5	No
2-17	Combination of mitigation bank credits and constructed mitigation	75% bank 25% constructed M6	$ 35,538,977	$ 441,495	$ 1,268,602	47.5	No

Note: Costs are shown at the 2023 price level and were annualized using the current FY23 Federal discount rate of 2.5 percent over a 50-year period of analysis.

Table I:14-2. Summary of Outputs and Costs: Riparian

Name of Alternative	Mitigation Site Name	Types of Activities	First Cost	Interest During Construction	Average Annual Cost	AAHUs	Cost Effective
No Action	-	-	$ -	$ -	$ -	-	-
3-1	**General Riparian Mitigation Bank**	**Purchase Mitigation Bank**	**$ 2,766,199**	**$ 34,364**	**$ 98,742**	**23.87**	**Yes**
3-2	Creek Southwest Lake-Ramsey Tchefuncte	100% constructed RS 28	$ 4,453,358	$ 55,323	$ 158,967	23.87	No
3-3	West Airport	100% constructed RS 27	$ 4,043,738	$ 50,235	$ 144,346	23.87	No
3-4	East Airport	100% constructed RS 29	$ 3,743,181	$ 46,501	$ 133,617	23.87	No
3-5	West Tchefuncte	100% constructed RS 30	$ 3,918,428	$ 48,678	$ 139,872	23.87	No
3-6	Combination of mitigation bank credits and constructed mitigation	25% bank 75% constructed RS-28	$ 4,459,816	$ 55,404	$ 159,198	23.87	No
3-7	Combination of mitigation bank credits and constructed mitigation	50% bank 50% constructed RS-28	$ 4,466,275	$ 55,484	$ 159,428	23.87	No
3-8	Combination of mitigation bank credits and constructed mitigation	75% bank 25% constructed RS-28	$ 4,472,733	$ 55,564	$ 159,659	23.87	No

3-9	Combination of mitigation bank credits and constructed mitigation	25% bank 75% constructed RS-27	$ 4,050,196	$ 50,315	$ 144,576	23.87	No
3-10	Combination of mitigation bank credits and constructed mitigation	50% bank 50% constructed RS-27	$ 4,056,655	$ 50,395	$ 144,807	23.87	No
3-11	Combination of mitigation bank credits and constructed mitigation	75% bank 25% constructed RS-27	$ 4,063,113	$ 50,475	$ 145,037	23.87	No
3-12	Combination of mitigation bank credits and constructed mitigation	25% bank 75% constructed RS-29	$ 3,749,639	$ 46,581	$ 133,847	23.87	No
3-13	Combination of mitigation bank credits and constructed mitigation	50% bank 50% constructed RS-29	$ 3,756,097	$ 46,661	$ 134,078	23.87	No
3-14	Combination of mitigation bank credits and constructed mitigation	75% bank 25% constructed RS-29	$ 3,762,555	$ 46,742	$ 134,308	23.87	No
3-15	Combination of mitigation bank credits and constructed mitigation	25% bank 75% constructed RS-30	$ 3,924,886	$ 48,758	$ 140,103	23.87	No
3-16	Combination of mitigation bank credits and constructed mitigation	50% bank 50% constructed RS-30	$ 3,931,345	$ 48,838	$ 140,334	23.87	No
3-17	Combination of mitigation bank credits and constructed mitigation	75% bank 25% constructed RS-30	$ 3,937,803	$ 48,919	$ 140,564	23.87	No

Note: Costs are shown at the 2023 price level and were annualized using the current FY23 Federal discount rate of 2.5 percent over a 50-year period of analysis.

Table I:14-3. Summary of Outputs and Costs: Pine Savanna

Name of Alternative	Mitigation Site Name	Types of Activities	First Cost	Interest During Construction	Average Annual Cost	AAHUs	Cost Effective
No Action	-	-	$ -	$ -	$ -	-	-
4-1	**General Pine Savanna Mitigation Bank**	**Purchase Mitigation Bank**	**$ 11,687,041**	**$ 145,186**	**$ 417,181**	**66.79**	**Yes**
4-2	Old Whispering Pines	100% constructed PS-25	$ 13,731,305	$ 170,582	$ 498,749	66.79	No
4-3	Near Talisheek	100% constructed PS-6	$ 18,871,687	$ 234,440	$ 681,036	66.79	No
4-4	Reed Brake	100% constructed PS-7	$ 22,492,687	$ 279,423	$ 810,292	66.79	No
4-5	Old Military Road Red Oak Fork	100% constructed M6	$ 14,963,105	$ 185,884	$ 543,321	66.79	No
4-6	Mentab	100% constructed M6	$ 13,837,970	$ 171,907	$ 501,352	66.79	No
4-7	Combination of mitigation bank credits and constructed mitigation	25% bank 75% constructed PS-25	$ 14,708,239	$ 182,718	$ 531,473	66.79	No
4-8	Combination of mitigation bank credits and constructed mitigation	50% bank 50% constructed PS-25	$ 15,685,173	$ 194,854	$ 564,197	66.79	No
4-9	Combination of mitigation bank credits	75% bank 25% constructed PS-25	$ 16,662,107	$ 206,991	$ 596,920	66.79	No

	and constructed mitigation						
4-10	Combination of mitigation bank credits and constructed mitigation	25% bank 75% constructed PS-6	$ 19,852,528	$ 246,625	$ 714,201	66.79	No
4-11	Combination of mitigation bank credits and constructed mitigation	50% bank 50% constructed PS-6	$ 20,833,368	$ 258,810	$ 747,365	66.79	No
4-12	Combination of mitigation bank credits and constructed mitigation	75% bank 25% constructed PS-6	$ 21,814,208	$ 270,994	$ 780,529	66.79	No
4-13	Combination of mitigation bank credits and constructed mitigation	25% bank 75% constructed PS-7	$ 23,473,528	$ 291,608	$ 843,456	66.79	No
4-14	Combination of mitigation bank credits and constructed mitigation	50% bank 50% constructed PS-7	$ 24,454,368	$ 303,793	$ 876,620	66.79	No
4-15	Combination of mitigation bank credits and constructed mitigation	75% bank 25% constructed PS-7	$ 25,435,208	$ 315,977	$ 909,785	66.79	No
4-16	Combination of mitigation bank credits and constructed mitigation	25% bank 75% constructed PS-19	$ 15,938,086	$ 197,996	$ 575,825	66.79	No
4-17	Combination of mitigation bank credits and constructed mitigation	50% bank 50% constructed PS-19	$ 16,913,067	$ 210,108	$ 608,328	66.79	No
4-18	Combination of mitigation bank credits and constructed mitigation	75% bank 25% constructed PS-19	$ 17,888,048	$ 222,220	$ 640,832	66.79	No

4-19	Combination of mitigation bank credits and constructed mitigation	25% bank 75% constructed PS-26	$ 14,316,988	$ 177,858	$ 516,604	66.79	No
4-20	Combination of mitigation bank credits and constructed mitigation	50% bank 50% constructed PS-26	$ 14,796,005	$ 183,808	$ 531,855	66.79	No
4-21	Combination of mitigation bank credits and constructed mitigation	75% bank 25% constructed PS-26	$ 15,275,023	$ 189,759	$ 547,106	66.79	No

Note: Costs are shown at the 2023 price level and were annualized using the current FY23 Federal discount rate of 2.5 percent over a 50-year period of analysis.

Table I:14-4. Best Buy Plans and Incremental Costs

Name of Alternative	Mitigation Site Name	Types of Activities	First Cost	Interest During Construc-tion	Average Annual Cost	AAHUs	Average Annual Cost per Habitat Unit	Additional Output (AAHUs)	Additional Average Annual Cost	Incremen-tal Cost (per AAHU)
No Action	-	-	$ -	$ -	$ -	-	$ -	-	$ -	$ -
2-3	East Fon-tainebleau	100% con-structed M2	$ 23,241,722	$ 288,728	$ 829,638	47.5	$ 17,466	47.5	$ 829,638	$ 17,466
3-1	General Riparian Mitigation Bank	Purchase Mitigation Bank	$ 2,766,199	$ 34,364	$ 98,742	23.87	$ 4,137	23.87	$ 98,742	$ 4,137
4-1	General Pine Sa-vanna Miti-gation Bank	Purchase Mitigation Bank	$ 11,687,041	$ 145,186	$ 417,181	66.79	$ 6,246	66.79	$ 417,181	$ 6,246

Note: Costs are shown at the 2023 price level and were annualized using the current FY23 Federal discount rate of 2.5 percent over a 50-year period of analysis.

Figure I:14-1. Marsh Full Range of Solutions

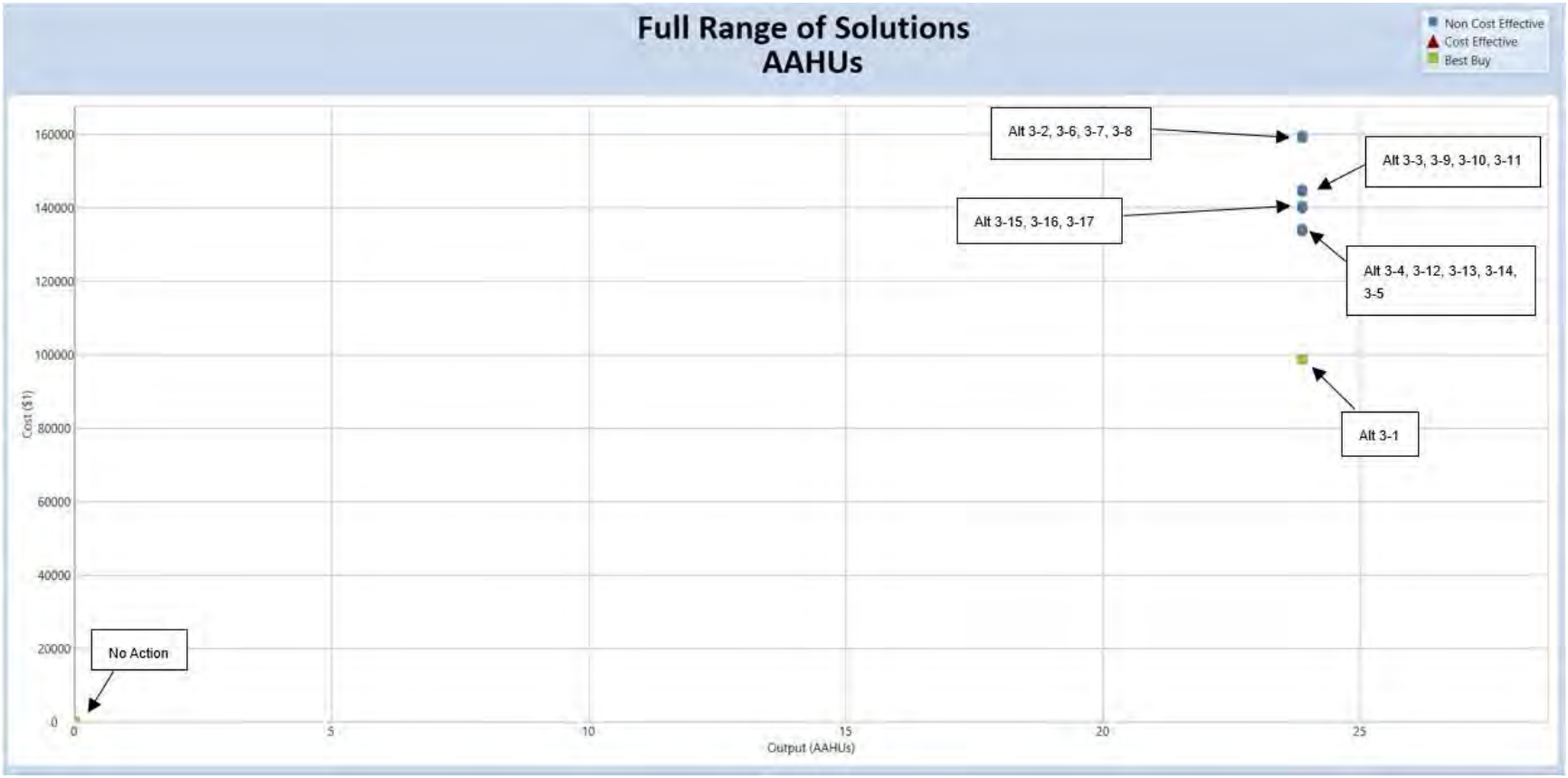

Figure I:14-2. Riparian Full Range of Solutions

Figure I:14-2. Riparian Full Range of Solutions

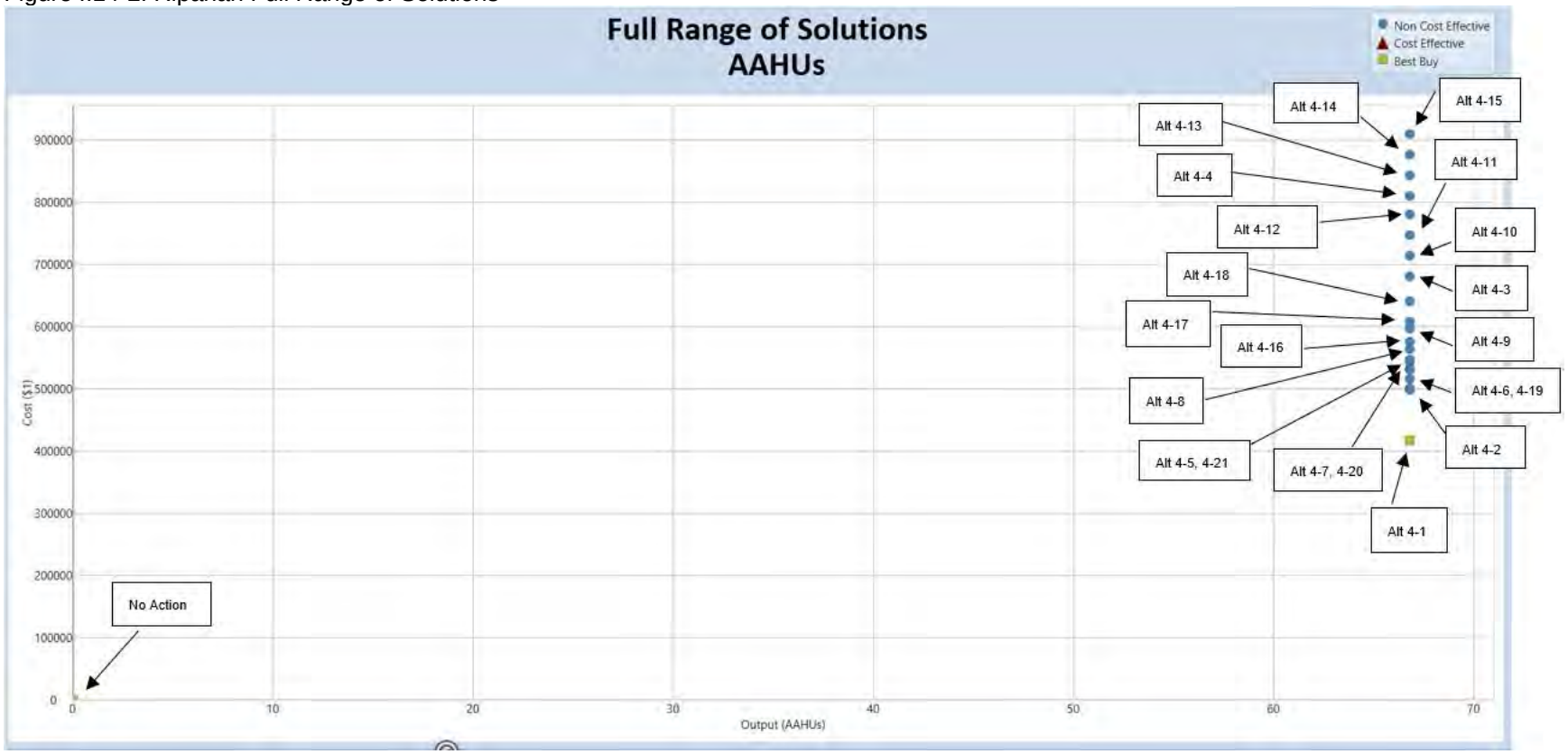

Figure I:14-3. Pine Savanna Full Range of Solutions

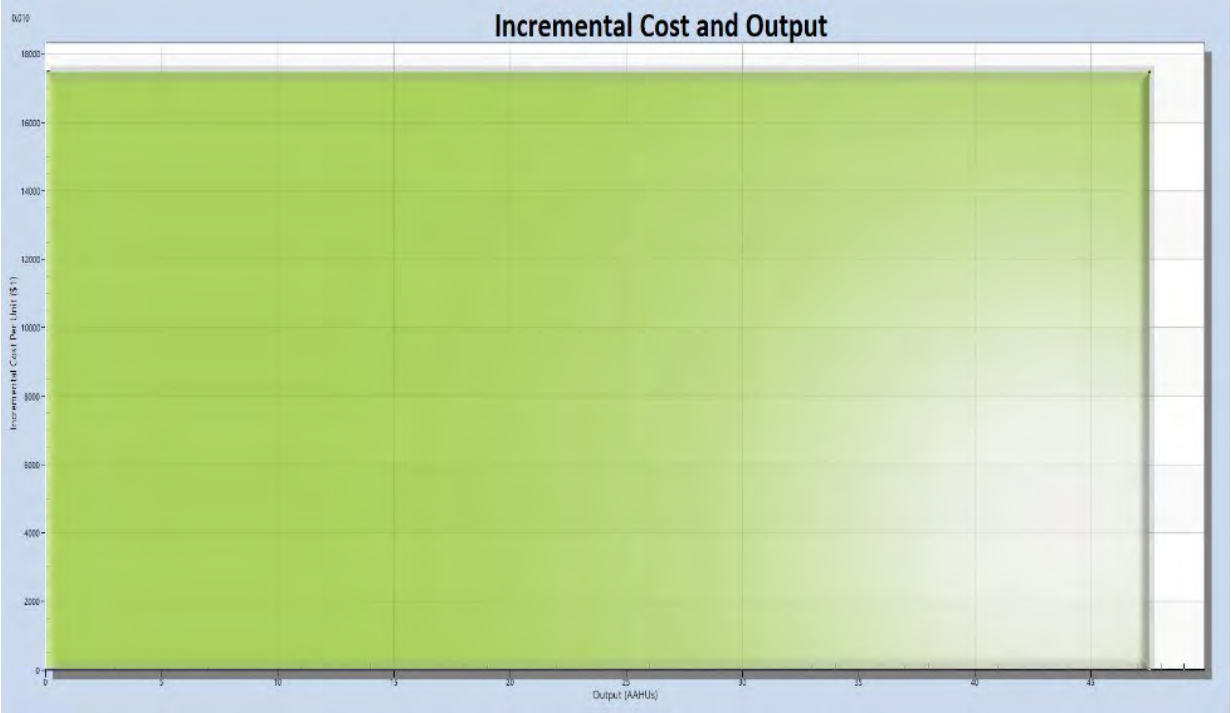

Figure I:14-4. Marsh – Best Buy Alternative 2-3

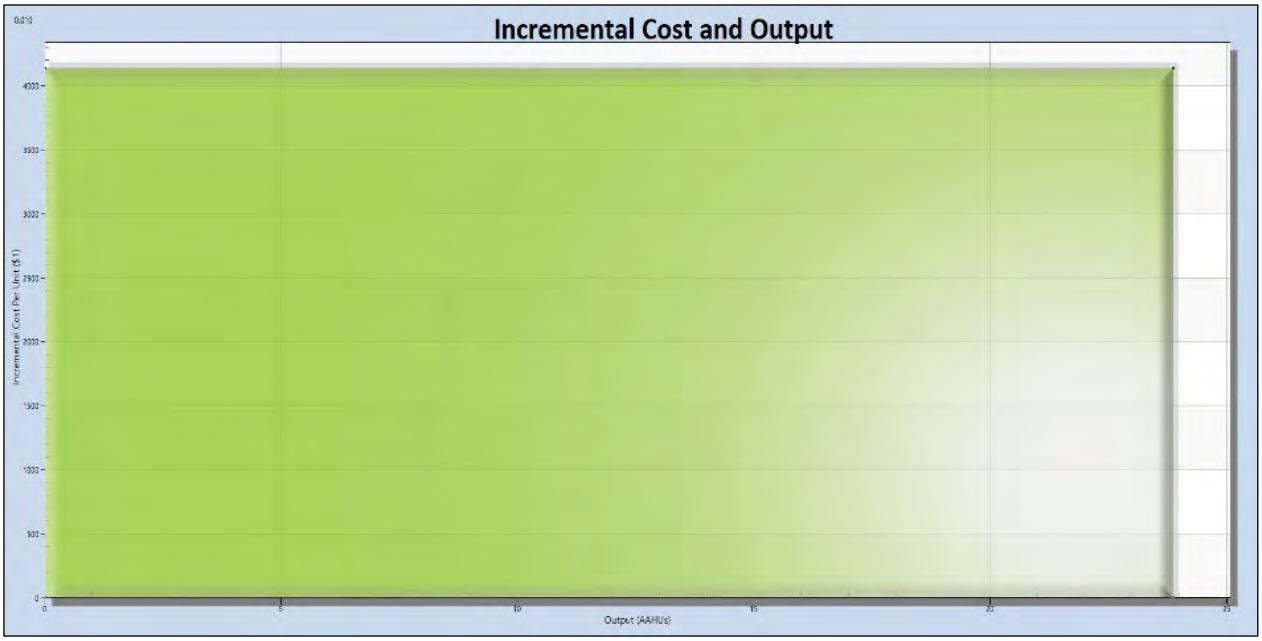

Figure I:14-5. Riparian- Best Buy Mitigation Bank

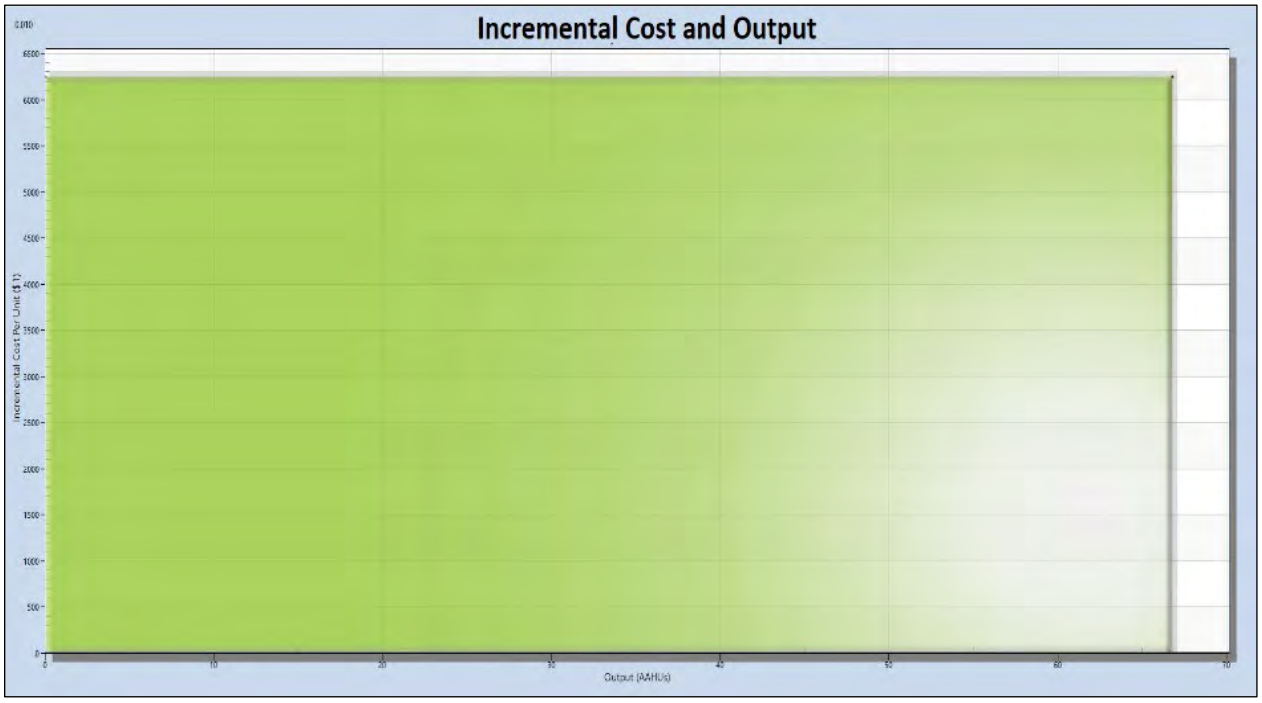

Figure I:14-6. Pine Savanna- Best Buy Mitigation Bank

SECTION 15
Recommended Compensatory Mitigation Plan

15.1 ER 1105-2-100, APPENDIX C, PART C-4(G)(8)

The following tentatively selected mitigation alternatives by habitat type were combined like building blocks to form the proposed mitigation action. The proposed action for mitigation is complete, effective, efficient and acceptable. It is the least cost alternative plan that provides full mitigation of losses specified in the planning objectives. The habitats mitigation will all occur in the watershed.

The comprehensive mitigation plan TSP would be a combination of mitigation bank credit purchases and USACE constructed projects. Constructed projects are proposed for marsh, stream and refuge pine savanna impacts and mitigation banks are proposed for riparian and non refuge pine savanna impacts.

Marsh TSP - MA 2-3 Non refuge Fresh and Intermediate Marsh - East Fontainebleau (Site M2), This alternative includes a 221 acre measure restoration site in St Tammany Parish. The site is within the acquisition boundary of the BBMNWR but is currently under private ownership. There is a proposed CWPPRA project (Bayou Cane Marsh Creation) #PO181 adjacent to this site. Measures include perimeter retention dikes, dredged material placement, interior terraces, pump and fill to require elevation, 1 year after dewatering brining down dikes, should naturally vegetate, external borrow if possible (Management Measure #3 and #10). There are 299 acres available. This site provides 47 AAHUS.

Riparian TSP - MA 3-1 Nonrefuge Riparian BLH – Purchase mitigation bank credits (RS-MB). Mitigation bank credits purchased would be selected through a solicitation process, through which any mitigation bank meeting eligibility requirements and having the appropriate resource type of credits could submit a proposal to sell credits. If appropriate and cost-effective, the Corps may choose to purchase mitigation bank credits from more than one bank to fulfill the compensatory mitigation requirements for a particular habitat type (Management Measure #1). This site provides 24 AAHUS.

Pine Savanna TSP - MA 4-1 Nonrefuge Pine Savanna – Purchase mitigation bank credits (PS-MB). Mitigation bank credits purchased would be selected through a solicitation process, through which any mitigation bank meeting eligibility requirements and having the appropriate resource type of credits could submit a proposal to sell credits. If appropriate and cost-effective, the Corps may choose to purchase mitigation bank credits from more

than one bank to fulfill the compensatory mitigation requirements for a particular habitat type (Management Measure #1). This site provides 67 AAHUS.

Refuge Pine Savanna TSP - PSR – 1 Refuge Pine Savanna- The proposed project involves the restoration of up to 70 acres of degraded wet Long-leaf Pine Savanna Forest as compensatory mitigation for coastal zone Pine Savanna impacts resulting from construction of the Slidell levee alignment, The restoration area is located entirely within the Big Branch National Wildlife Refuge, St Tammany Parish, LA. The site is located south and east of Bayou Bonfouca, west of the Norfolk Southern railroad and Pontchartrain Drive (state highway 11) and north of the Lake Pontchartrain Northshore, LA.

The project includes eradication of invasive species such as Tallow. Removal of undesirable hardwood species, and reintroduction of fire across the entire site. Removal of undesirable hardwood species coupled with the reintroduction of frequent fires are effective tools in restoring ground cover in remnant longleaf pine savannas.

Stream- M-12a Mile Branch Backwater Beneficial Use of Staging Area- Create a backwater area off of Mile Branch that provides 3 acres of mud bottom as a project feature. Culverts would allows frequent water exchange between Mile Branch and the backwater area to avoid stagnation. The site would be excavated below the average stage to Mile Branch to achieve both deep-water and shallow water habitat. A buffer would be planted with bottomland hardwoods around the east, south, and west perimeter of the site. Some shallow areas should be provided for marsh or swamp vegetation growth.

The TSP is outlined in Table I:15-1.

Table I:15-1. Mitigation TSP

Habitat Type	St Tammany Project Feature Impacts	Mitigation Site	AAHUs	Cost*
Non-Refuge Marsh	Levee and Floodwall System	M2 – East Fontainebleau	48	$25,570,000
Non-Refuge Riparian	Mile Branch	Mitigation Bank	24	$2,770,000
Non-Refuge Pine Savanna	Levee and Floodwall System	Mitigation Bank	67	$11,690,000
Refuge Pine Savanna	Levee and Floodwall System	Pine Savanna BBNWR PSR-1	8	$2,720,000
Stream	Mile Branch	Adjacent to Mile Branch	3 acres	$4,060,000
Total Mitigation Cost				**$46,800,000**

Purchase of mitigation bank credits for riparian and pine savanna habitat would be dependent on receipt of an acceptable proposal(s) and total purchase cost. No particular bank(s) is (are) proposed for use at this time. The bank(s) from which credits would be purchased would be selected through a solicitation process, through which any mitigation bank meeting eligibility requirements and having the appropriate resource type of credits could submit a proposal to sell credits.

If the projects in the proposed action are unable to satisfy the whole mitigation need for the St. Tammany Parish Feasibility Study, additional projects in the final array of mitigation alternatives would be utilized in order of ranking of least cost alternatives. In cases where the alternatives ranked similarly in CE/ICA the results of the rankings in Section 12 were considered.

- The next ranked alternative for marsh habitat is M2-9-which is a combination of mitigation bank credit purchase and constructed mitigation at the East Fountain Bleu site, if the East Fontainebleau site and or mitigation bank purchases are not available the next constructed site would be Alternative 2-4 Milton Island Marsh Restoration.

- The next ranked riparia alternatives after purchase of mitigation banks is Alternative 3-2 Creek Southwest Lake Ramsey Tchefuncte.

- The next ranked non refuge pine savanna alternatives after purchase of mitigation banks is Alternative 4-2 old Whispering Pine and then Alternative 4-6 the Mentab site.

- There are no additional refuge pine savanna sites. If the proposed action on the refuge does not meet the mitigation needs, further coordination with USFWS is needed and there is the potential that the pine savanna mitigation need for BBNWR refuge impacts would have to be mitigation on another USFWS NWR.

- If the identified stream backwater project is determined not to be feasible, the team would need to explore the purchase of mitigation credits out of the watershed and investigate additional sites.

SECTION 16
Implementation Risks

16.1 ER 1105-2-100, PART 2-4(F) & (G), AND APPENDIX C, PART C-4(E)(4)

The planning team identified a suite of foreseeable implementation risk factors across each phase of implementation (PED, Construction, and Operations) (Table I:16-1). These factors are based upon experience from similar projects and the consideration of regional risks generally associated with design and construction work in wet environments. Each risk was assessed and assigned a significance level. Potential risk management measures were identified and will be considered should the need arise during implementation or adaptive management.

Table I:16-1. Risk Assessment and Management Measures

Pre-Construction Engineering and Design Phase			
Risk Factor	**Risk Potential**	**Risk Rating**	**Risk Management Measures**
Increase in habitat impacts	Low	Low	Include mitigation sequence commitments in P&S development. Employ Best Management Practices in P&S. Confirm during BCOES review. Planning to make sure sites could be expanded with additional acreage.
Poor soil conditions	Low	High	Address through design considerations. Inability to address could lead to change in mitigation site or plan.
Construction Phase			
Risk Factor	**Risk Potential**	**Risk Rating**	**Risk Management Measures**
Excessive rainfall or flooding	Medium	Medium	Plan for construction during more favorable weather seasons. Anticipate weather events before initiating weather-dependent phases of construction. Use appropriate equipment for site conditions.
Construction management	Medium	varies	Monitor use of Best Management Practices during construction work. Confirm construction as-built requirements are met. Document all conditions pre- and post-construction at site.
Operations Phase			
Risk Factor	**Risk Potential**	**Risk Rating**	**Risk Management Measures**
Storm impacts to mitigation	High	High	Incorporate engineering with nature elements into mitigation design. Develop a storm impact assessment and response plan. Employ adaptive management measures to address impacts that prevent the achievement of ecological success criteria.
Herbivory	High	varies	Monitor vegetation for survival and resistance to herbivores. Adaptively manage by implementing exclusion or treatment measures to address herbivore impacts as needed.
Invasive Species	Medium	Low	Monitor vegetation. Adaptively manage by implementing invasive species control treatment measures as needed.
Controlled Burns	Medium	Medium	Monitor vegetation. Adaptively manage by adjusting control burn plan based on monitoring results.

SECTION 17
Criteria for Determining Ecological Success

17.1 [ER 1105-2-100, APP C, PART C-4(G)(8)(C).]

The ecological success criteria for the proposed mitigation plan are summarized in the section. Criteria are included for the proposed construction projects (Marsh , Refuge Pine Savanna and Stream) and are based on the replacement of lost functions and values of the habitat, including hydrologic and vegetative characteristics. These criteria will allow for meaningful evaluation and review of the mitigation projects' target for success in meeting compensatory requirements.

Since the recommended plan includes the purchase of credits from a mitigation bank for Riparian and Non Refuge Pine Savanna habitats specific ecological success criteria are not included for these habitats in accordance with Section 2036(c)(3)(A) of the Water Resources Development Act of 2007. In these instances, the mitigation bank operator is responsible for demonstrating and reporting that the bank's success criteria are being met.

Table I:17-1 defines the success criteria for the proposed action. Collectively the achievement of all the criteria should ensure the mitigation project meets the planning objective(s). The specific time-period or point in time to achieve the criteria are linked to the construction schedule including degradation of dikes and growing seasons.

Section 2036(a) of the Water Resources Development Act of 2007 requires the District to hold an annual mitigation consultation meeting with the appropriate Federal agencies and states. For each project, the meeting should focus on the ecological success criteria, the likelihood that the project will achieve success, the timeline to achieve success, and any recommendations for improving the likelihood of success. Section 3 identifies the agencies invited to the District's annual meeting.

Table I:17-1. Ecological Success Criteria (Initial)

Habitat	Pine Savanna	Refuge Pine Savanna	Freshwater and Intermediate Marsh	Riparian (BLH)	Stream
Objective	55 average annual habitat units	98 average annual habitat unit	48 average annual habitat units	23 average annual habitat units	3 acres
Proposed Action	Mitigation Bank	Constructed-Site	Constructed-	Mitigation Bank	Constructed
Success Criteria – Topography or Bathymetry	The recommended plan is to purchase credits from a mitigation bank. The mitigation bank operator is responsible for demonstrating and reporting that the bank's success criteria are being met. Therefore, no specific ecological success criteria are developed for this plan	Post-construction assure ≥ 80% of total area must be within 0.5 ft of target elevation	Post-construction assure 90% of the area contains substrate at +1.5 ft NGVD and 10% of the area is 2.0 feet deep or less.	The recommended plan is to purchase credits from a mitigation bank. The mitigation bank operator is responsible for demonstrating and reporting that the bank's success criteria are being met. Therefore, no specific ecological success criteria are developed for this plan	Post-construction assure ≥ 80% of total area must be within 0.5 ft of target elevation
Success Criteria –Hydraulic Conditions		Ground surface elevations must be conducive to establishment and support of hydrophytic vegetation	N/A		Connectivity to Mile Branch at designed events
Success Criteria –Vegetation Characteristics		During dry season, non-indigenous hardwood overstory species within the savanna areas would be removed to a level below 10% canopy coverage and non-indigenous pine species would be thinned to below 40% canopy coverage	Attain 100% vegetative cover of marsh substrate. Document species diversity reflective of a sustainable freshwater marsh.		Attain 80% survival of planted riparian/BLH species and freshwater marsh; maintain less that 5% invoice species.
Timber Management		One round of controlled burns, thinning of invasive and or unwanted species must have occurred throughout the site	N/A		N/A
Aquatic Invertebrate	N/A	N/A	N/A	N/A	5 years post restoration diversity assemblages consistent or exceeding those in Mile Branch

SECTION 18
Monitoring and Adaptive Management

18.1 ER 1105-2-100, APPENDIX C, PART C-4(K)(1)

The interagency planning team developed a plan for site monitoring to determine the success of the mitigation work see Attachment I.1. Tables I:18-1 through I:18-3 include a summary of monitoring work and identifies the entity that will be responsible for the monitoring activity. The elements of the monitoring plan are designed to measure the attainment of ecological success criteria at key points over the course of the mitigation construction and operation periods. The costs of monitoring activities prior to and during construction are generally shared. Most post-construction monitoring costs are part of OMRR&R and are the responsibility of the NFS.

The recommended plan is to purchase credits from a mitigation bank for portions of the mitigation TSP. For mitigation banks a specific monitoring and adaptive management plan is not needed (see Section 2036(c)(3)(A) of the Water Resources Development Act of 2007) is not needed for the mitigation bank portion of the recommended plan. In these instances, the bank operator is responsible for monitoring and reporting that the bank is meeting performance expectations. Therefore, no specific monitoring activities are included for non-refuge pine savanna or riparian habitats. In addition, the bank is responsible for any contingency plans (adaptive management) for taking corrective actions in cases where monitoring demonstrates that mitigation measures are not achieving the ecological success criteria. The mitigation bank used is responsible for monitoring, reporting, and assuring performance of the mitigation bank in accordance with the requirements of the approved mitigation banking instrument.

Monitoring work also offers an opportunity to build upon partnerships with local interests, non-governmental organizations, universities, and the public. The USACE and the NFS are interested in these partnership opportunities. Parties interested in participating in monitoring efforts are encouraged to discuss potential work with the sponsors.

Table I:18-1. Monitoring Activities Fresh and Intermediate Marsh

Year	Activity	Data	Entity Performing
-1	Pre-construction surveys	Water-depth, hydrology, land cover	USACE
0	Pre-construction monitoring	Baseline ecological data	USACE
~0-3 months post initial construction activities	As-Built Surveys and Construction Completion Report for initial construction activities	Confirm project is built to P&S	USACE
Within 1 year following initial construction activities	Baseline vegetation monitoring survey (qualitative)	Document early ecological condition, information may inform nuisance/invasive species treatment and the final monitoring plan	USACE
1 year after initial construction activities	Topographic Survey associated with final construction activities	Elevations (compared to hydrologic conditions)	USACE
2 years following initial construction activities or 1 years following final construction activities, whichever is later	Topographic Survey for Initial Success Criteria	Elevations (compared to hydrologic conditions)	USACE
2 growing seasons following initial construction activities or 1 growing season following final construction activities, whichever is later	Vegetation monitoring survey – Initial Success Criteria	Quantify initial success for native herbaceous, nuisance, and invasive plant species criteria	USACE
2 years following attainment of initial success guidelines	Vegetation monitoring – intermediate success criteria	Quantify intermediate success for native herbaceous, nuisance, and invasive plant species criteria	Non-Federal Sponsor
5 years following attainment of initial success guidelines and every 5 years afterwards throughout the remaining 50-year Project life	Vegetation monitoring survey – long term success	Quantify long-term success for native herbaceous, nuisance, and invasive plant species criteria	Non-Federal Sponsor
End of 50-year Project life	Final monitoring report	Comprehensive report	Non-Federal Sponsor

The estimated monitoring costs for the M-2 site are $ $2,138,278.00.

Table I:18-2. Monitoring Activities Refuge Pine Savanna

Year	Activity	Data	Entity Performing
-1	Pre-construction surveys	Water-depth, hydrology, land cover	USACE
0	Pre-construction monitoring	Baseline ecological data; vegetation composition and structure	USACE
1	As-Built Surveys and Construction Completion Report	Confirm project is built to P&S	USACE
1	Bathymetric survey	ground elevation	USACE
1	Hydrologic monitoring	elevations must be conducive to establishment and support of hydrophytic vegetation	USACE
1	Vegetation survey	Invasive species removal needs; vegetation composition and structure	USACE
5	Hydrologic monitoring	demonstrating that wetland hydrology has been re-established	Non-Federal Sponsor
5	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
10	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
15	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
20	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
30	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
40	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
50	Final monitoring report	Comprehensive report	Non-Federal Sponsor

The estimated monitoring costs for the Pine Savana site PSR-01 is $420,000.

Table I:18-3. Monitoring Activities Stream

Year	Activity	Data	Responsible Entity
-1	Pre-construction surveys	Water-depth, hydrology, land cover	USACE
0	Pre-construction monitoring	Baseline ecological data	USACE
1	As-Built Surveys and Construction Completion Report	Confirm project is built to P&S	USACE
1	Bathymetric survey	Water depth	USACE
1	Hydrologic monitoring	Tidal connection	USACE
1	Aquatic Fauna Sampling	Fish and Invertebrate	USACE
1	Vegetation survey	Invasive species removal needs	USACE
5	Hydrologic monitoring	Tidal connection	USACE
5	Vegetation survey	Plant survival	USACE
5	Hydrologic monitoring	Tidal connection	USACE
5	Aquatic Fauna Sampling	Fish and Invertebrate	USACE
10	Vegetation survey	Tree and aquatic	Non-Federal Sponsor
10	Hydrologic monitoring	Tidal connection	Non-Federal Sponsor
10	Aquatic Fauna Sampling	Fish and Invertebrate	Non-Federal Sponsor
15	Vegetation survey	Tree and aquatic	Non-Federal Sponsor
20	Vegetation survey	Tree and aquatic	Non-Federal Sponsor
30	Vegetation survey	Tree and aquatic	Non-Federal Sponsor
40	Vegetation survey	Tree and aquatic	Non-Federal Sponsor
50	Final monitoring report	Comprehensive report	Non-Federal Sponsor

The estimated monitoring costs for the 3 acres Stream site are $250,000

Reports documenting the monitoring activities and the results should be prepared after each activity. Results should be shared with the USACE and interested resource agencies. The project team should discuss the project at the district's annual mitigation consultation meeting with resources agencies (per Section 2036(a) of the WRDA of 2007).

Any adaptive management activities will be informed by the results of the project monitoring. It is important that a science-based monitoring plan target the collection of performance information that can help inform potential adaptive management actions if needed. Adaptive management allows the project team to use monitoring feedback to potentially make changes to project features or operations to improve attainment of ecological success criteria. This contingency plan outlines a range of corrective actions in cases where monitoring demonstrates that mitigation features are not achieving ecological success goals.

The mitigation bank operator is responsible for demonstrating and reporting that the bank's success criteria are being met for the portion of the TSP that will be purchasing mitigation

banks. Therefore, no specific adaptive management activities are included for non-refuge pine savanna or riparian habitats.

The adaptive management plan for the constructed fresh and intermediate marsh, refuge pine savanna and stream mitigation projects are summarized in Tables I:18-1 through I:18-3. Please see Attachments I.2, I.4, and I.6 for the monitoring and adaptive management plans for the constructed marsh, pine savanna refuge and stream project.

Table I:18-1. Adaptive Management Actions Marsh

Element	Expected Condition	Potential Issue	Potential Corrective Action
Landscape characteristics	Bathymetry appropriate for sustainable growth of marsh vegetation	Water that is deeper or shallower than ideal conditions for targeted vegetations.	Modify land elevation; marsh renourishment to obtain elevations necessary for marsh establishment and maintenance
Connectivity	Obtain necessary hydrology	Limited water exchange or excessive flooding, wave action or salinity.	Modify channels to obtain necessary connectivity adjust gapping in dikes in the future to maintain sufficient marsh hydrology and connectivity Construction feature to reduce wave and salinity influences on the marsh restoration feature.
Vegetation community composition	Healthy vegetative communities free of invasive species, assuming natural colonization	Invasive species dominance, native species do not establish, poor marsh survival,	Invasive species control, marsh plantings

The estimated Adaptive Management costs for the M2 marsh restoration site is $ 600,000.

Table I:18-2 Adaptive Management Actions Refuge Pine Savanna

Element	Expected Condition	Potential Issue	Potential Corrective Action
Landscape characteristics	Bathymetry appropriate for sustainable growth of targeted vegetation	Site frequently flooded	Modify water depth and frequency and or increase land elevation to reduce flooding
Vegetation community composition	Healthy vegetative communities free of invasive species.	Invasive species dominance, poor tree survival, sub-optimal tree growth, incorrect community composition	Invasive species control, replanting larger tree for targeted species, canopy thinning or other forest management practices including controlled burns

The estimated adaptive management costs for pine savanna are $337,800.

Table I:18-3 – Adaptive Management Actions- Stream Backwater

Element	Expected Condition	Potential Issue	Potential Corrective Action
Landscape characteristics	Bathymetry appropriate for water bottoms and the sustainable growth of targeted riparian vegetation	Water that is deeper or shallower than ideal conditions Water spills out of backwater area during high flow events.	Modify water depth. Add perimeter features or pumps to control water levels.
Stream connectivity	Water exchange during Flow event.	Limited flow exchange or excessive flooding.	Resize culverts or move feature to control water during non-storm conditions.
Vegetation community composition	Healthy vegetative communities free of invasive species.	Invasive species dominance,	Invasive species control Vegetative plantings

The estimated adaptive management costs for the stream backwater site are $463,000.

SECTION 19

Compensatory Habitat Mitigation Laws, Guidance, Policies and Regulations

Laws

- Clean Water Act
- Fish and Wildlife Coordination Act
- Magnuson – Stevens Fishery Conservation and Management Act
- National Environmental Policy Act
- Water Resources Development Acts of 1986, 1990, 2000, 2007, 2014, and 2016.
- 33 U.S.C. 2283

Implementation Guidance

- Section 2036(a) of the Water Resources Development Act of 2007 - Mitigation for Fish and Wildlife and Wetlands Losses. Issued by ASA(CW) 31 August 2009.
- Section 1162 of the Water Resources Development Act of 2016 (WRDA 2016), Wetlands Mitigation. Issued by ASA(CW) 01 February 2018.
- Section 1162 of the Water Resources Development Act of 2016 and Section 1040 of the Water Resources Reform and Development Act of 2014, Fish and Wildlife Mitigation (Section 906 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 2283) (WRDA 2016). Issued by ASA(CW) 08 March 2019.
- Section 1163 of the water Resources Development Act of 2016 (WRDA 2016, Wetlands Mitigation. Issued by ASA(CW) 08 March 2019.

Policy

- Cost Sharing for Lands Associated with Fish and Wildlife Mitigation. Issued by USACE Director of Civil Works 19 September 2006.

Regulations

- 40 CFR 230.92, definition of mitigation bank.
- 40 CFR 1500.3(b)(2), include alternatives input from State, Tribal and local governments.
- 40 CFR 1503.3(e), cooperating agencies must cite statutory authority to specify mitigation.
- 40 CFR 1508.5, definition of cooperating agency.
- 40 CFR 1508.20, definition of mitigation.
- Engineer Circular 1105-2-412 Assuring Quality of Planning Models.
- Engineer Regulation 1105-2-100 Planning Guidance Notebook, Appendix C.

- Engineer Regulation 200-1-5 Policy for Implementation and Integrated Application of the U.S. Army Corps of Engineers (USACE) Environmental Operating Principles (EOP) and Doctrine.
- Engineer Regulation 200-2-2 Procedures for Implementing NEPA.

SECTION 20
References and Resources

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SECTION 21
List of Acronyms and Abbreviations

AAHU	Average Annual Habitat Unit
BBMNWR	Big Branch Marsh National Wildlife Refuge
BLH	Bottomland Hardwood
CEM	Conceptual Ecological Model
DEIS	Draft Environmental Impact Statement
DIFR	Draft Integrated Feasibility Report
EPA	Environmental Protection Agency
FWS	Fish and Wildlife Services
FWOP	Future With Out Project
GIS	Geographic Information System
HEP	Habitat Evaluation Procedure
HET	Habitat Evaluation Team
HSI	Habitat Suitability Index
IWR	Institute for Water Resources
LDWF	Louisiana Department of Wildlife and Fisheries
MA	Mitigation Alternative
MVN	New Orleans District
NFS	Non- Federal Sponsor
NMFS	National Marine Fisheries Service
NWR	National Wildlife Refuge
O&M	Operation and Maintenance
OMRR&R	Operations, Maintenance, Repair, Rehabilitation, and Replacement
PED	Pre-Construction Engineering and Design
SEIS	Supplemental Environmental Impact Statement
TSP	Tentatively Selected Plan
USACE	United States Army Corps of Engineers
USEPA	United Stated Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
WRDA	Water Resources Development Act
WVA	Wetland Value Assessment

Mississippi Valley Division,
Regional Planning and Environment Division South

St. Tammany Parish, Louisiana Feasibility Study

Appendix I: Attachment 1 – Project Description Constructed Marsh Project

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SECTION 1

Fresh and Intermediate Marsh Mitigation Site

1.1 PROJECT LOCATION

The proposed marsh mitigation site (M-2) is located on the north shore of Lake Pontchartrain, east of the Causeway Bridge near Lacombe (Figures I1:1-1 and I1:1-2). The site is within the acquisition boundary of the Big Branch Marsh National Wildlife Refuge, but is currently under private ownership. The site would provide 200 acres (47 AAHUs) of fresh and intermediate marsh habitat to compensate for unavoidable wetland impacts from the construction of the South and West Slidell levee and floodwall system under the St. Tammany Parish, Louisiana Feasibility study. Estimated footprint is 200 acres with a dike perimeter of 16,067 feet. An open water site visit is recommended to conduct WVA evaluation, collect preliminary site data, and visually observe site conditions.

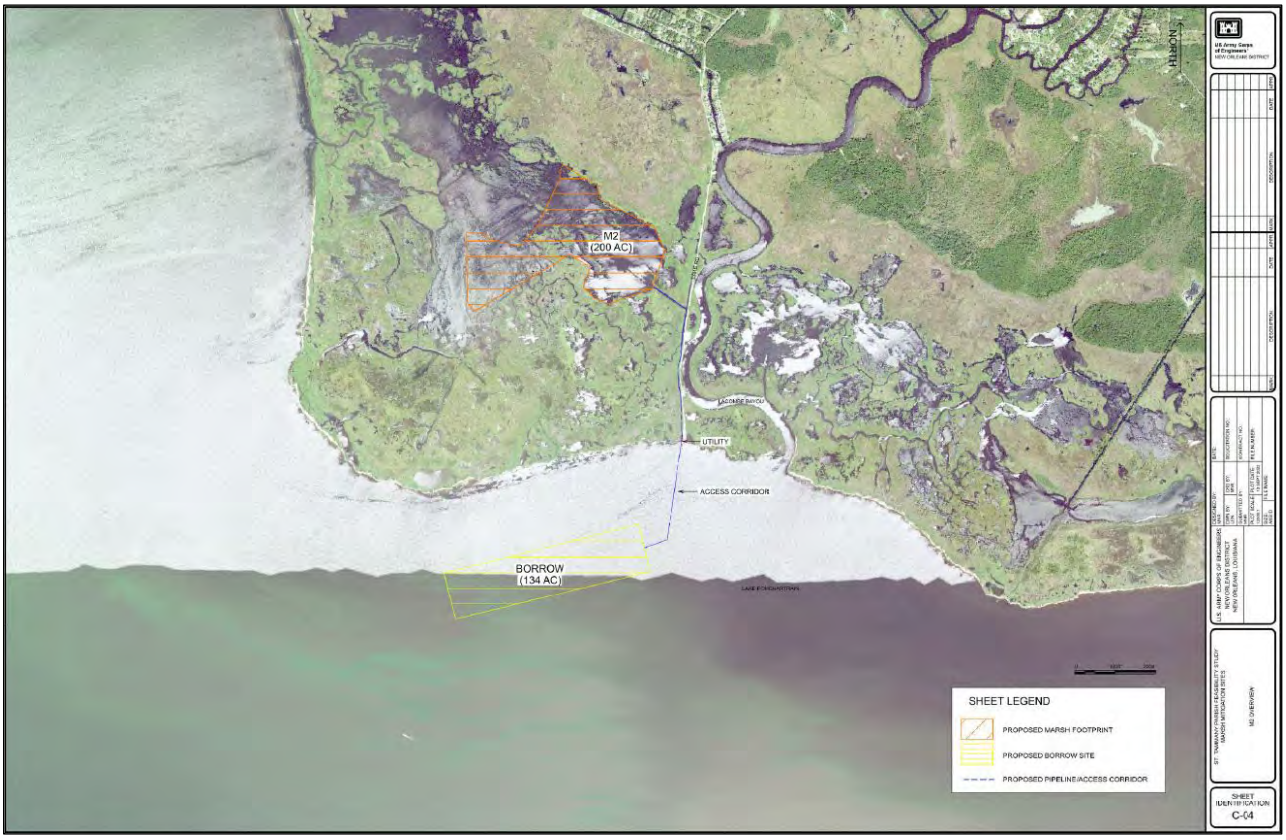

Figure I1:1-1. Project Location

1.2 PROJECT DESCRIPTION

This project alternative (Figure I1:1-2) currently consists of 200 acres of marsh creation. The assumed existing elevation is -1.65 feet NAVD88. Initial target elevation for dredge fill will be to approximate elevation +2.5 NAVD88, to ultimately hit a target marsh elevation of +1.0 NAVD88. At this 35 percent design level, total perimeter retention will be required to retain dredge material and allow for vertical accretion. Approximately 16,067 linear ft of new retention dike will be required along the limit of the project footprint. The dike will be built with borrow from within the footprint. The dike will be built with a 5 feet crown width to elevation +4.8 feet NAVD88, to provide 1 foot of freeboard during pumping operation and allow for settlement. This dike will be degraded in year 1, upon settlement and dewatering of the created marsh platform. The degraded material can be disposed of in the original borrow canal if settlement allows or cast into the open water immediately outside of the project footprint. Spill boxes or weirs will be constructed at pre-determined locations within the retention dike to allow for effluent water release from within the marsh creation area. If deemed necessary by the construction contractor, low level interior weir or baffle dikes can be constructed to assist in vertical stacking of dredged material.

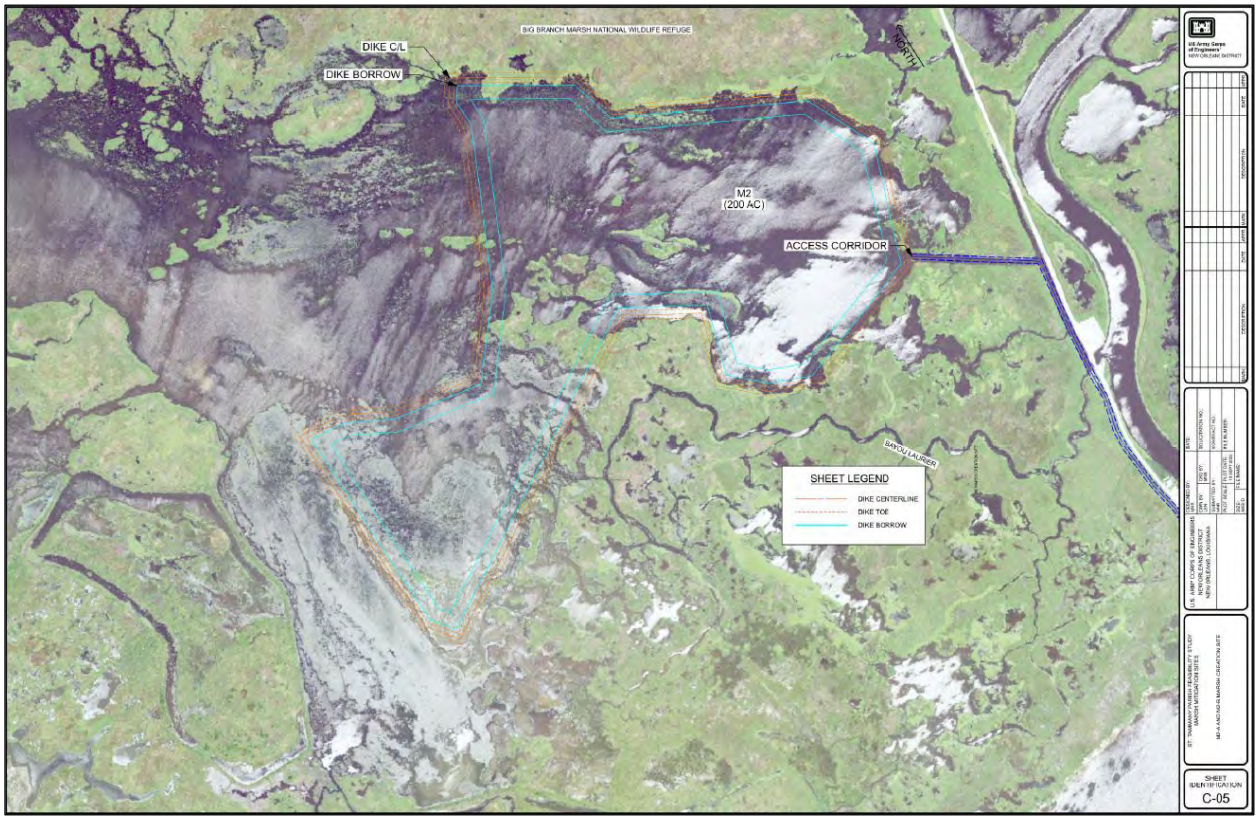

Figure I1:1-2. Marsh Mitigation Site

1.2.1 Borrow Requirements

Marsh creation would require borrow of approximately 2,200,000 cubic yards of material. A borrow site of 134 acres would accommodate this requirement. The borrow plan is to obtain material from Lake Pontchartrain, requiring a buffer of 2000 ft between the existing shoreline and the borrow area limit. Borrow would not be allowed greater than 10 feet below the existing lake bottom, except that a tolerance of 1-foot below this target elevation will be provided the contractor to account for inaccuracies in the dredging process. To assure adequate borrow, the fill quantity was doubled account for unsuitable materials, unknown utilities, unidentified anomalies, and/or unsighted cultural finds. An access corridor of approximately 7,340 linear feet will be allowed from the lake to the proposed marsh creation site. The access corridor can be used to establish a pipeline corridor, offload equipment as necessary, and transport personnel to and from the worksite. The contractor will be instructed to minimize usage and damage within the access corridor, by using existing waterways for daily transportation of supplies and personnel where possible.

1.2.2 Relocations

Based on a review by the CEMVN ED of pipeline and utility information available to the Corps through existing GIS pipeline and utility databases, there appears to be no pipeline crossings through the M2 site. The NOAA chart 11369 “Lake Pontchartrain and Maurepas” shows an unknown pipeline at the access channel. No impacts to pipelines or utilities are anticipated, however, the actual disposition of pipelines and utilities within the project area will have to be coordinated and verified with the owners by the ED Relocations Team.

Mississippi Valley Division,
Regional Planning and Environment Division South

St. Tammany Parish, Louisiana Feasibility Study

Appendix I: Attachment 2 – Monitoring and Adaptive Management – Constructed Marsh Project

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SECTION 1

Fresh and Intermediate Marsh Restoration Site

The proposed marsh mitigation site (M-2) is located on the north shore of Lake Pontchartrain, east of the Causeway Bridge near Lacombe (Figures I1:1-1 and I1:1-2). The site is within the acquisition boundary of the Big Branch Marsh National Wildlife Refuge but is currently under private ownership. The site would provide 200 acres (47 AAHUs) of fresh and intermediate marsh habitat to compensate for unavoidable wetland impacts from the construction of the South and West Slidell levee and floodwall system under the St. Tammany Parish, Louisiana Feasibility study. Estimated footprint is 200 acres with a dike perimeter of 16,067 feet. An open water site visit is recommended to conduct WVA evaluation, collect preliminary site data, and visually observe site conditions.

Figure I2:1-1. Project Location

1.1 PROJECT DESCRIPTION

This project alternative (Figure I2:1-2) currently consists of 200 acres of marsh creation. The assumed existing elevation is -1.65 feet NAVD88. Initial target elevation for dredge fill will be to approximate elevation +2.5 NAVD88, to ultimately hit a target marsh elevation of +1.0 NAVD88. At this 35 percent design level, total perimeter retention will be required to retain dredge material and allow for vertical accretion. Approximately 16,067 linear feet of new retention dike will be required along the limit of the project footprint. The dike will be built with borrow from within the footprint. The dike will be built with a 5 feet crown width to elevation +4.8 feet NAVD88, to provide one ft of freeboard during pumping operation and allow for settlement. This dike will be degraded in year 1, upon settlement and dewatering of the created marsh platform. The degraded material can be disposed of in the original borrow canal if settlement allows or cast into the open water immediately outside of the project footprint. Spill boxes or weirs will be constructed at pre-determined locations within the retention dike to allow for effluent water release from within the marsh creation area. If deemed necessary by the construction contractor, low level interior weir or baffle dikes can be constructed to assist in vertical stacking of dredged material.

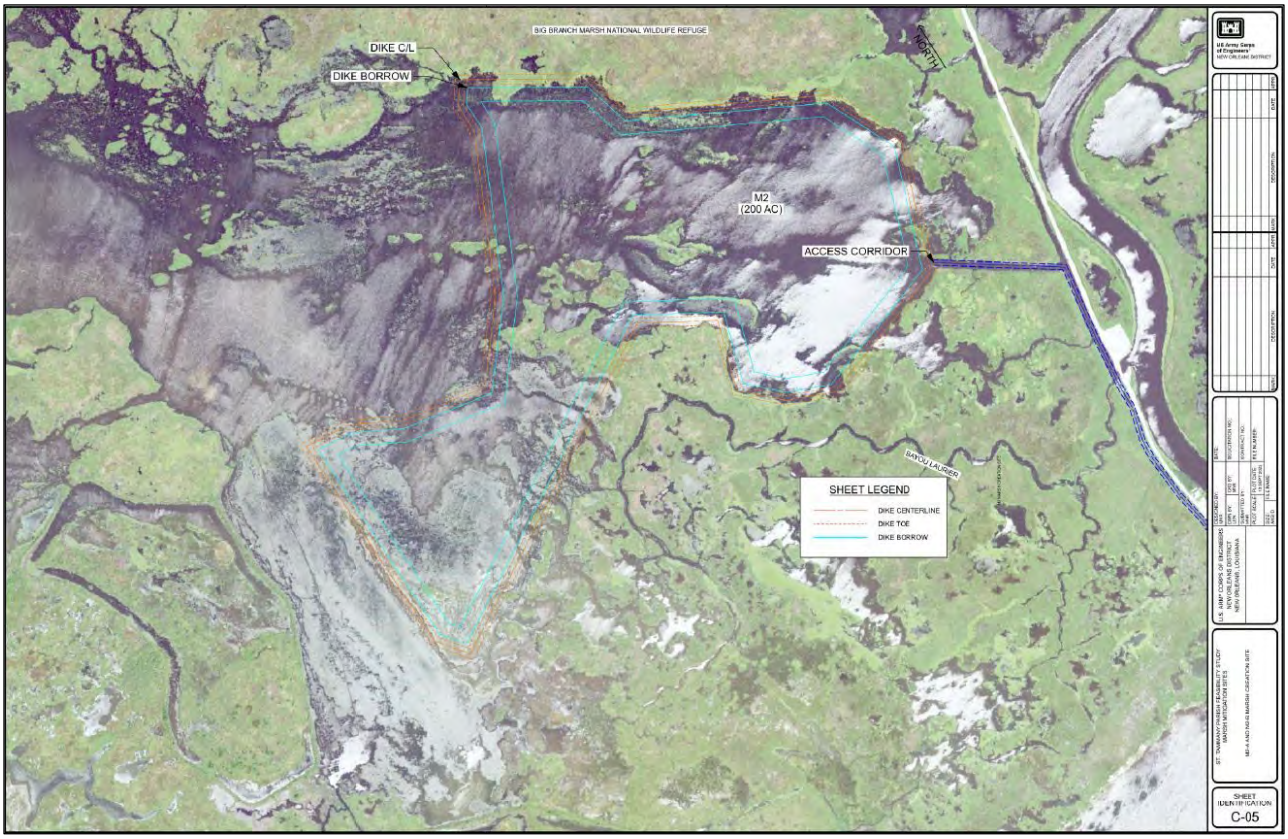

Figure I2:1-2. Marsh Mitigation Site

1.1.1 Borrow Requirements

Marsh creation would require borrow of approximately 2,200,000 cubic yards of material. A borrow site of 134 acres would accommodate this requirement. The borrow plan is to obtain material from Lake Pontchartrain, requiring a buffer of 2000 ft between the existing shoreline and the borrow area limit. Borrow would not be allowed greater than 10 ft below the existing lake bottom, except that a tolerance of 1-foot below this target elevation will be provided the contractor to account for inaccuracies in the dredging process. To assure adequate borrow, the fill quantity was doubled account for unsuitable materials, unknown utilities, unidentified anomalies, and/or unsighted cultural finds. An access corridor of approximately 7,340 linear feet will be allowed from the lake to the proposed marsh creation site. The access corridor can be used to establish a pipeline corridor, offload equipment as necessary, and transport personnel to and from the worksite. The contractor will be instructed to minimize usage and damage within the access corridor, by using existing waterways for daily transportation of supplies and personnel where possible.

1.1.2 Relocations

Based on a review by the CEMVN ED of pipeline and utility information available to the Corps through existing GIS pipeline and utility databases, there appears to be no pipeline crossings through the M2 site. The NOAA chart 11369 “Lake Pontchartrain and Maurepas” shows an unknown pipeline at the access channel. No impacts to pipelines or utilities are anticipated; however, the actual disposition of pipelines and utilities within the project area will have to be coordinated and verified with the owners by the ED Relocations Team.

SECTION 2
USACE Guidance

U.S. Army Corps of Engineers (USACE) monitoring and adaptive management policy is required by the Water Resources Development Act of 2007 and presented in planning guidance (Engineering Regulation (ER) 1105-2-100, Engineering Circular (EC) 1105-2-409, and Memorandum on Implementation Guidance for Section 2036 of the Water Resources Development Act of 2007). Monitoring includes the systematic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management will be needed to attain project benefits. Adaptive management addresses the uncertainties about a project's actual performance that exist when implementation decisions are made to undertake a water resources project. This technique allows decision making and implementation to proceed with the understanding that outputs will be assessed and evaluated and that some structural or operational changes to the project may be necessary to achieve desired results. At the heart of adaptive management is an appropriate monitoring program to determine if the outputs/results meet the required mitigation need, and to determine if any adjustments are needed.

The purpose of this plan is to demonstrate ecological success of the project. This success is determined by monitoring metrics that are specifically tied to project objectives, and success criteria. In addition, the plan identifies what adaptive management (contingency) is proposed if the performance targets are not met. This plan presents the framework for the above methodology, and will be refined as the project proceeds into Pre-construction, Engineering, and Design (PED) phase in collaboration with the non-Federal sponsors, as well as other stakeholders who may take responsibility for monitoring ecological variables in the watershed.

SECTION 3
Mitigation Success Criteria

The success (performance) criteria described herein are applicable to all proposed marsh habitats (fresh marsh, intermediate marsh, and brackish marsh restoration features), unless otherwise indicated.

3.1 GENERAL CONSTRUCTION

A. Complete all initial mitigation construction activities (e.g. construction of temporary retention/perimeter dikes, placement of fill (borrow material/dredged material), construction of permanent dikes if applicable, etc.) in accordance with the mitigation work plan and final project plans and specifications. Upon completion of construction, USACE or its contractor shall provide construction surveys to include all project features. These activities are classified as "initial construction requirements."

B. Approximately 1 year following completion of all initial mitigation construction activities (when the restored marsh feature has stabilized to the point that the containment berms are no longer required to prevent the loss of fill material from the project site), USACE or its contractor shall complete all final mitigation construction activities, in accordance with the mitigation work plan and final project plans and specifications. Such activities may include, but are not limited to: degrading temporary retention/perimeter dikes; completion of armoring of permanent dikes; "gapping" or installation of "fish dips;" soil testing; completion of plantings; and construction of trenasses or similar features within marsh features as a means of establishing shallow water interspersion areas within the marsh. Finishing the aforementioned construction activities will be considered as the "completion of final construction requirements."

3.2 TOPOGRAPHY[1]

A. Initial Success Criteria:

1. Two years after completion of fill placement or one year after final construction (whichever is later):
   - Demonstrate that at least 80 percent of each mitigation feature has a surface elevation that is within +0.5 to – 0.5 feet of the desired target surface elevation as determined by the settlement curve for that year.

2. Three years after completion of fill placement or two years after final construction (whichever is later):
   - Demonstrate that at least 80 percent of the mitigation site has a surface elevation that is within +0.5 feet to – 0.25 of the desired target surface elevation as determined by the settlement curve for that year.

B. Intermediate Success Criteria:
   1. Two years following achievement of Topography Criteria 2.A.2. —
      - Demonstrate that at least 80 percent of the mitigation site has a surface elevation that is within the functional marsh elevation range[2].
      - There are no additional monitoring or attainment requirements for topography beyond meeting the Intermediate Success Criteria for topography.

Notes: [1]Elevation survey data and report will be provided to the IET for review in order to determine concurrence. The surveys must include water levels inside and outside the marsh creation site at locations representative of site conditions.

[2]The "functional marsh elevation range," i.e. the range of the marsh surface elevation that is considered adequate to achieve proper marsh functions and values, is determined during the final design phase.

3.3 NATIVE VEGETATION

A. Fresh marsh:
   1. Initial Success Criteria (2 growing seasons following completion of initial construction activities in General Construction 1.A.):
      - Achieve a minimum average cover of 50 percent comprised of native herbaceous species.
      - Demonstrate that vegetation satisfies USACE hydrophytic vegetation criteria. (USACE 2010)

   2. Intermediate Criteria (2 years following attainment of Native Vegetation Criteria 3.A.1.):
      - Achieve a minimum average cover of 60 percent comprised of native herbaceous species.
      - Demonstrate that vegetation satisfies USACE hydrophytic vegetation criteria.

   3. Long-Term Success Criteria[3] (Every monitoring event after attainment of Native Vegetation Criteria 3.A.2.):

      - Achieve a minimum average cover of 60 percent comprised of native herbaceous species.
      - Demonstrate that vegetation satisfies USACE hydrophytic vegetation criteria.

Notes:

[1]Fresh marsh is typically not planted due to the expectation that it will naturally vegetate more quickly than intermediate or brackish marsh.

However, if percent cover success criteria are not met, plantings may become necessary in the absence of other recommended actions

A. Intermediate marsh and brackish marsh:

1. Initial Success Criteria (2 growing seasons following completion of initial construction activities in General Construction 1.A.):
   - Initial plantings must attain at least 80% survival of planted species, or achieve a minimum average cover of 25% native herbaceous species (includes planted species and volunteer species). If site self-vegetates, the site must achieve a minimum average cover of at least 50% native herbaceous species.
   - Demonstrate that vegetation satisfies USACE hydrophytic vegetation criteria.

2. Intermediate Criteria (2 years following attainment of Native Vegetation Criteria 3.B.1):
   - Achieve a minimum average cover of 60 percent, comprised of native herbaceous species (includes planted species and volunteer species).
   - Demonstrate that native vegetation satisfies USACE hydrophytic vegetation criteria.

3. Long-Term Success Criteria[3] (Every monitoring event after attainment of Native Vegetation Criteria 3.B.2.):
   - Achieve a minimum average cover of 60 percent, comprised of native herbaceous species (includes planted species and volunteer species).
   - Demonstrate that native vegetation satisfies USACE hydrophytic vegetation criteria.

Note:

[1]There is not a minimum average cover requirement for years 21 – 50. However, vegetation data will be collected throughout the 50-year project life[2].

[2]The 50-year period of monitoring begins once final construction of the project is complete.

- For projects that are NOT planted - at NCC if, at the end of the first growing season after all final construction activities are completed, the colonization of appropriate vegetation has begun to the satisfaction of CEMVN Environmental Branch (such that it is anticipated that the site is on track to meet initial success criteria).

- For projects that are planted - at NCC if, at the end of the first growing season after all final construction activities are completed (including planting), planting has been conducted to the satisfaction of CEMVN Environmental Branch (such that it is anticipated that the site is on track to meet initial success criteria).

3.4 INVASIVE AND NUISANCE VEGETATION (FOR ALL MARSH TYPES)

A. Initial, Intermediate, and Long-term[1] Success Criteria

- Maintain the project area such that the total average vegetative cover accounted for by invasive species and the total average vegetative cover accounted nuisance species each constitute less than 5 percent of the total average plant cover each throughout the 50- year project life. The list of invasive and nuisance species is found in Appendix A and will be tailored to reflect specific site needs.

Note:

[1]Yearly inspections to determine the need for invasive/nuisance control would be conducted until the long term success criteria for vegetation is achieved. After it is achieved, the frequency of inspections to determine the need for invasive/nuisance control would be adjusted based on site conditions.

SECTION 4
Mitigation Monitoring Guidelines

The guidelines for mitigation monitoring provided herein are applicable to all types of marshes being restored unless otherwise indicated.

4.1 BASELINE MONITORING REPORT (FIRST MONITORING REPORT)

A “baseline” monitoring report will be prepared upon completion of Final Construction Requirements 1.B. and upon any re-plantings associated with construction. Information provided will typically include the following:

- A detailed discussion of all mitigation activities completed.
- A plan view drawing of the mitigation site showing the approximate boundaries of the restored marsh, significant interspersion features established within the marsh features (as applicable), proposed monitoring transect locations, proposed sampling plot locations, photo station locations and water level survey locations.
- Initial and final construction surveys of all project features (including but not limited to the fill area, fish dips, weirs, culverts, etc.) and an analysis of the survey data will be provided addressing attainment of topographic success criteria. If a project is immediately adjacent to existing marsh habitat, the topographic survey will include spot elevations collected within the existing marsh habitat near the restored marsh.
- Photographs documenting conditions in the project area will be taken at the time of monitoring. Photos will be taken at permanent photo stations within the restored marsh. At least two photos will be taken at each station with the view of each photo always oriented in the same general direction from one monitoring event to the next. The number of photo stations required and the locations of these stations will vary depending on the mitigation site. The USACE will make this determination in coordination with the Interagency Team and will specify the requirements in the Mitigation Monitoring Plan. At a minimum, 4 photo stations will be established within each marsh cell.
- For planted marsh only - A detailed inventory of all species planted, including the number of each species planted, the stock size planted, and where the species were planted will be documented. For mitigation sites that include more than one planted marsh cell/feature, provide a breakdown itemization indicating the number of each species planted in

each feature and correlate this itemization to the marsh features depicted on the plan view drawing of the mitigation site.

- As part of the as-built/final construction survey, water level surveys will be taken inside and outside the marsh creation site at predetermined locations identified in coordination with the IET and NFS. Each interior water level elevation should have a corresponding exterior water level elevation taken consecutively and within close proximity. If there appears to be disparity in water levels within the marsh creation site, additional shots may be required. The baseline monitoring report will provide the surveyed water level data and will compare it to mean high and mean low water elevation data collected from a tidal elevation recording station in the general vicinity of the mitigation site. The report will further address estimated mean high and mean low water elevations at the mitigation site based on field indicators.

- Various qualitative observations will be made in the mitigation site to help assess the status and success of mitigation and maintenance activities. These observations will include: general estimate of the average percent cover by native plant species; general estimates of the average percent cover by invasive and nuisance plant species; general observations concerning colonization of the mitigation site by volunteer native plant species; general condition of native vegetation; trends in the composition of the plant community; wildlife utilization as observed during monitoring (including fish species and other aquatic organisms); the condition of interspersion features (tidal channels, trenasses, depressions, etc.) constructed within the marsh features, noting any excessive scouring and/or siltation occurring within such features; the natural formation of interspersion features within restored marshes; observations regarding general surface water flow characteristics within marsh interspersion features; the general condition of “gaps,” “fish dips,” or similar features constructed in permanent dikes; if present, the general condition of any armoring installed on permanent dikes. General observations made during the course of monitoring will also address potential problem zones and other factors deemed pertinent to the success of the mitigation project.

- A summary assessment of all data and observations along with recommendations as to actions necessary to help meet mitigation and management/maintenance goals and mitigation success criteria.

- A brief description of anticipated maintenance/management work to be conducted during the period from the current monitoring report to the next monitoring report.

4.2 ADDITIONAL MONITORING REPORTS

All monitoring reports generated after the Baseline Monitoring Report will be called either Initial, Intermediate or Long-Term Monitoring Reports and shall include the year in which the monitoring occurred (i.e. Monitoring Report 2019). All Monitoring Reports shall provide the following information unless otherwise noted:

- All items listed for the Baseline Monitoring Report with the exception of: (a) the topographic surveys, although additional topographic surveys are required for specific monitoring reports (see below); and (b) the inventory of species and location map for all planted species.
- Quantitative data for all plants in each stratum. Data will be collected from permanent sampling quadrats established at approximately equal intervals along permanent monitoring transects established within each marsh feature. Each sampling quadrat will be approximately 1 meter X 1 meter in size (although the dimensions of each quadrat may be increased, if necessary, to provide better data in planted marsh features). The number of monitoring transects and number of sampling quadrats per transect will vary depending on size of the mitigation site and will be determined by the IET during the final design phase of the project. The resulting requirements, including quadrat dimensions, will be specified in the Final Mitigation Monitoring Plan for the project. Data recorded from the sampling quadrats will include but not be limited to: average total percent cover by native plant species; average total percent cover by invasive plant species; average total percent cover by nuisance plant species; percent cover of each plant species; the wetland indicator status of each species; and the average percent survival of each planted species (i.e. number of living planted species as a percentage of total number of plants installed), if discernable at the time of monitoring.
- One photograph shall be taken from the SE corner of each sampling plot to clearly capture the vegetation plot and must include a sign that indicates the plot number and sampling date.
- A brief description of maintenance and/or management work performed since the previous monitoring report along with a discussion of any other significant occurrences.

Topographic surveys of each marsh restoration feature for initial and intermediate monitoring events (at approximately 2 years and 4 years following completion of final construction activities (General Construction 1.B.)). These surveys will cover the same components as described for the topographic survey conducted for the Baseline Monitoring Report. In addition to the surveys themselves, each of the two monitoring reports will include an analysis of the topographic data in regards to the attainment of applicable topographic success criteria.

If the surveys indicate topographic success criteria have not been achieved and supplemental topographic alterations are necessary, then another topographic survey will be required following completion of the supplemental alterations. This determination will be made by USACE and the IET.

4.3 MONITORING REPORTS FOLLOWING PLANTING OR RE-PLANTING ACTIVITIES

Planting or re-planting of certain areas within restored marsh habitats may be necessary to ensure attainment of applicable native vegetation success criteria. Any monitoring report submitted following completion of a planting event must include an inventory of the number of each species planted, the stock size used, and the locations for each species planted. It must also include a depiction of the areas re-planted or those planted, as applicable, cross-referenced to a listing of the species and number of each species planted in each area. The perimeter of re-planted area should be documented with GPS coordinates. If single rows are replanted, then GPS coordinates should be taken at the end of the transect.

SECTION 5
Mitigation Monitoring Schedule and Responsibilities

Monitoring will typically take place in mid to late summer during the required years for monitoring, but may be delayed until later in the growing season due to site conditions or other unforeseen circumstances. Monitoring Reports will be submitted by December 31 of each year of monitoring to the USACE, NFS, and the IET. The various monitoring and reporting responsibilities addressed in this section are all subject to the provisions set forth in the Introduction section.

The USACE will be responsible for conducting the monitoring events and preparing the associated monitoring reports until such time that the following mitigation success criteria are achieved (criteria follow numbering system used in success criteria section):

1. General Construction – 1.A. and 1.B.
2. Topography – 2.A.1 and 2.A.2.
3. Native Vegetation – For fresh marsh features, criteria 3.A.1; for intermediate marsh and brackish marsh features, criteria 3.B.1.
4. Invasive & Nuisance Vegetation – 4.A. until such time as monitoring responsibilities are transferred to the NFS.

The USACE will be responsible for conducting Baseline and Initial Success Monitoring events and preparing the associated monitoring reports.

The NFS will be responsible for conducting the required monitoring events and preparing the associated monitoring reports for all other required years after the USACE has achieved the initial success criteria listed above. The responsibility for management, maintenance, and monitoring of the non-structural components of the mitigation project (i.e. vegetation) will typically be transferred to the NFS during the first quarter of the year immediately following submittal of the monitoring report that demonstrates attainment of the initial success criteria. Once monitoring responsibilities have been transferred to the NFS, the next monitoring event (Intermediate) should take place 2 growing seasons after Initial Success (Topography 2.A.2 and Native Vegetation 3.A.1 or 3.B.1) has been met. After Intermediate Success Criteria (Topography 2B and Native Vegetation 3.A.2 or 3.B.2) has been met, Long-Term Success Criteria monitoring will be conducted every 5 years throughout the remaining 50-year period of analysis.

In certain cases, it is possible that the marsh mitigation features may be established along with other mitigation features, like swamp or bottomland hardwood habitats, at the same mitigation site. This scenario could require some adjustments to the typical monitoring schedule described above in order to develop a reasonable and efficient monitoring schedule that covers all the mitigation features. Such adjustments, if necessary, would be

made at the time final mitigation plans are generated. This schedule must be in general accordance with the guidance provided above and will be prepared by the USACE and the IET.

If certain success criteria are not achieved, failure to attain these criteria would trigger the need for additional monitoring events not addressed in the preceding paragraphs. The USACE would be responsible for conducting such additional monitoring and preparing the associated monitoring reports in the following instances:

A. For fresh marsh features –
    - If the initial vegetative cover success criteria (3.A.1) are not achieved, a monitoring report will be required for each consecutive year until two sequential annual reports indicate that the applicable vegetative cover criteria have been satisfied. This requirement only exists if planting the marsh mitigation feature is required to meet the success criteria, the USACE would be responsible for the purchase and installation of the required plants.

B. For intermediate and brackish marsh features –
    - If the initial survival criteria for planted species or the initial vegetative cover criterion (3.B.1) are not achieved a monitoring report will be required for each consecutive year until two sequential annual reports indicate that the applicable survival criteria or vegetative cover criteria have been satisfied. The USACE would be responsible for the purchase and installation of supplemental plants needed to attain the success criteria.

C. For all types of marsh features–
    - If initial topographic success criteria (2.A.1 and 2.A.2) are not achieved, the IET would convene to determine whether corrective actions are necessary. If corrective actions are necessary additional surveys and a monitoring report will be required to indicate whether applicable criteria have been satisfied. The USACE would also be responsible for performing the necessary corrective actions.
    - If initial invasive and nuisance species criteria (4.A) are not achieved a monitoring report will be required for each consecutive year until two sequential annual reports indicate that the applicable criteria have been satisfied. The USACE would be responsible for the irradiation activities needed to attain the success criteria.

There could also be cases where failure to attain certain success criteria would trigger the need for additional monitoring events for which the NFS would be responsible:

A. For fresh marsh features –
    - If the native vegetation intermediate success criteria (3.A.2) are not achieved, a monitoring report will be required for each consecutive year

until two sequential annual reports indicate that the success criteria have been satisfied. The Sponsor would also be responsible for the purchase and installation of supplemental plants needed to attain the success criteria.

B. For intermediate and brackish marsh features –

- If the native vegetation intermediate success criteria (3.B.2) are not achieved, a monitoring report will be required for each consecutive year until two sequential annual reports indicate that the native vegetation intermediate success criteria has been satisfied. The Sponsor would also be responsible for the purchase and installation of supplemental plants needed to attain the success criteria.

C. For all types of marsh features –

- If the topographic intermediate success criteria (2.B.) are not achieved, the IET would convene to determine whether corrective actions are necessary. If corrective actions are necessary, additional surveys and a monitoring report will be required to indicate whether applicable criteria have been satisfied. The NFS would also be responsible for performing the necessary corrective actions if the IET determines such corrective actions are necessary.
- If the native vegetation long term success criteria (3.A.3 and 3.B.3) are not achieved, the IET would convene to discuss whether corrective actions would be necessary. If corrective actions are necessary, a monitoring report will be required for each consecutive year following completion of the corrective actions until two sequential annual reports indicate that the native vegetative cover criteria have been attained. The NFS would be responsible for performing the corrective actions, conducting the additional monitoring events, and preparing the associated monitoring reports.
- If the intermediate and long term invasive and nuisance species criteria (4.A) are not achieved a monitoring report will be required for each consecutive year until two sequential annual reports indicate that the applicable criteria have been satisfied. The NFS would be responsible for the irradiation activities needed to attain the success criteria.

Once monitoring responsibilities have been transferred to the NFS, the NFS will retain the ability to modify the monitoring plan and the monitoring schedule should this become necessary due to unforeseen events or to improve the information provided through monitoring. Fifteen years following achievement of Long Term Success Criteria, the number of monitoring transects and/or quadrats that must be sampled during monitoring events may be reduced substantially if it is clear that mitigation success is proceeding as anticipated. Any significant modifications to the monitoring plan or the monitoring schedule must first be approved by the USACE and the IET.

SECTION 6
Adaptive Management Plan

6.1 FRESH/INTERMEDIATE MARSH

6.1.1 Adaptive Management Planning

Adaptive management planning elements included: 1) development of a Conceptual Ecological Model (CEM), 2) identification of key project uncertainties and associated risks, 3) evaluation of the mitigation projects as a candidate for adaptive management and 4) the identification of potential adaptive management actions (contingency plan) to better ensure the mitigation project meets identified success criteria. The adaptive management plan is a living document and will be refined as necessary as new mitigation project information becomes available.

6.1.1.1 Conceptual Ecological Model

A CEM was developed to identify the major stressors and drivers affecting the proposed mitigation project (Table I2:6-1). The CEM does not attempt to explain all possible relationships of potential factors influencing the mitigation site; rather, the CEM presents only those relationships and factors deemed most relevant to obtaining the required acres/average annual habitat units (AAHUs). Furthermore, this CEM represents the current understanding of these factors and will be updated and modified, as necessary, as new information becomes available.

Table I2:6-1. Conceptual Ecological Model

Alternatives/Issues/Drivers	Fresh/Intermediate Marsh
Subsidence	-
Sea Level Rise	-
Runoff	-
Storm Induced	+/-
Salinity Impacts	+/-
Wave Action	-
Storm Surge	-
Vegetative Invasive Species	-
Herbivory	-
Hydrology (water table; wet/dry days; soil inundation)	+/-
Topography (elevation)	+/-

Key to Cell Codes: - = Negative Impact/Decrease
+ = Positive Impact/Increase
+/- = Duration Dependent

6.1.1.2 Sources of Uncertainty and Associated Risks

A fundamental tenet underlying adaptive management is decision making and achieving desired project outcomes in the face of uncertainties. There are many uncertainties associated with restoration of the coastal systems. The project delivery team (PDT) identified the following uncertainties during the planning process.

- Climate change, such as relative sea level rise, drought conditions, and variability of tropical storm frequency, intensity, and timing
- Subsidence and water level trends
- Uncertainty relative to achieving ecological success
- Long-term sustainability of project benefits
- Adaptability

6.1.1.3 Adaptive Management Evaluation

The project site was evaluated and planned to develop a project with minimal risk and uncertainty. The items listed below were incorporated into the mitigation project implementation plan and Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) plan to minimize project risks.

- Detailed planting guidelines for intermediate marsh
- General monitoring guidelines for project success
- Specified success criteria (i.e., mitigation targets)
- Invasive species control
- Supplementary plantings as necessary (contingency)
- Corrective actions to meet topographic success as required (contingency)

Subsequently, as part of the adaptive management planning effort the project features were re-evaluated against the CEM and sources of uncertainty and risk were identified to determine if there was any need for additional adaptive management actions.

Based on the uncertainties and risks associated with the project implementation the following contingency/adaptive management actions have been identified to be implemented if needed to ensure the required AAHUs are met (Table I2:6-2).

Table I2:6-2. Adaptive Management Actions Marsh

Element	Expected Condition	Potential Issue	Potential Corrective Action
Landscape characteristics	Bathymetry appropriate for sustainable growth of marsh vegetation	Water that is deeper or shallower than ideal conditions for targeted vegetations.	Modify land elevation; marsh renourishment to obtain elevations necessary for marsh establishment and maintenance
Connectivity	Obtain necessary hydrology	Limited water exchange or excessive flooding, wave action or salinity.	Modify channels to obtain necessary connectivity adjust gapping in dikes in the future to maintain sufficient marsh hydrology and connectivity Construction feature to reduce wave and salinity influences on the marsh restoration feature.
Vegetation community composition	Healthy vegetative communities free of invasive species, assuming natural colonization	Invasive species dominance, native species do not establish, poor marsh survival,	Invasive species control, marsh plantings

The CEMVN would be responsible for the proposed mitigation construction and monitoring until the initial success criteria are met. Initial construction and monitoring would be funded in accordance with all applicable cost-share agreements with the NFS. The CEMVN would monitor (on a cost-shared basis) the completed mitigation to determine whether additional construction, invasive/nuisance plant species control, and/or plantings are necessary to achieve initial mitigation success criteria. Once the CEMVN determines that the mitigation has met the initial success criteria, monitoring would be performed by the NFS as part of its OMRR&R obligations. If after meeting initial success criteria, the mitigation fails to meet its intermediate and/or long-term ecological success criteria, the CEMVN would consult with other agencies and the NFS to determine the appropriate management or remedial actions required to achieve ecological success. The CEMVN would retain the final decision on whether or not the project's required mitigation benefits are being achieved and whether or not remedial actions are required. If structural changes are deemed necessary to achieve ecological success, the CEMVN would implement appropriate adaptive management measures in accordance with the contingency plan and subject to cost-sharing requirements, availability of funding, and current budgetary and other guidance.

Mississippi Valley Division,
Regional Planning and Environment Division South

St. Tammany Parish, Louisiana Feasibility Study

Appendix I: Attachment 3 – Project Description Constructed Refuge Pine Savanna Project

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SECTION 1
Refuge Pine Savanna Mitigation Site

1.1 PROJECT LOCATION

The proposed refuge pine savanna mitigation site (PSR-1) is located entirely within the Big Branch Marsh National Wildlife Refuge (BBMNWR) in St. Tammany Parish Louisiana, (Figure I3:1-1). The site is located south and east of Bayou Bonfouca, west of the Norfolk Southern and Pontchartrain Drive (state highway 11) and north of the Lake Pontchartrain Northshore, Louisiana. The site would provide 9 acres (7.4 AAHUs) of pine savanna habitat for the red-cockaded woodpecker (RCW) and 50 acres (2 AAHUs) for the pine warbler (PW) within the BBMNWR to compensate for unavoidable wetland impacts from implementation of the restore up to (~)70 acres of degraded wet Long-leaf Pine Savanna Forest as compensatory mitigation for coastal zone Pine Savanna impacts from construction of the South and West Slidell levee and floodwall system under the St. Tammany Parish, Louisiana Feasibility study.

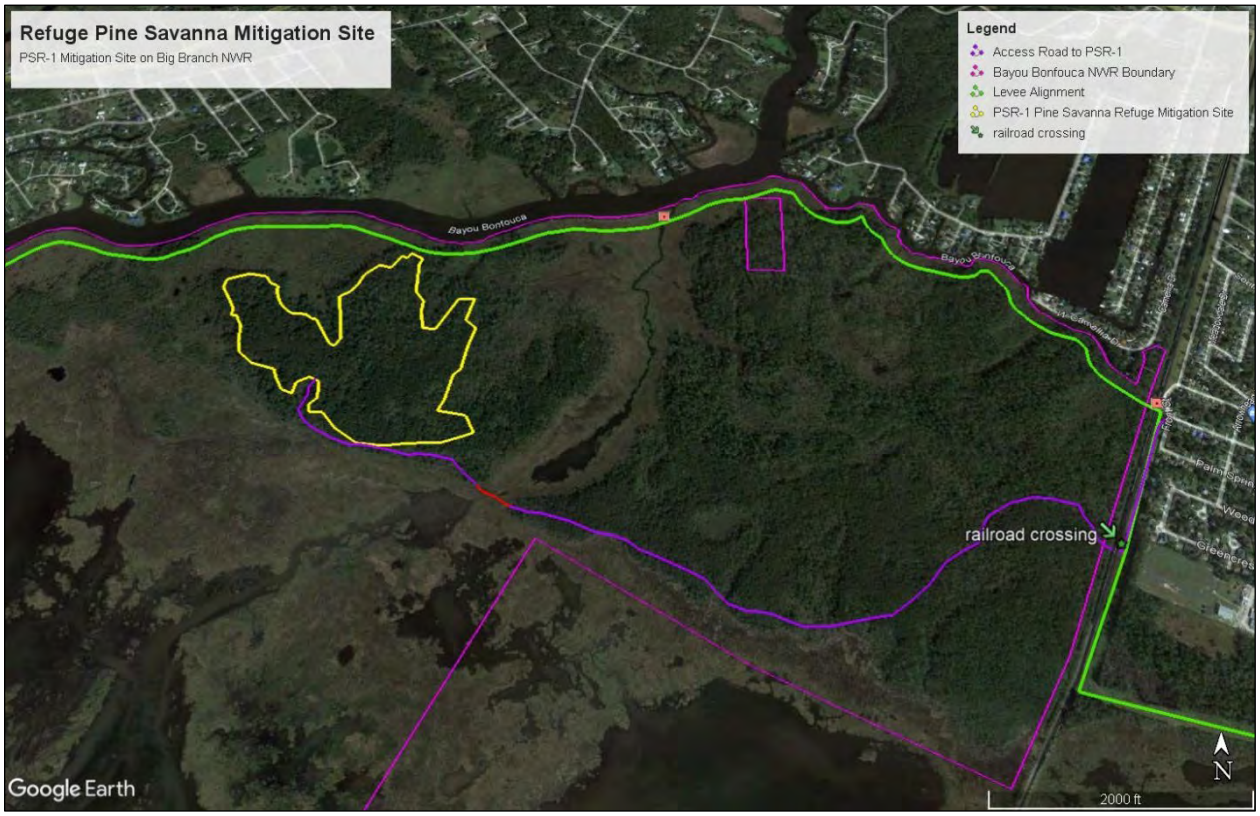

Figure I3:1-1. Refuge Pine Savanna Mitigation Site Location

1.2 PROJECT DESCRIPTION

The project includes eradication of invasive species such as Tallow. Removal of undesirable hardwood species, and reintroduction of fire across the entire site. Removal of undesirable hardwood species coupled with the reintroduction of frequent fires can be effective in restoring ground cover in remnant longleaf pine savannas.

Potential earthwork activities include establishing/improving an existing access road, across the existing railroad crossing westward to the PSR-1 mitigation site. A staging area would be established within areas identified for the proposed levee work in proximity to improvement of the NWR access road.

1.2.1 Site Access

Access to the project work limits would be as follows:

Access to the site from the Northeast would be from the intersection of Front Street and Sun Valley Drive, Slidell, Louisiana to be made via route LA-11 (Pontchartrain Drive). At the intersection of Front Street and Sun Valley Dr equipment/vehicles would traverse along the existing Slidell-Oak Harbor levee south parallel to the railroad and cross at the established railroad crossing. Access from the southeast can be made via route LA-11 to the existing Slidell-Oak Harbor levee traveling east and then north to the existing railroad crossing. Once across the railroad, access to the mitigation site would be via an existing dirt road traversing in a westerly direction approximately 1.8 miles the PSR-1 mitigation site.

1.2.2 Staging

A staging area for improvement of the access road to the mitigation site could be established just northeast of the existing railroad crossing within an already established/disturbed area.

1.2.3 Maintenance/Management Activities

After completion of all excavation, grading, and soil preparation activities, herbicides may be applied to the mitigation areas to help control invasive and nuisance plant species. Herbicide applications may also occur to help suppress undesirable vegetation. Throughout this period, access/maintenance roads would be maintained as necessary.

The first monitoring event would occur in the fall of the year of the initial plantings. Thisreport could show additional plantings are needed or it may not. Regardless, various mowing events and herbicide application events would take place during the period from the first monitoring event to the second monitoring event. It is assumed that the second monitoring event would show success criteria for the plantings had been achieved as were success criteria about control of invasive and nuisance plants. In thiscase, the Non-Federal Sponsor would take over the project including all management and maintenance work.

1.2.4 Equipment

Equipment to be used for the respective work is assumed as follows:

- Herbicide Spraying: ATVs and/or UTVs, back-packsprayers and/or boom sprayers;
- Controlled Burns: ATVs and/or UTVs, back-packsprayers and/or boom sprayers.

Mississippi Valley Division,
Regional Planning and Environment Division South

St. Tammany Parish, Louisiana Feasibility Study

Appendix I Attachment 4 – Monitoring and Adaptive Management – Constructed Refuge Pine Savanna Project

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SECTION 1
Refuge Pine Savanna Mitigation Site

1.1 PROJECT LOCATION

The proposed refuge pine savanna mitigation site (PSR-1) is located entirely within the Big Branch Marsh National Wildlife Refuge (BBMNWR) in St. Tammany Parish Louisiana, (Figure I4:1-1). The site is located south and east of Bayou Bonfouca, west of the Norfolk Southern and Pontchartrain Drive (state highway 11) and north of the Lake Pontchartrain Northshore, Louisiana. The site would provide 9 acres (7.4 AAHUs) of pine savanna habitat for the red-cockaded woodpecker (RCW) and 50 acres (2 AAHUs) for the pine warbler (PW) within the BBMNWR to compensate for unavoidable wetland impacts from implementation of the restore up to (~)70 acres of degraded wet Long-leaf Pine Savanna Forest as compensatory mitigation for coastal zone Pine Savanna impacts from construction of the South and West Slidell levee and floodwall system under the St. Tammany Parish, Louisiana Feasibility study.

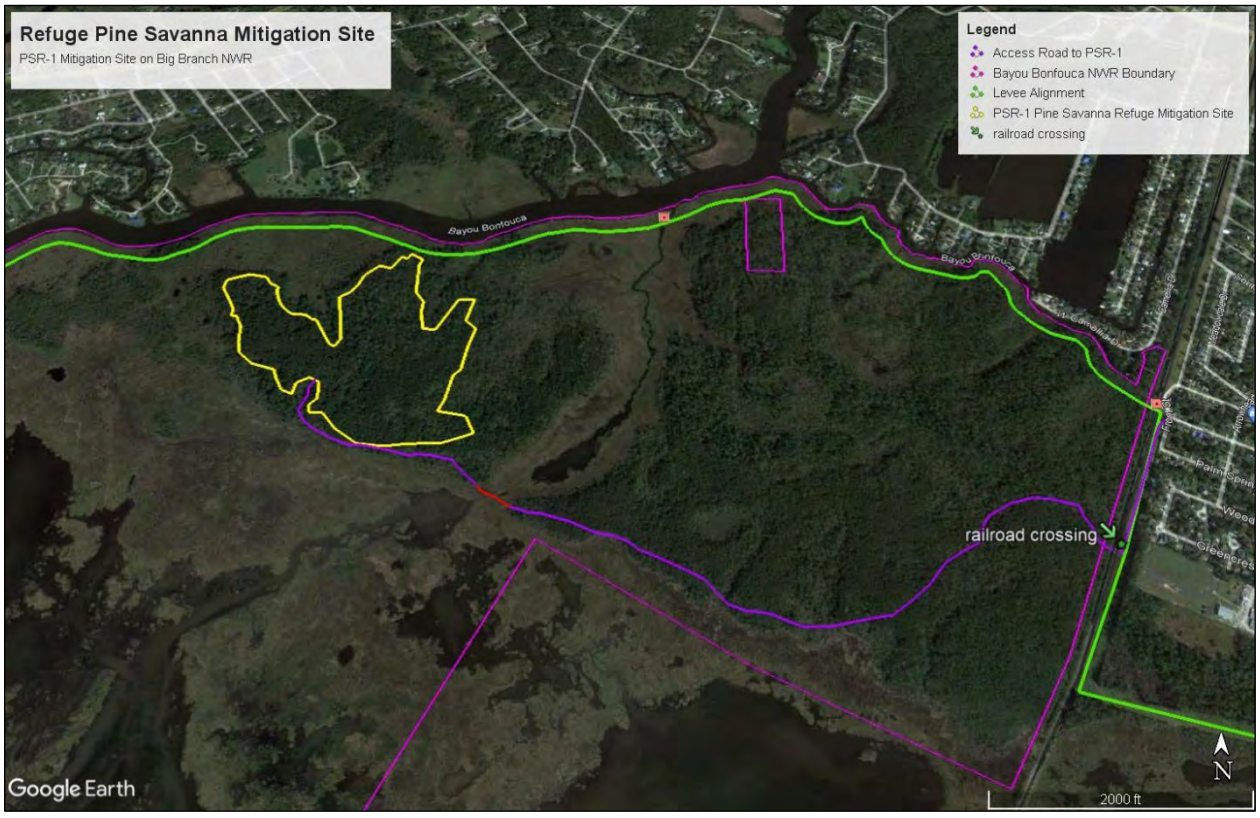

Figure I4:1-1. Refuge Pine Savanna Mitigation Site Location

1.2 PROJECT DESCRIPTION

The project includes eradication of invasive species such as Tallow. Removal of undesirable hardwood species, and reintroduction of fire across the entire site. Removal of undesirable hardwood species coupled with the reintroduction of frequent fires can be effective in restoring ground cover in remnant longleaf pine savannas.

Potential earthwork activities include establishing/improving an existing access road, across the existing railroad crossing westward to the PSR-1 mitigation site. A staging area would be established within areas identified for the proposed levee work in proximity to improvement of the NWR access road.

1.2.1 Site Access

Access to the project work limits would be as follows:

Access to the site from the Northeast would be from the intersection of Front Street and Sun Valley Drive, Slidell, Louisiana to be made via route LA-11 (Pontchartrain Drive). At the intersection of Front Street and Sun Valley Dr equipment/vehicles would traverse along the existing Slidell-Oak Harbor levee south parallel to the railroad and cross at the established railroad crossing. Access from the southeast can be made via route LA-11 to the existing Slidell-Oak Harbor levee traveling east and then north to the existing railroad crossing. Once across the railroad, access to the mitigation site would be via an existing dirt road traversing in a westerly direction approximately 1.8 miles the PSR-1 mitigation site.

1.2.2 Staging

A staging area for improvement of the access road to the mitigation site could be established just northeast of the existing railroad crossing within an already established/disturbed area.

1.2.3 Maintenance/Management Activities

After completion of all excavation, grading, and soil preparation activities, herbicides may be applied to the mitigation areas to help control invasive and nuisance plant species. Herbicide applications may also occur to help suppress undesirable vegetation. Throughout this period, access/maintenance roads would be maintained as necessary.

The first monitoring event would occur in the fall of the year of the initial plantings. Thisreport could show additional plantings are needed or it may not. Regardless, various mowing events and herbicide application events would take place during the period from the first monitoring event to the second monitoring event. It is assumed that the second monitoring event would show success criteria for the plantings had been achieved as were success criteria about control of invasive and nuisance plants. In thiscase, the Non-Federal Sponsor would take over the project including all management and maintenance work.

1.2.4 **Equipment**

Equipment to be used for the respective work is assumed as follows:

- Herbicide Spraying: ATVs and/or UTVs, back-packsprayers and/or boom sprayers;
- Controlled Burns: ATVs and/or UTVs, back-packsprayers and/or boom sprayers.

1.3 AQUATIC RESOURCE TYPE AND FUNCTIONS TO BE RESTORED

An assessment was conducted to determine if there would be significant resources (Table I4:1-1) impacted by implementation of the proposed project. This assessment assists teams in understanding the ecosystem impacts of the parent project and the linkages of the resources to other parts of the system or watershed. The impacted resources are recognized as significant across institutional, public, and technical perspectives.

The St. Tammany Feasibility Study proposed project includes features that would impact the BBNWR. As a result, a Compatible Use Determination will be required. The National Wildlife Refuge (NWR) System Improvement Act of 1997 authorized that no new or expanded use of a refuge may be allowed unless it is first determined to be compatible. A compatibility determination is a written determination signed and dated by the Refuge Manager and Regional Refuge Chief, that determines whether a proposed action is either compatible with the existing use of the NWR or is not a compatible use. A compatible use is defined as a proposed or existing wildlife-dependent recreational use or any other use of a NWR that, based on sound professional judgement, would not materially interfere with or detract from the fulfillment of the NWR System mission or purposes of the NWR.
A Compatibility determination would include a public review period before issuing a final determination. It is highly unlikely that a major levee and associated structures would be found compatible with the purposes of BBMNWR. Without a positive compatibility determination, ROE to BBMNWR for construction would not be granted. The compatibility determination would occur conducted during PED.

The Final Policy on the NWR System and Compensatory Mitigation Under the Section 10/404 Program (federal register notice (64 FR 49229) for mitigation on refuge lands: (https://www.govinfo.gov/content/pkg/FR-1999-09-10/html/99-23627.htm) stipulates that the Service would not allow compensatory mitigation for off-refuge habitat losses authorized through the Section 10/404 program to be implemented on lands and waters within the NWR System, except under limited and exceptional circumstances. At this time, the Refuge does not support pursuing waivers to the mitigation policy for the St. Tammany Feasibility Study. A land exchange would be required for any direct impacts associated with the project that occur on refuge lands. In other words, the USACE would be required to purchase land in the refuge acquisition boundary, exchange and donate those properties to the refuge to offset the direct impacts on the refuge associated with the proposed project. The USACE would then own the land in which the project would cause direct impacts. The USACE would then be required to provide compensatory mitigation for the habitats impacted as off

refuge impacts. In a refuge land exchange, land is not swapped on an acre for acre basis, but rather it is swapped on a value for value based as determined by the appraised value so, tracts of land larger or smaller than the acres impacted may be exchanged. USFWS has indicated that the land exchanged should be of similar habitat and quality as the habitat impacted and the lands must be within the approved refuge acquisition boundary. In addition, any indirect impacts on the Refuge associated with implementation of the project would be mitigated for on refuge property.

Table I4:1-1. Significance of Habitat Type Impacted

Habitat Type	Significance of Resource	Significance – Is the Resource Scarce or Unique at Various Levels?		
		National	Regional	State
Pine Savanna	High diversity plant, mammal, reptile, amphibian, and avian habitat. Stabilizes the soil and stores carbon.	Longleaf pine once occupied over 90 million acres in the southern U.S. and are now considered globally imperiled. Pine flatwood habitat has been reduced to less than 3% of their historic range due to development, fire suppression, forest conversion and logging.	Longleaf pine habitats are scarce and unique for Louisiana.	Rarity rank S1G1 (imperiled in state; critically imperiled globally) assigned by LDWF.

1.3.1 **Existing Conditions**

The refuge mitigation site is ideally situated (geologically, topographically, hydrologically, etc.) to support a restoration and enhancement effort.

1.3.2 **Geology**

The site lies primarily in what has been called the “pine flatwoods region” of Louisiana’s southeastern Florida Parishes but is immediately adjacent to and abuts the pine hills region that lies generally to northwest of the site. It is located primarily on the Pleistocene Prairie Terraces geologic formation, the terraces that underpin the pine flatwoods region. There is a hill complex in the south central portion of the property that represents a disjunctive outlier of the Pleistocene High Terraces geologic formation (the high terraces underpin the pine hills region). Materials of the Prairie Terraces were deposited 10,000 to 75,000 years ago (USDA/NRCS, Soil Survey of St. Tammany Parish, LA, March 1990), with soils developing on these terraces since that time.

1.3.3 **Soils**

The most recent soil survey of the parish (USDA, NRCS, Soil Survey of St. Tammany Parish, LA, March 1990) (Exhibit 2) indicates that soils present in the pine flatwoods zone include the following series classified as non-hydric: Abita silt loam, Latonia fine sandy loam, Prentiss fine sandy loam (both 0 – 1% slopes and 1 – 3% slopes), and Stough fine sandy loam (note that soils mapped as Stough series are often hydric). Soil series classified as hydric that are mapped in the pine flatwoods zone include: Myatt fine sandy loam, Myatt fine sandy loam – frequently flooded, Guyton silt loam – occasionally flooded, and Ouachita and Bibb – frequently flooded.

1.3.4 **Soils/Hydrologic Plan**

A detailed work descriptions and written specifications for all work that is intended to affect the current hydrology of the project site will be developed including but not limited to the following:

1. Complete description of all construction methods used with timing and sequence. If work is to be performed in phases provide an explanation of the reason for such decision as well as a map depicting the different phases.
2. Complete description of all work. This description shall include a preparatory plan that discusses any clearing, grading, and pre-planting burns.
3. Provide plan views and cross-sectional views of all work, with appropriate legends on the drawings to depict the work that is being done.
4. Maps that identify the location of adjacent waterways and are referenced in this section.
5. Proposed grading plan, including elevations and slopes of substrates with drawings that depict such work.
6. Soil management and erosion control measures.
7. An explanation of how the completion of such work will support this restoration project.]

1.3.5 **Vegetation Plan**

1. List of plant communities to be established. Typical PF/S woody species include longleaf pine (*Pinus palustris*), slash pine (*P. elliottii*), swamp black gum (*Nyssa biflora*), blackjack oak (*Quercus marilandica*), laurel oak (*Quercus laurifolia*) and pond cypress (*Taxodium ascendens*). Typical PF/S herbaceous species include broomsedges (*Andropogon* spp.), little bluestem (*Schizachyrium scoparium*),slender bluestem (*S. tenerum*), panic grasses (*Panicum* spp.), three-awn grasses (*Aristida* spp.), toothache grass (*Ctenium aromaticum*), hairawn muhly (*Muhlenbergia capillaries*), plume-grasses (*Erianthus* spp.), jointgrasses (*Coelorachis* spp.), beak-rushes (*Rhynchospora* spp.), yellow-eyed grasses (*Xyris* spp.), umbrella grasses (*Fuirena* spp.), nut-rushes (*Scleria* spp.), and white top sedge (*Dichromena latifolia*).

2. Complete species list and the percentage of each species planted. (Note: For an initial longleaf pine planting there must be present an initial density of 300trees per acre. Seedlings can be planted in cohorts or patches where a well- developed grassy ground cover is in place, averaging 25-50 trees per cohort, or may be planted in a linear fashion in areas lacking a well-developed grassy ground cover where follow-up chemical release of seedlings will be necessary.)

3. Methodology used for the establishment of desired plant communities.

4. Discussion of regeneration.

5. Species distribution.

6. Planting methods.

7. Herbivory minimization and control plan.

8. Weed species minimization and control plan.

9. Exotic nuisance vegetation control and management plan.

1.3.6 **Maintenance Plan**

A detailed description and schedule of the perceived maintenance requirements for the project will be provided, throughout the different work phases, to support the restoration efforts. This information should reflect the maintenance (including a burn plan) that is required to ensure the continued viability of the resource once initial construction is completed and before the long-term milestones have been achieved.

SECTION 2

USACE Guidance

U.S. Army Corps of Engineers (USACE) monitoring and adaptive management policy is required by the Water Resources Development Act of 2007 and presented in planning guidance (Engineering Regulation (ER) 1105-2-100, Engineering Circular (EC) 1105-2-409, and Memorandum on Implementation Guidance for Section 2036 of the Water Resources Development Act of 2007). Monitoring includes the systematic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management will be needed to attain project benefits. Adaptive management addresses the uncertainties about a project's actual performance that exist when implementation decisions are made to undertake a water resources project. This technique allows decision making and implementation to proceed with the understanding that outputs will be assessed and evaluated and that some structural or operational changes to the project may be necessary to achieve desired results. At the heart of adaptive management is an appropriate monitoring program to determine if the outputs/results meet the required mitigation need, and to determine if any adjustments are needed.

The purpose of this plan is to demonstrate ecological success of the project. This success is determined by monitoring metrics that are specifically tied to project objectives, and success criteria. In addition, the plan identifies what adaptive management (contingency) is proposed if the performance targets are not met. This plan presents the framework for the above methodology, and will be refined as the project proceeds into Pre-construction, Engineering, and Design (PED) phase in collaboration with the non-Federal sponsors, as well as other stakeholders who may take responsibility for monitoring ecological variables in the watershed.

SECTION 3

Mitigation Success Criteria

In order for the Mitigation project to be considered acceptable for mitigating wetland impacts associated with the St Tammany Parish Feasibility Study, the selected mitigation site will be restored in accordance with the Mitigation Plan such that it meets wetland criteria as described in the 1987 Corps of Engineers Wetland Delineation Manual (the 1987 Manual) as well as the November 2010 Regional Supplement for the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region Version 2.0. Performance standards (success criteria) used to measure the success of the Mitigation project are provided below.

Ecological enhancement of pine flatwoods/savanna and related habitats is measured by the progress from its current state (as described in the baseline conditions) towards an open, highly species diverse pine flatwood/savanna ecosystem. Elements that can be measured to show this progression include basic hydrologic information, longleaf pine seedling survival and growth data, vegetation composition and structure (including overstory species and percent (%) cover, midstory woody composition and percent (%) cover, and groundcover composition and percent (%) cover). The control of woody shrubs and hardwood encroachment or lack of encroachment into savanna areas can be used to measure the success of management in moving the site to a high quality ecosystem. The following criteria use these elements to measure success.

3.1.1.1 Initial Success Criteria

1. *Hydrology*: Ground surface elevations must be conducive to establishment and support of hydrophytic vegetation, and re-establishment and maintenance of hydric soil characteristics. To that end, all alterations of the natural topography (ditching, spoil mitigation projects, land leveling, bedding, fire breaks, etc.) that have affected the duration and extent of surface water have been removed or otherwise rendered ineffective in accordance with this Mitigation Plan.

2. *Vegetation*: Floristic survey of current site conditions completed. During dry season, non-indigenous hardwood overstory species within the savanna areas would be removed to a level below 10% canopy coverage and non-indigenous pine species would be thinned to below 40% canopy coverage. Controlled burns must have occurred throughout the site including along the margins of and into bayheads.

3.1.1.2 Interim Success Criteria

1. *Hydrology*: By Year 5 (**four** years following attainment of the one-year survivorship criteria) site hydrology will be restored such that the Property meets the wetland criterion as described in the 1987 Manual as well as the November 2010 Regional Supplement to the Corps of Engineers wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region Version 2.0. Data demonstrating that wetland hydrology has been re-established is to be

collected by the Sponsor and submitted to CEMVN in the monitoring report for the interim success criteria.

2. Vegetation and Vegetative Plantings:

a. A minimum of 40 longleaf pine seedlings/saplings per acre have survived through 3 growing seasons. These must exhibit at least 4 consecutive years (after 1 year survivorship) of annual increase in stem ground diameter or height from ground to bud tip.

b. Plant composition of pine flatwoods/savanna and related habitats. Vegetative monitoring data should indicate that:

(1) The diversity of desirable indigenous herb species shows progress toward the long-term standard of 10+ species on average per square meter (10.75 sq. feet) with a minimum average of 5 desirable species per square meter, and;

(2) Undesirable species have become less prominent, averaging less than 1 undesirable species present per plot**,** and;

(3) Woody shrub height and density are managed such that the average height is less than five feet and cover is less than 20%. The Mitigation project and the perimeter will be virtually free (approximately 5% or less on an acre-by-acre basis) of exotic/invasive vegetation.

c. At least two prescribed burns should have occurred throughout the pine flatwood/savanna habitat and at least once along the margins of and into bayheads and/or flatwood ponds.

3.1.1.3 C. Long-Term Success Criteria (Year 5 and beyond)

1. Vegetative cover (Table I4:3-1) for high quality rehabilitated longleaf pine flatwood wetland savanna will fall within the following ranges:

Table I4:3-1. Vegetation Strata and Percent Cover

Vegetation Strata	Estimated Total Percent Cover
Longleaf pine overstory	10-50%
Total overstory (longleaf pine plus various hardwoods)	15-55%
Woody understory (shrubs/small trees)	<20%

Herbaceous groundcover	90-100%

2. Pine flatwoods/savanna vegetation composition should consist of a variety of indigenous species with a predominance of longleaf pine in the overstory, and additional age classes of longleaf pine in the understory. Undesirable species will be maintained at a minimum level. General goals (Table I4:3-2) are:

Table I4: 3-2. Vegetation and Species/ Type Composition

Vegetation Composition	Species/type Composition
Overstory (>10 ft. ht.)	70-90%* longleaf pine
Understory (2-10 ft. ht.)	>50%* longleaf pine; at least 4 species of indigenous-shrubs/hardwood trees in pine flatwood wetlands.
Herbaceous groundcover (<2 ft.)	50-90%* grasses/sedges; 10-50%* forbs; >10 native species/meter square; >50 herbaceous species/site; undesirable **species <1%***

*Percent of total cover of designated strata

Select one of the appropriate success criteria for habitat inclusions below:

3. Vegetative composition of flatwood ponds dominated by obligate and facultative wet graminoids and virtually free (<1%) of undesirable species.

4. Prescribed burns throughout the pine flatwood/savanna habitat as well as along the margins have occurred at a frequency of once every 2-3 years.

6. The Mitigation project and the perimeter will be virtually free (approximately 1% or less on an acre-by-acre basis) of exotic/invasive vegetation.

SECTION 4
Mitigation Monitoring Guidelines

The activities necessary to monitor the Mitigation project to demonstrate compliance with the success criteria are established in this Mitigation Plan. The Mitigation project will be monitored in the fall of each year using the guidelines within this section of this Mitigation Plan. No deviation from the Mitigation Plan may occur without prior approval from the USACE and Interagency Environmental Team (IET). The monitoring reports will include a discussion of the coordination with USACE, NFS and IET members, a description of and reasons for any approved deviation.

Surveys of permanent monitoring stations will occur in the following time frame:

1. A baseline report, prior to beginning of site restoration, to be provided in conjunction with the work schedule to establish baseline information.

2. An “as-built report” providing documentation that vegetative plantings (if needed) and the work necessary to restore site topography and wetland hydrology of the mitigation project have been completed.

3. An initial success criteria report documenting successful completion of the construction work as specified in this MWP (Description of Work) and in the P&S and in conjunction with initial success criteria as stated in this MWP. This report will be provided the first fall of 1 year after planting.

4. An interim success criteria report (3-4 years after successfully meeting the initial success criteria as stated in this MWP).

5. Long-term success criteria report (5 years after meeting the interim success criteria or when the long-term success criteria have been met**,** and every fifth year thereafter).

If monitoring for any given year determines that the Mitigation project is not progressing as expected, monitoring will continue on an annual basis until the Mitigation project successfully meets or exceeds established milestones. After achieving the initial success criteria, monitoring will occur as stated above.

Surveys will include a summary and map of where, when and percent coverage of burns that have occurred since the previous monitoring report. Data collected for initial, interim and long-term monitoring will be the same as for baseline conditions using the same sample plots.

The survey of the permanent monitoring stations will collect data to evaluate the survival and growth rates of planted vegetation. In addition to planted seedlings, surveys will include the number by species of volunteering trees, shrubs and woody vines. Surveys will also collect information regarding colonizing plant species, the wetland plant status (scaled from obligate (OBL) to upland (UPL)) of each, and the number of undesirable species.

6. Beyond Long-term success the number of monitoring plots can be reduced to half the number, and surveys will include a summary and map of where, when and percent coverage of burns have occurred since the previous monitoring report. Data will be collected to evaluate the survival and presence of appropriate vegetation, and a map will be submitted with the data to show the location of the monitoring plots as well as burn history of those particular plots, photos of those plots (as well as general photos of the overall mitigation project), and overall description of what is taking place with the plots and the mitigation project. Other information may be requested by the IET if necessary.

4.1 MANAGEMENT UNITS

Prior to any restoration work on the site of the Mitigation project, the management units will be established by dividing the site to account for habitat types present and areas with management histories that are significantly different from each other or divided as necessary for logistical management of the site. A map and discussion shall be provided defining/labeling these divisions and providing supportive information for the establishment patterns of such units.

4.2 PERMANENT CIRCULAR MONITORING PLOTS

The establish plots shall be established randomly located across each management unit in a manner to ensure that they capture the variation in habitat conditions across each unit. Plot locations will be permanently marked with fire-resistant materials (e.g., rebar or aluminum conduit poles). GPS coordinates shall be recorded for each plot and plot locations shall be depicted on maps and drawings submitted.

Two types of permanent monitoring plots or stations will be established, one type for general vegetation structure and composition monitoring and one type for tree survival and growth monitoring.

1. General Vegetation Plots

- A minimum of 1 set of permanent circular nested vegetation structure and composition monitoring plots (plots with a common center point, 10.75 sq. feet and 1/40th acre) per 20 acres will be randomly located in each management unit.
- At least one set of sampling plots shall be placed in non-jurisdictional buffer areas to gauge progress in those areas where present.
- Plot size and data to be collected from plots for vegetative structure and composition monitoring are listed below. Additional plant species noted outside sample plots will also be reported to obtain a total species list for the site. This

information will be provided in tabular form. Cover will be determined from sample plots as shown in the table 3 below.

2. Tree Survival and Growth Monitoring Plots

Tree Survival Monitoring Plots will be established according to the following methodology (Table I4:4-1).

- One permanent circular (1/4th acre plots (1000 sq. meters)) plot per 20 acres will be randomly established in each management unit to monitor longleaf seedling survival and growth.
- The survey of the permanent monitoring stations will collect data to evaluate the survival and growth rate of planted longleaf seedlings. Growth rate will either be gauged by measuring stem diameter at ground level, or increase in height from ground to bud tip, for each seedling present in plots.

Tree Survival Monitoring Plots Methodology

Plot size	Strata	Data Collected
10.75 sq. feet (1 M^2)	Groundcover (herbaceous) and woody plants <2 feet	Species present Cover by species Total cover (undesirable species) Total cover (all species) Total cover (all species minus undesirable species) Percent cover grasses/sedges (excluding undesirable species) Percent cover forbs (excluding undesirable species
1/40th of an acre (1089 sq. feet)	Understory (woody plants 2-10 feet tall)	Species present Cover by species Total cover all species Total cover undesirable species

1/40th of an acre (1089 sq. feet)	Overstory (>10 ft.)	Species present Cover by species Total cover all species Total cover undesirable species
1/40th of an acre (1089 sq. feet)	Groundcover (<2ft)	Additional species not found in 10.75 sq. feet (1 M^2) plots

4.3 WETLAND DELINEATION

At year 5, a wetland delineation will be required to demonstrate that the Property meets the wetland criterion as described in the 1987 Manual as well as the Regional Supplement of the Corps of Engineers Wetland Delineation Manual Atlantic and Gulf Coastal Plain Region Version 2.0.

To submit the information for a wetland delineation the necessary data for the Mitigation project will be collected and provide it to CEMVN and the IET for review and verification.

4.4 FLORISTIC SURVEY

To document the attainment of the long-term success criteria a comprehensive floristic survey will be completed for the Mitigation project as part of the monitoring requirements.

4.5 PHOTOGRAPHS

Digital images shall be taken from ground level at each monitoring station and from elevated positions throughout the Mitigation project to document overall conditions. These ground level images should provide a North, South, East and West image for each station.

4.6 QUALITATIVE ANALYSIS

The entire extent of the Mitigation project (or phase of the Mitigation project that this report represents) should be evaluated and provided observations. These observations will include: general estimates of the average percent cover by native plant species in the canopy, midstory, and understory strata; general estimate of the average percent cover by invasive and nuisance plant species;

- general estimates concerning the growth of planted canopy and mid-story species;
- general observations concerning the colonization by volunteer native plant species;
- general observations made during the course of monitoring will also address potential problem zones, general condition of native vegetation,

trends in the composition of the plant communities, wildlife utilization as observed during monitoring, and other pertinent factors.

- and any other information that is pertinent to achievement of initial success criteria.

4.7 HYDROLOGIC CONDITIONS

A description of the condition of any applicable hydrology altering features (culverts, ditches, plugs, etc.) and a general discussion of hydrologic conditions at monitoring stations.

A summary of rainfall data will be collected during the year preceding the monitoring report based on rainfall data recorded at a station located on or in close proximity to the mitigation site. Once all hydrology success criteria have been achieved, reporting of rainfall data will no longer be required.

SECTION 5

Monitoring Reports

Independent of the baseline and as-built report monitoring reports will be submitted documenting monitoring efforts at the Mitigation project to the CEMVN by fall/winter of the year in which monitoring occurs. The monitoring reports will follow the guidelines listed below:

The monitoring report will include data sufficient for comparison to the success criteria/performance standards found in this Plan and include the items outlined in the Monitoring Requirements Section of this Mitigation Plan. These reports shall also include a discussion of all activities which took place at the Mitigation project. All monitoring reports generated after the Baseline Monitoring Report will be called As Built, Initial, Intermediate or Long-Term Success Criteria Monitoring Reports and shall be numbered sequentially based on the year in which the monitoring occurred (i.e., Initial Success Criteria Monitoring Report 2026). If monitoring for any given year determines that the mitigation project is not progressing as expected, monitoring will continue on an annual basis until the project successfully meets or exceeds established milestones. After achieving the success criteria, monitoring will occur as stated below.

5.1 BASE LINE DATA REPORT

To demonstrate site rehabilitation through management, a Floristic Survey would be performed using an acknowledged scientific methodology and collect vegetative monitoring data from the permanent plots prior to performing any site management. This baseline data would be collected at each sample plot. In addition, a report detailing the hydrologic disturbances that need attention and a plan identifying work necessary to accomplish hydrologic restoration will be provided. Report shall include a description of the various features and habitats within the mitigation site. Various qualitative observations will be made to document existing conditions and will include, but not be limited to, potential problem zones, general condition of native vegetation, and wildlife utilization as observed during monitoring. See Monitoring requirements Section.

5.2 AS-BUILT REPORT

An as-built report will be submitted to CEMVN within 60 days following completion of all final construction activities (e.g., eradication of invasive and nuisance plants, planting of native species, completion of earthwork, grading, wetland rating, surface water management system alterations/construction, etc.) required to restore or enhance special aquatic sites. The as-built report will describe in detail the work performed and provide a list of species planted, the number of each species, and the wetland rating. No deviation from the Mitigation Plan may occur without prior approval from CEMVN and the IET. The as-built

report will include a discussion of the coordination with IET members, a description of and reasons for any approved deviation. The as-built report shall provide:

a. A survey showing finished grades and plantings (if needed) with written documentation, plan view and cross-sectional drawings of all construction and establishment work implemented on the mitigation project.

b. Quantitative survey data collected from the permanent monitoring stations and the transects as described in the Monitoring Requirements Section of this MWP. This survey data should include the number of species planted, timing of all work events, and maps showing the location (including latitude/longitude) of all monitoring stations as described in this Plan.

c. Detailed descriptions of site preparation, planting procedures, etc.

Photographs as described within the Monitoring Requirements Section

d. A detailed discussion of all mitigation activities completed. A brief description of maintenance and/or management and/or mitigation work performed since the previous monitoring report along with a discussion of any other significant occurrences.

e. A description of the various features and habitats within the mitigation site. Various qualitative observations will be made to document existing conditions and will include, but not be limited to, potential problem zones, general condition of native vegetation, and wildlife utilization as observed during monitoring.

f. A plan view drawing and shapefiles of the mitigation site showing the approximate boundaries of different mitigation features including planted areas, planted rows, areas involving eradication of invasive and nuisance plant species, surface water management features, access rows, proposed monitoring transects locations, sampling plot locations, photo station locations, and if applicable, piezometer and staff gage locations.

- A detailed inventory of all canopy and midstory species planted (if plantings are determined to be necessary, including the number of each species planted and the stock size planted. In addition, provide an itemization of the number of each species planted and correlate this itemization to the various areas depicted on the plan view drawing of the mitigation site.

5.3 FIRE MANAGEMENT REPORTING

For burn events, the following information will be reported in the as-built, initial, interim and long-term monitoring reports: dates of burn, percentage coverage burn by unit, and a map showing the location of the area burned. This information will also be provided on any reports subsequent to the long-term monitoring report. Surveys will include a summary and map of where, when and percent coverage of burns that have occurred since the previous

monitoring report. Data collected for initial, interim and long-term monitoring will be the same as for baseline conditions using the same sample plots.

5.4 INITIAL SUCCESS CRITERIA REPORT

The following will be submitted at the end of the first year after planting.

The report shall provide details on any maintenance/management work conducted on the Mitigation project after submission of the As-Built Report. The report shall provide a brief description of any anticipated maintenance/management work to be conducted prior to attainment of interim success criteria.

5.4.1 Vegetation

5.4.1.1 Permanent Monitoring Plot Data

The report shall provide plot data summarized in tabular form for general vegetation monitoring plots and seedlings survival/growth monitoring plots as described and as established in accordance with the Monitoring Requirements Section of this Mitigation Plan.

A description of the general condition of the seedlings, including the number and species of surviving seedlings in each monitoring plot**,** and a discussion of likely causes of mortality for the non-survivors, and a description of the generalized degree and distribution of exotic/invasive species will also be provided. This vegetative monitoring data will be compared to baseline data to demonstrate rehabilitation and/or maintenance of the pine flatwoods/savanna and related habitats.

5.4.2 Hydrologic Data

The report shall provide a description of the condition of any applicable hydrology altering features (culverts, ditches, plugs, etc.), a general discussion of hydrologic conditions at monitoring stations and date(s) of activities documentation (fire and roadside berm restoration which will be returned to natural grade) demonstrating unimpeded sheet flow.

5.4.3 Photographs

The Sponsor must submit digital photographs in accordance with the Monitoring Requirements Section of this Mitigation Plan.

5.4.4 Qualitative Analysis

The Sponsor must provide a qualitative analysis of the site as described in the Monitoring Requirements Section. of this Mitigation Plan.

5.4.5 Management Report

A summary Fire Management Report will be provided with the Initial Success Criteria Report in accordance with specifications given in the Monitoring Report Section of this Mitigation Plan.

5.5 INTERIM SUCCESS CRITERIA REPORT

5.5.1 Vegetation

Vegetation monitoring data (see Monitoring Requirements Section) will be provided. In addition, documentation will be provided on the percentage of seedling survival and increase in growth of planted seedlings (if plantings are deemed necessary)**.** This vegetative monitoring data will be compared to the initial success criteria report to demonstrate rehabilitation and/or maintenance of the pine flatwoods/savanna and related habitats.

5.5.1.1 Permanent Monitoring Plot Data

The report shall provide plot data summarized in tabular form for general vegetation monitoring plots and seedlings survival/growth monitoring plots as described and as established in accordance with the Monitoring Requirements Section of this Mitigation Plan. Documentation will be provided that shows seedling growth has occurred for 3 consecutive years for the minimum number of seedlings per acres. A description of the general condition of the longleaf seedlings, including the number and species of surviving seedlings in each monitoring station, the tag number (if appropriate) and a discussion of likely causes of mortality for the non-survivors will be provided. In addition, a description of the generalized degree and distribution of undesirable species and whether they are seed bearing trees or seedlings will also be provided.

5.5.2 Hydrologic Data

By Year 3, two years following attainment of the one-year survivorship criteria, **a wetland determination will be required.** A wetland delineation report will be submitted and a request for a jurisdictional determination to CEMVN as described in the 1987 Manual as well as the November 2010 Regional Supplement to the Corps of Engineers wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region Version 2. Hydrologic restoration information will also include photographic documentation (fire break and roadside berm restoration) demonstrating unimpeded sheet flow.

5.5.3 Photographs

Digital photographs in accordance with the Monitoring Requirements section of this Mitigation Plan will be submitted.

5.5.4 Qualitative Analysis

The report must provide a qualitative analysis of the site as described in the Monitoring Requirements Section of this Mitigation Plan. The report shall provide details on any maintenance/management work conduction on the Mitigation project after submission of the Initial Success Criteria Report. The report shall provide a brief description of any anticipated

maintenance/management work to be conducted prior to attainment of long-term success criteria. Note: By year 5, four years following successful attainment of the one-year survivorship criteria, the developing community must exhibit characteristics and diversity indicative of a viable native pine flatwoods/savanna wetland community commensurate with stand age and site conditions; the Mitigation project and the perimeter will be virtually free (approximately 5% or less on an acre-by-acre basis) of exotic/invasive vegetation.

5.5.5 **Fire Management Reports**

A summary Fire Management Reports will be provided with the Interim Success Criteria Report in accordance with the specifications given in the Monitoring reporting section of this mitigation plan.

5.6 LONG TERM SUCCESS CRITERIA REPORT

the Mitigation project shall be monitored five years following attainment of the interim success criteria for the Mitigation project, and every five years thereafter. This long term success criteria report will document the attainment of the long term success criteria. Should information in any of these reports indicate that the long-term success criteria are not attained, an Adaptive Management Plan should be submitted to CEMVN. This plan should identify and describe the problem(s) and provide a plan of action on solving these problems.

5.6.1 **Vegetation**

The vegetative monitoring data will be compared to the interim success criteria report to demonstrate rehabilitation and/or maintenance of the pine flatwoods/savanna and related habitats.

5.6.1.1 Permanent Circular Plot Data

The report shall provide plot data in tabular form for each permanent circular monitoring plot as described and as established in accordance with Monitoring Requirements of this Mitigation Plan. A description of the generalized degree and distribution of exotic/invasive species and whether they are seed bearing trees or seedlings will also be provided.

5.6.2 **Hydrologic Data**

The report must provide documentation to verify that the restored hydrology of the site as achieved in the Interim Success Criteria is still in place.

5.6.3 **Photographs**

Digital photographs in accordance with section Monitoring Requirements Section of this Mitigation Plan must be included in the report.

5.6.4 **Qualitative Analysis**

The report must provide a qualitative analysis of the site as described in the Monitoring Requirements Section of this Mitigation Plan. The report shall provide details on any

maintenance/management work conducted on the Mitigation project after submission of the Interim Success Criteria Report.

5.6.5 Fire Management Reports

Fire Management Reports will be provided for each burn event.

5.7 BEYOND LONG TERM SUCCESS CRITERIA REPORT

the Mitigation project shall be monitored for five years following attainment of the long-term success criteria for the Mitigation project, and every five years thereafter. This long-term success criteria report will document the maintenance of the long term success criteria. Should information in any of these reports indicate that the long-term success criteria is no longer met, an Adaptive Management Plan should be submitted to CEMVN. This plan should identify and describe the problem(s) and provide a plan of action on solving these problems.

5.7.1 Vegetation

5.7.1.1 Permanent Circular Plot Data

The report shall provide plot data in tabular form for half of the number of permanent circular monitoring plots as described and as established in accordance with this Mitigation Plan. A description of the generalized degree and distribution of exotic/invasive species and whether they are seed bearing trees or seedlings will also be provided.

5.7.2 Hydrologic Data

The report must provide documentation to verify that the restored hydrology of the site as achieved and shown for Long-term Success Criteria is still in place.

5.7.3 Photographs

The report must submit digital photographs in accordance with the Monitoring Requirements Section of this Mitigation Plan.

5.7.4 Qualitative Analysis

The report must provide a qualitative analysis of the site as described in IX.F. of this Mitigation Plan. The report shall provide details on any maintenance/management work conducted on the Mitigation project after submission of the Interim Success Criteria Report.

5.7.5 Fire Management Reports

Fire Management Reports will be provided for each burn event

Monitoring Reports Following Re-Planting Activities (if plantings are deemed necessary)

Re-planting of certain areas within the mitigation site may be necessary to ensure attainment of applicable native vegetation success criteria. Any monitoring report submitted following completion of a re-planting event must include:

- an inventory of the number of each species planted and the stock size used;
- a depiction of the areas re-planted, cross-referenced to a listing of the species and number of each species planted in each area;
- documented GPS coordinates for the perimeter of the re-planted area. If single rows are replanted, then GPS coordinates should be taken at the end of the transect; and
- all requirements listed under “Additional Monitoring Reports” of the Mitigation Monitoring Guidelines.

SECTION 6

Mitigation Monitoring Schedule and Responsibilities

Monitoring will be dependent upon site conditions but may be delayed until later in the growing season due to site conditions or other unforeseen circumstances. Monitoring reports will be submitted by December 31 of each monitoring year to the USACE, NFS, and the IET. The various monitoring and reporting responsibilities addressed in this section are all subject to the provisions set forth in the Introduction section.

The USACE and the NFS will be responsible for conducting the monitoring events and preparing the associated monitoring reports until such time that the following initial success criteria are achieved (criteria follow numbering system used in success criteria section):

1. Hydrology – 3.1.1.1 (1) and 3.1.1.2 (1)
2. Vegetation – 3.1.1.1 (2) and 3.1.1.2 (2)

Monitoring events associated with the above will include the first or baseline monitoring event plus annual monitoring events thereafter until the monitoring responsibilities are transferred to the NFS.

The NFS will be responsible for conducting the required monitoring events and preparing the associated monitoring reports for all other required years after the CEMVN has demonstrated the initial success criteria listed above have been achieved. The responsibility for management, maintenance, and monitoring of the non-structural components of mitigation project (vegetative) will typically be transferred to the NFS during the first quarter of the year immediately following submittal of the monitoring report that demonstrates attainment of the initial success criteria. Once monitoring responsibilities have been transferred to the NFS, the next monitoring event (intermediate) should take place 2 growing seasons after initial success has been met. After intermediate success has been met, monitoring will be conducted every 5 years throughout the remaining 50-year period of analysis.

If the native vegetation success criteria are not achieved, a monitoring report will be required for each consecutive year until two annual sequential reports indicate that these criteria have been satisfied. The NFS will be responsible for conducting this additional monitoring and preparing the monitoring reports. The NFS will also be responsible for the purchase and installation of supplemental plants needed to attain these success criteria.

If timber management activities are conducted by the NFS, the NFS will be responsible for conducting the additional monitoring and preparing the associated monitoring reports necessary for such activities (e.g., one monitoring event and report in the year immediately preceding timber management activities and one monitoring event and report in the year that

timber management activities are completed). Management activities conducted should be documented in the monitoring report.

Once monitoring responsibilities have transferred to the NFS, the NFS will retain the ability to modify the monitoring plan and the monitoring schedule should this become necessary due to unforeseen events or to improve the information provided through monitoring. Twenty years following completion of initial success criteria, the number of monitoring plots and/or monitoring transects that must be sampled during monitoring events may be reduced substantially if it is clear that mitigation success is proceeding as anticipated. Any significant modifications to the monitoring plan or the monitoring schedule must first be approved by the CEMVN in coordination with the IET.

Table I6:6-1. Monitoring Activities Refuge Pine Savanna

Year	Activity	Data	Responsible Entity
-1	Pre-construction surveys	Water-depth, hydrology, land cover	USACE
0	Pre-construction monitoring	Baseline ecological data; vegetation composition and structure	USACE
1	As-Built Surveys and Construction Completion Report	Confirm project is built to P&S	USACE and construction contractor
1	Bathymetric survey	ground elevation	USACE and Non-Federal Sponsor
1	Hydrologic monitoring	elevations must be conducive to establishment and support of hydrophytic vegetation	USACE and Non-Federal Sponsor
1	Vegetation survey	Invasive species removal needs; vegetation composition and structure	USACE and Non-Federal Sponsor
5	Hydrologic monitoring	demonstrating that wetland hydrology has been re-established	Non-Federal Sponsor
5	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
10	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
15	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
20	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
30	Vegetation survey	invasive species removal needs; vegetation composition and structure;	Non-Federal Sponsor

		long leaf pine growth data	
40	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
50	Final monitoring report	Comprehensive report	Non-Federal Sponsor

SECTION 7
Adaptive Management

Adaptive Management prescribes a process (Figure I4:7-1) wherein management actions can be changed in response to monitored system response, as to maximize restoration efficacy or achieve a desired ecological state. For this project Adaptive Management will be used to ensure that the required AAHUs needed for compensatory mitigation are met. The basic steps include:

- Plan: Defining the desired goals and objectives, evaluating alternative actions, and selecting a preferred strategy with recognition of sources of uncertainty.
- Design: Identifying or designing a flexible management action to address the challenge.
- Implement: Implementing the selected action according to its design.
- Monitor: Monitoring the results or outcomes of the management action.
- Evaluate: Evaluating the system response in relation to specified goals and objectives.
- Adjust: Adjusting (adapting) the action if necessary to achieve the stated goals and objectives.

Figure I4:7-1. Adaptive Management Process

7.1 ADAPTIVE MANAGEMENT PLANNING

Adaptive management planning elements included: 1) development of a Conceptual Ecological Model (CEM), 2) identification of key project uncertainties and associated risks, 3) evaluation ofthe mitigation project as a candidate for adaptive management and 4) the identification of potential adaptive management actions (contingency plan) to better ensure the mitigation projectmeets identified success criteria. The adaptive management plan is a living document and will be refined as necessary as new mitigation project information becomes available.

7.2 CONCEPTUAL ECOLOGICAL MODEL

A CEM was developed to identify the major stressors and drivers affecting the proposed mitigation project (see Figure I4:7-2). The CEM does not attempt to explain all possible relationships of potential factors influencing the mitigation site; rather, the CEM presents only those relationships and factors deemed most relevant to obtaining the required

acres/average annual habitat units (AAHUs). Furthermore, this CEM represents the current understanding of these factors and will be updated and modified, as necessary, as new information becomes available.

A Conceptual Ecological Model (CEM) was developed to identify the major stressors and drivers affecting the proposed project.

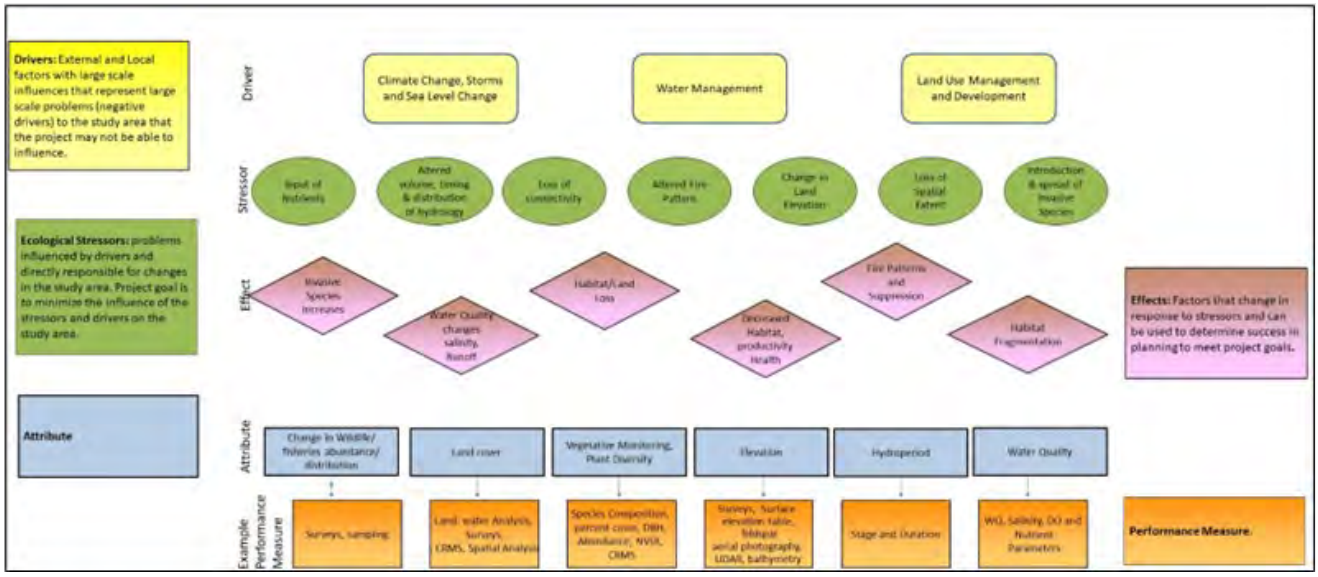

Figure I4:7-2. Conceptual Model St. Tammany Parish Pine Savanna Habitat

7.3 SOURCES OF UNCERTAINTY AND ASSOCIATED RISKS

A fundamental tenet underlying adaptive management is decision making and achieving desiredproject outcomes in the face of uncertainties. There are many uncertainties associated with restoration of the coastal systems. The project delivery team identified the following uncertainties during the planning process.

Climate change, such as relative sea level rise, drought conditions, and variability of tropical storm frequency, intensity, and timing

Subsidence and water level trends at the mitigation sites

Uncertainty Relative to Achieving Ecological Success:

Water, sediment, and nutrient requirements for Riparian/BLH

Magnitude and duration of wet/dry cycles

Nutrients required for desired productivity

Growth curves based on hydroperiod and nutrient application

Tree litter production based on nutrient and water levels

Tree propagation in relation to management/regulation of hydroperiod

Loss rate of vegetative plantings

Long-Term Sustainability of Project Benefits

7.4 ADAPTIVE MANAGEMENT EVALUATION

The project site was evaluated and planned to develop a project with minimal risk and uncertainty. The items listed below will be incorporated into the mitigation project implementation plan and Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) plan to minimize project risks.

- Specified success criteria (i.e., mitigation targets)
- Detailed planting guidelines for BLH
- Invasive species control
- Supplementary plantings as necessary (contingency)
- Corrective actions to meet topographic and hydrologic success as required (contingency)

Adaptive Management Evaluation

Subsequently, as part of the adaptive management planning effort the mitigation project features were re-evaluated against the CEM and sources of uncertainty and risk were identified to determine if there was any need for additional actions and costs under the adaptive management plan to ensure that the project meets the required success criteria. Based on the uncertainties and risks associated with the project implementation the following contingency actions have been identified to be implemented if needed to ensure the required AAHUs are met.

Table I4:7-2. Adaptive Management Actions Refuge Pine Savanna

Element	Expected Condition	Potential Issue	Potential Corrective Action
Landscape characteristics	Bathymetry appropriate for sustainable growth	Site frequently flooded	Modify water depth and frequency and or

	of targeted vegetation		increase land elevation to reduce flooding
Vegetation community composition	Healthy vegetative communities free of invasive species.	Invasive species dominance, poor tree survival, sub-optimal tree growth , incorrect community composition	Invasive species control, replanting larger tree for targeted species, canopy thinning or other forest management practices including controlled burns

The CEMVN would be responsible for the proposed mitigation construction and monitoring until the initial success criteria are met. Initial construction and monitoring would be funded in accordance with all applicable cost-share agreements with the NFS. The CEMVN would monitor (on a cost-shared basis) the completed mitigation to determine whether additional construction, invasive/nuisance plant species control, and/or plantings are necessary to achieve initial mitigation success criteria. Once the CEMVN determines that the mitigation has met the initial success criteria, monitoring would be performed by the NFS as part of its OMRR&R obligations. If after meeting initial success criteria, the mitigation fails to meet its intermediate and/or long- term ecological success criteria, the CEMVN would consult with other agencies and the NFS to determine the appropriate management or remedial actions required to achieve ecological success. The CEMVN would retain the final decision on whether or not the project's required mitigation benefits are being achieved and whether or not remedial actions are required. If structural changes are deemed necessary to achieve ecological success, the CEMVN would implement appropriate adaptive management measures in accordance with the contingency plan and subject to cost-sharing requirements, availability of funding, and current budgetary and other guidance.

SECTION 8
References and Resources

USACE 1987 Wetland Delineation Manual

USACE November 2010 Regional Supplement for the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region Version 2.0. Performance standards

USDA/NRCS, Soil Survey of St. Tammany Parish, LA, March 1990

Websites:

The Final Policy on the NWR System and Compensatory Mitigation Under the Section 10/404 Program (federal register notice (64 FR 49229)

(https://www.govinfo.gov/content/pkg/FR-1999-09-10/html/99-23627.htm)

Mississippi Valley Division,
Regional Planning and Environment Division South

St. Tammany Parish, Louisiana Feasibility Study

Appendix I: Attachment 5 – Project Description Constructed Stream Project

May 2023

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SECTION 1
Stream Mitigation Site

1.1 PROJECT LOCATION

The proposed stream mitigation site (M 6-2) is located off of Mile Branch and encompasses the City of Covington boundary for the gravel/storage yard as well as the area adjacent to the channel (Figure I5:1-1). This site will be used as staging during construction and when construction is completed on this segment of Mile Branch, the site will be beneficially used for restoration of water bottoms as the backwater area. The nature-based feature would rectify 3 acres of impacts (work will be done within the entire 5 acres) to Mile branch mud bottom from the construction of the Mile Branch channel improvements under the St. Tammany Parish, Louisiana Feasibility study.

Per ER 1105-2-100, Appendix C, 4e.(3): Separable Features. Full credit shall be given to the beneficial aspects of an alternative plan, or project, before consideration is given to adding separable ecological mitigation features. The significance of the ecological resources affected by an alternative plan/project, and the significance of adverse impacts to these resources shall be evaluated to determine the need for separable ecological mitigation features. Evaluation of a separable ecological mitigation feature is appropriate when it is determined that the net adverse impacts of an alternative plan/project exceed its net beneficial effects, and/or when the resulting losses include values (monetary and non-monetary) of such significance that specific consideration is justified.

This feature was also discussed and considered as a nature-based feature along Mile Branch as the restoration of stream bottoms and is expected to provide flood reduction benefits with additional overbank storage.

Figure I5:1-1. Location of Backwater Site to Create Stream Mud Bottom along Mile Branch

Note: The light blue line is the approximate area. The purple line represents the extent of the city owned property adjacent to Mile Branch.

1.2 PROJECT DESCRIPTION

A conceptual design was developed for the backwater feature off of Mile Branch that provides 3 acres of mud bottom as a project feature (Figure I5:1-2). It would be further designed during Pre-Construction Engineering and design (PED). A free exchange of water between Mile Branch and the backwater area would be preferred, however, if access to Mile Branch must be provided along the full length of Mile Branch, then culverts (4-60 feet; 2 inflow; 2 outflow) would be required to allow inflow and outflow between the two areas. The culverts should be placed at an elevation that allows frequent water exchange between Mile Branch and the backwater area to avoid stagnation. The site would need to be excavated 3-5-feet deep below the average stage to Mile Branch to achieve both deep-water and shallow water habitat. A 40-feet buffer would be planted with bottomland hardwoods around the east, south, and west perimeter of the site. The 40-feet buffer should not be higher than the existing elevation to allow run-off from adjacent areas to flow into the backwater area. The deep-water area would be excavated at a 3:1 slope away from the buffer to achieve the required depth of the site. Finger islands would be created within the site and planted with BLH. Excavated material from within the site would be hauled off-site. The internal tree "fingers" would be at a lower elevation than the perimeter forested buffer. The fingers should be at the former natural ground elevation or maybe a foot or two lower but would be sufficient to support BLH species. Deep water "channels" (see "D" on Figure I5:1-2) would

extend through the southern end of the tract to encourage circulation throughout the site. Some shallow areas should be provided for marsh or swamp vegetation growth.

1.2.1 Real Estate

Real estate will be acquired as needed for the channel improvements staging area, but should be permanent/conservation servitude to protect the area to function as intended post construction.

1.2.2 Operating Plan

The operating plan will be developed in PED when the features are further modeled. It is expected that named storm events and water elevation triggers would be used to determine closing. Final Operations Plan would be completed through coordination with NMFS and USFWS.

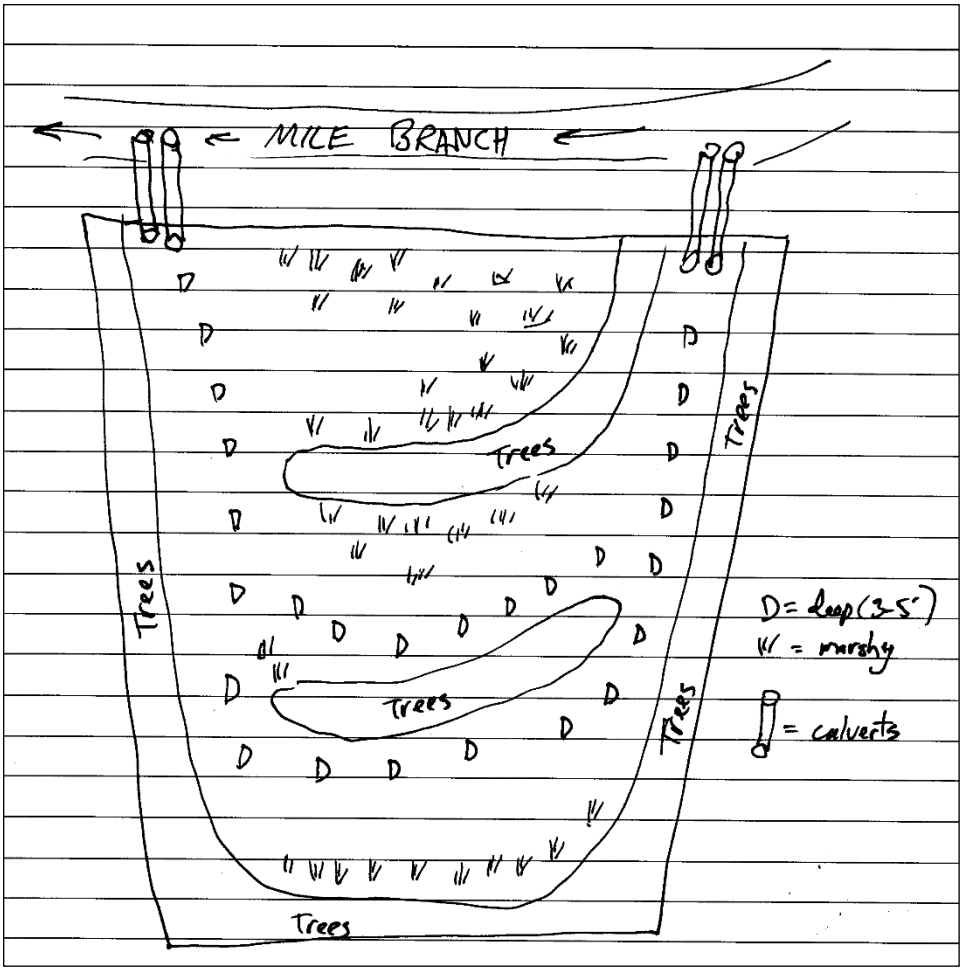

Figure I5:1-2. Conceptual Design for Mile Branch Backwater Feature

St Tammany Parish Feasibility Study

Mile Branch Stream Mitigation- Site 12a

I-6-Monitoring and Adaptive Management Plan

May 2023

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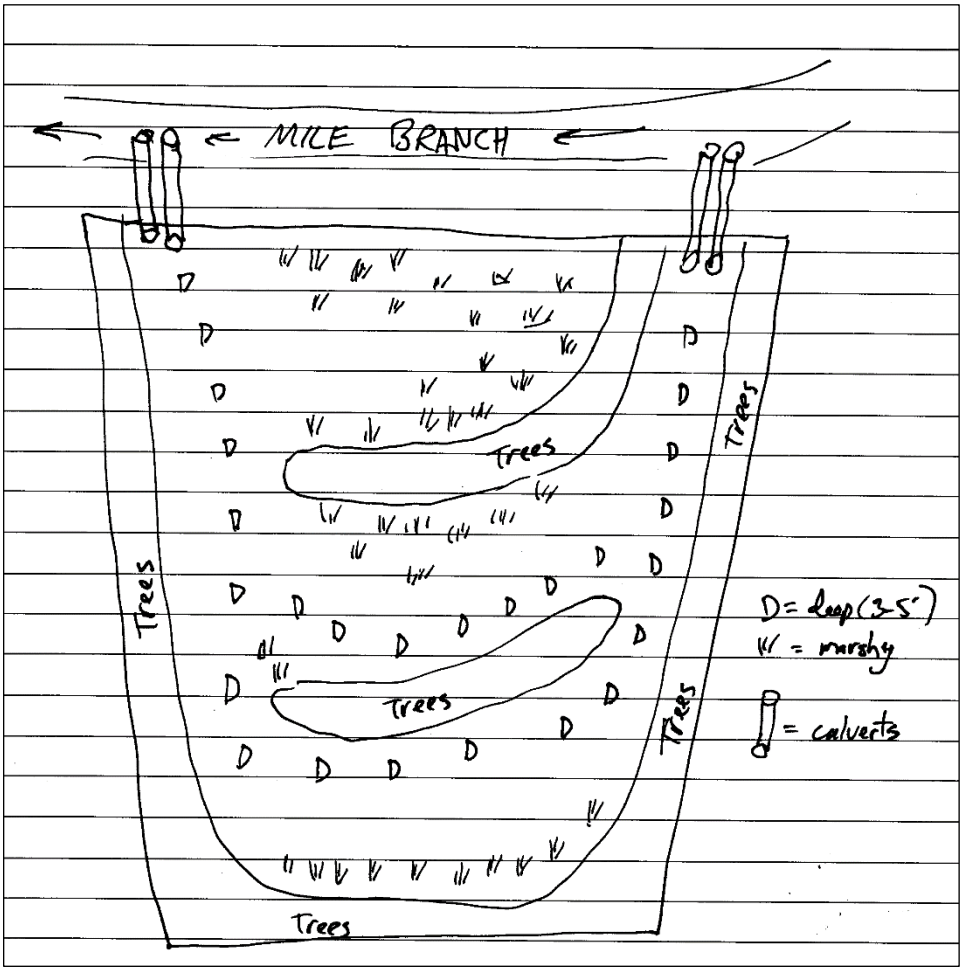

Figure I6:1-2. Conceptual Design for Mile Branch Backwater Feature

Section 2
USACE Guidance

U.S. Army Corps of Engineers (USACE) monitoring and adaptive management policy is required by the Water Resources Development Act of 2007 and presented in planning guidance (Engineering Regulation (ER) 1105-2-100, Engineering Circular (EC) 1105-2-409, and Memorandum on Implementation Guidance for Section 2036 of the Water Resources Development Act of 2007). Monitoring includes the systematic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management will be needed to attain project benefits. Adaptive management addresses the uncertainties about a project's actual performance that exist when implementation decisions are made to undertake a water resources project. This technique allows decision making and implementation to proceed with the understanding that outputs will be assessed and evaluated and that some structural or operational changes to the project may be necessary to achieve desired results. At the heart of adaptive management is an appropriate monitoring program to determine if the outputs/results meet the required mitigation need, and to determine if any adjustments are needed.

The purpose of this plan is to demonstrate ecological success of the project. This success is determined by monitoring metrics that are specifically tied to project objectives, and success criteria. In addition, the plan identifies what adaptive management (contingency) is proposed if the performance targets are not met. This plan presents the framework for the above methodology, and will be refined as the project proceeds into Pre-construction, Engineering, and Design (PED) phase in collaboration with the non-Federal sponsors, as well as other stakeholders who may take responsibility for monitoring ecological variables in the watershed.

Section 3
Mitigation Success Criteria

3.1 GENERAL CONSTRUCTION

- Complete all initial mitigation construction activities (e.g. construction of temporary retention/perimeter dikes, placement of fill (borrow material/dredged material), construction of permanent dikes if applicable, etc.) in accordance with the mitigation work plan and final project plans and specifications. Upon completion of construction, USACE or its contractor shall provide construction surveys to include all project features. These activities are classified as "initial construction requirements."
- Approximately 1 year following completion of all initial mitigation construction activities (when the constructed feature has stabilized to the point that the containment berms are no longer required to prevent the loss of fill material from the project site), USACE or its contractor shall complete all final mitigation construction activities, in accordance with the mitigation work plan and final project plans and specifications. Such activities may include, but are not limited to: degrading temporary retention/perimeter dikes; completion of armoring of permanent dikes; "gapping" or installation of "fish dips"; soil testing; completion of plantings; and construction of trenasses or similar features within backwater area as a means of establishing shallow water and deep water interspersion areas. Finishing the aforementioned construction activities will be considered as the "completion of final construction requirements".

3.2 TOPOGRAPHY

- Initial Success Criteria:
    - One year after final construction:
        - Demonstrate that at least 80% of each mitigation feature has a surface elevation that is within +0.5 to – 0.5 feet of the desired target surface elevation as determined by the settlement curve for that year.
- Two years after final construction:
    - Demonstrate that at least 80% of the mitigation site has a surface elevation that is within +0.5 feet to – 0.25 of the desired target surface elevation as determined by the settlement curve for that year.
- Intermediate Success Criteria:
    - Two years following achievement of Topography Criteria 2.A.2. —
        - Demonstrate that at least 80% of the mitigation site has a surface elevation that is within the functional marsh elevation range[2].
        - There are no additional monitoring or attainment requirements for topography beyond meeting the Intermediate Success Criteria for topography.

Notes:

[1]Elevation survey data and report will be provided to the IET for review in order to determine concurrence. The surveys must include water levels inside and outside the backwater site at locations representative of site conditions.

[2]The "functional elevation range", i.e. the range of the surface elevation that is considered adequate to achieve proper backwater area functions and values, is determined during the final design phase.

3.3 VEGETATION

- Fresh marsh:

    - o Initial Success Criteria (2 growing seasons following completion of initial construction activities in General Construction 1.A.):
    - o Achieve a minimum average cover of 50% comprised of native herbaceous species.
    - o Demonstrate that vegetation satisfies USACE hydrophytic vegetation criteria. (USACE 2010)
        - o Intermediate Criteria (2 years following attainment f Native Vegetation Criteria 3.A.1.):
    - o Achieve a minimum average cover of 60% comprised of native herbaceous species.
    - o Demonstrate that vegetation satisfies USACE hydrophytic vegetation criteria.

- Long-Term Success Criteria[3] (Every monitoring event after attainment of Native Vegetation Criteria 3.A.2.):

    - o Achieve a minimum average cover of 60% comprised of native herbaceous species.
    - o Demonstrate that vegetation satisfies USACE hydrophytic vegetation criteria.

Notes:

[1]Fresh marsh is typically not planted due to the expectation that it will naturally vegetate more quickly than intermediate or brackish marsh. However, if percent cover success criteria are not met, plantings may become necessary in the absence of other recommended actions

- Riprian BLH:

    - o In mature riparian floodplain forests, canopy tree stem density is roughly 150 stems per acre, indicating a tree spacing of 16 to 18 feet, according to USDA-NRCS Riparian Forest Buffer Specifications. This stem density of native trees will be used as the success criteria. Total average vegetative cover

accounted for by invasive species constituting less than 5% of the total average plant cover would be used as success criteria. If tree density and/or invasive species success criteria are not met, adaptive management would be required.

3.4 INVASIVE AND NUISANCE VEGETATION

3.4.1 Initial, Intermediate, and Long-term1 Success Criteria

- Maintain the project area such that the total average vegetative cover accounted for by invasive species and the total average vegetative cover accounted nuisance species each constitute less than 5% of the total average plant cover each throughout the 50- year project life. The list of invasive and nuisance species will be developed and tailored to reflect specific site needs.

Note:

[1]Yearly inspections to determine the need for invasive/nuisance control would be conducted until the long term success criteria for vegetation is achieved. After it is achieved, the frequency of inspections to determine the need for invasive/nuisance control would be adjusted based on site conditions.

3.5 HYDROLOGY

Success criteria includes increased connectivity compared to baseline conditions.

3.6 AQUATIC FAUNA -FISH AND INVERTEBRATE

Habitat conditions and faunal communities would be compared to baseline conditions to document changes. There are no specific performance criteria for this. Generally, increased habitat complexity will result in new habitats for aquatic communities.

Section 4
Mitigation Monitoring Guidelines

A diverse riverine fauna is dependent on habitat diversity, such as diversity in connection frequency, substrate heterogeneity and structural complexity. This monitoring plan proposes the framework for monitoring the changes in aquatic species and habitat that will occur with construction of the backwater mitigation project. Fish, invertebrate, water quality and habitat data will ideally be collected seasonally in habitats affected by project measures or stratified representative habitats within the project reach. Proposed monitoring will be finalized during Preconstruction, Engineering and Design (PED). As monitoring is completed, data will be reported and analyzed by USACE and the NFS to facilitate adaptive management.

The following activities summarize the basic monitoring steps.

- Complete: bathymetry, aquatic habitat, hydrologiy, and aquatic fauna surveys.
- Conduct field work to document species and habitat pre- and post-project
- Elevation – channel or waterbody bed surveys
- Benthic invertebrates and mussels – grab samples
- Adult and juvenile fish –seine
- Hydrology – YSI hydrolab and turbidimeter (temperature, pH, conductivity, dissolved oxygen, turbidity)
- Physical parameters – stadia rod and flowmeter (substrate, aquatic vegetation coverage, velocity, and depth cross section)

4.1 TOPOGRAPHY

Elevation Surveys will be used to estimate pre and post project connectivity. Additional more frequent surveys may be needed by engineering to monitor project design and channel conditions.

Eco-mapper: For small, isolated floodplain waterbodies, bathymetric data could be collected by a YSI i3XO EcoMapper ® autonomous underwater vehicle (AUV) or other remote survey vehicle such as ERDC-CHL's remotely operated survey vessel. Where possible, an evenly < 20 ft spaced grid of depth readings collected during higher water would provide good coverage of the waterbody's bed. If a grid is not possible, the depth readings could be recorded parallel and closest to the shoreline and then in transects perpendicular to the waterbody's long axis with a transect spacing of < 100 ft and at least three transects per waterbody. Stadia rod readings with GPS coordinates may provide supplemental depth readings for large shallow < 2 ft deep areas of the waterbody.

Depending on time and monetary constraints, water surface elevation to convert depth readings may be determined in several ways. The National Geodetic Survey database could be searched to find suitable benchmarks. A Trimble R8 RTK GPS receiver could be utilized to provide survey vessel navigation and positioning. This would provide real time sub-meter level accuracy latitude and longitude for each depth reading. An R8 Base Station affixed with a high output radio could allow for RTK water surface elevation collection at random intervals throughout the survey. A less time-consuming low-cost alternative may be used by intersecting

GPS points collected at the water's edge with Lidar data, or by using a surveyor's level set up on the nearby levee slope. For this method, multiple water surface elevations would be calculated, where possible, and averaged to improve accuracy.

4.2 HYDROLOGY

Maximum water depth, water velocity, and instream structure, if any, will be recorded along with water quality (temperature C, dissolved oxygen mg/l, conductivity microsiemiens/cm, pH, and turbidity nephelometric turbidity units (NTU)). Water quality will be recorded in flowing and floodplain waterbodies with a YSI ProDss unit. Readings will be taken throughout the water column and sampling area to characterize sampling conditions and if stratification is present. In select waterbodies, data loggers may be deployed to collect more frequent readings.

4.3 VEGETATIVE MONITORING

Vegetative monitoring would utilize established monitoring techniques and published scientific resources to 1) document increases in wetland functions as a result of the restoration activities, 2) identify data-driven success trajectories and milestones, 3) adaptively manage wetland conditions within the project area based upon observed data related to changes in wetland functional capacity over time, and 4) promote native species.

4.3.1 Data Acquisition

- tree density (e.g., tree basal area, density by coverage),
- vegetative speciation (e.g., overstory composition),
- sustainability (e.g., regeneration, species represented in vertical strata)
- soil conditions (e.g., O and A horizon)

4.3.2 Native species

To promote the native vegetation, with an emphasis on those hard mast species lacking in the study area, appropriate vegetation should be planted on sites designated for reforestation of bottomland hardwood (BLH) and riparian buffers. Only native plants should be planted (Table A9-3) depending on availability at nurseries. Typical planting densities were assumed to be on 10-ft centers; however, site specific determinations would be determined once a site and specific vegetation suite has been selected.

Table I6:4-1. Native vegetation targeted for planting at restoration sites.

Acer drummondii	Planera aquatica
Acer negundo	Platanus occidentalis
Acer rubrum	Populus heterophylla
Acer saccharinum	Quercus lyrata
Carya aquatica	Quercus nigra
Carya laciniosa	Quercus nuttallii

Celtis laevigata	Quercus pagoda
Diospyros virginiana	Quercus palustris
Forestiera acuminata	Quercus phellos
Fraxinus pennsylvanica	Salix nigra
Fraxinus tomentosa	Taxodium distichum
Gleditsia aquatica	Taxodium ascendens
Liquidambar styraciflua	Ulmus americana
Nyssa aquatica	Ulmus crassifolia
Nyssa sylvatica	Emergent Wetland Seed Mix

Monitoring would also be conducted to demonstrate that vegetation satisfies USACE hydrophytic vegetation criteria. The community would be monitored to ensure it exhibits characteristics and diversity indicative of a viable native forested wetland community, i.e. vegetation community where more than 50% of all dominant species are facultative (FAC), FAC wet and/or obligate. Table A9-4 shows the common wetland vegetation; a site-specific list will be developed in conjunction with the resource agencies.

Table I6:4-2. Common vegetation of the Lower Mississippi Valley.

Abbreviation	Scientific Name	Common Name	Status
ACNE	Acer negundo	box elder	FACW
ACRU	Acer rubrum	red maple	FACW
ACSA	Acer saccharinum	silver maple	FAC
ALPH	Alteranthera philoxeroides	alligator weed	OBL
AMTR	Ambrosia trifida	ragweed	FAC
AMAR	Ampelopsis arborea	pepper vine	FAC+
AMBR	Amphicarpa bracteata	hog peanut	FAC
ANVI	Adropogon virginicus	Broom sedge	FAC-
ANCA	Anisostichus capreolata	cross vine	Upland
ARGI	Arundinaria gigantea	river cane	FACW
ARTE	Arundinaria tecta	switch cane	FACW
ARTR	Arisaema triphyllum	Jack-in-the-pulpit	FACW-
ASPE	Asclepias perenius	milkweed	OBL
ASPA	Asimina parviflora	Paw Paw	FACU
BESC	Berchemia scandens	rattan vine	FACW
BICA	Bignonia capreolata	cross vine	FAC
BOCY	Boehmeria cylindrica	bog hemp	FACW+
BRCI	Brunnichia cirrhosa	redvine	FACW

CACAM	Callicarpa americana	beauty-berry	FACU-
CAFL	Calycanthus floridus	spicebush	FACU+
CARA	Campsis radicans	trumpet creeper	FAC
CACH	Carex cherokeensis	Cherokee sedge	FACW
CATA	Chaerophyllum tainturieri	Hairfruit chervil	FAC
CACA	Carpinus caroliniana	ironwood	FAC
CAAQ	Carya aquatica	bitter pecan	OBL
CAGL	Carya glabra	pignut hickory	FACU
CAIL	Carya illinoinensis	pecan	FACU
CATO	Carya tomentosa	mockernut hickory	Upland
CEOC	Cephalanthus occidentalis	buttonbush	OBL
CECA	Cercis canadensis	redbud	FACU
CELA	Celtis laevigata	sugarberry	FACW
COCA	Cocculus carolina	Caroline snailseed	FAC
COCO	Commelina communis	dayflower	FAC
COAM	Cornus amomum	swamp dogwood	FACW+
COFL	Cornus florida	flowering dogwood	FACU
COST	Cornus foemina (stricta?)	stiff dogwood	FACW-
CRSP	Crataegus spathulata	hawthorne	FAC
DEBA	Decumaria barbara	climbing hydrangea	FACW
DEIL	Desmanthus illinoensis	Illinois bundleflower	FAC
DIVI	Diospyros virginiana	persimmon	FAC
ECCR	Echinochloa crus-galli	American barnyard grass	FACW
ELUM	Elaeagnus umbellata	silverberry	FACU
ELCA	Elephantopus carolinianus	elephant's-foot	FAC
FIAU	Fimbristylis autumnalis	beak rush	OBL
FOAC	Forestiera acuminata	swamp privet	OBL
FRVI	Fragaria virginiana	wild strawberry	FAC-
FRAM	Fraxinus americana	white ash	FACU
FRPE	Fraxinus pennsylvanica	green ash	FACW
GECA	Geum canadense	white avens	FAC
GLTR	Gleditsia triacanthos	honey locust	FAC-
HACA	Halesia carolina	Carolina silverbell	FACU+
HIMI	Hibiscus laevis (militaris)	rose mallow	OBL
ILDE	Ilex decidua	deciduous holly	FACW-
IMCA	Impatiens capensis	jewel-weed	FACW

IVAN	Iva annua	Sump weed	FAC
JUNI	Juglans nigra	black walnut	FACU
JURE	Juncus repens	lesser creeping rush	OBL
JUTE	Juncus tenuous	path rush	FAC
LELE	Leersia lenticularis	catchfly cutgrass	OBL
LISI	Ligustrum sinense	privet	FAC
LIST	Liquidambar styraciflua	sweetgum	FAC+
LITU	Liriodendron tulipifera	yellow poplar	FAC
LOJA	Lonicera japonica	Japanese honeysuckle	FAC-
LUPA	Ludwigia papilloides	floating primrose-willow	OBL
MIVI	Microstegium virmineum	Microstegium	NL
MORU	Morus rubra	red mulberry	FAC
NYSY	Nyssa sylvatica	blackgum	FAC
OPHI	Oplismenus hirtellus	basket grass	FACU+
OSVI	Ostrya virginiana	hop hornbeam	FACU-
PAQU	Parthenocissus quinquefolia	Virginia creeper	FAC
PHAU	Phyllostachys aurea	Chinese bamboo	
PIPU	Pilea pumila	clearweed	FACW+
PITA	Pinus taeda	loblolly pine	FAC
PLAQ	Planera aquatica	water elm	OBL
PLOC	Platanus occidentalis	sycamore	FACW-
POAC	Polystichum acrostichoides	Christmas fern	FAC
PODE	Populus deltoides	cottonwood	FAC+
POHY	Polygonum hydropiperoides	swamp smartweed	OBL
POPU	Polygonum punctatum	knotweed	FACW+
POPE	Polygonum pennsylvanica	Pennsylvania Smartweed	FACW
PRSE	Prunus serotina	black cherry	FACU
PULO	Pueraria lobata	kudzu	Upland
QULY	Quercus lyrata	overcup oak	OBL
QUNI	Quercus nigra	water oak	FAC
QUNU	Quercus nuttallii	Nuttall oak	OBL
QUPA	Quercus pagoda	cherrybark oak	FAC
QUPH	Quercus phellos	willow oak	FACW-
QURU	Quercus rubra	red oak	FACU

RUAR	*Rubus argutus*	blackberry	FAC-
RUCR	*Rumex crispus*	Curly dock	FAC
SACE	*Saururus cernuus*	lizard's tail	OBL
SANI	*Salix nigra*	black willow	OBL
SACA	*Sambucus canadensis*	elderberry	FACW-
SEEX	*Sesbania exaltata*	bigpod sesbania	FACW
SMLA	*Smilax laurifolia*	green briar	FACW+
SMRO	*Smilax rotundifolia*	green briar	FAC
SOAL	*Solidago altisima*	Goldenrod	FACU
SOHA	*Sorghum halpense*	Johnson grass	FACU
TADI	*Taxodium distichum*	Cypress	OBL
TORA	*Toxicodendron radicans*	poison ivy	FAC
TRDE	*Treclospermum deforma*	climbing star-jasmine	FACW
TOVI	*Tovara virginiana*	jumpseed	FAC
ULAL	*Ulmus alata*	winged elm	FACU+
ULAM	*Ulmus americana*	American elm	FACW
UNLA	*Chasmanthium latifolium*	Spikegrass	FACU
VAST	*Vaccinium stamineum*	huckleberry	FACU
VEHA	*Verbena hastata*	swamp verbena	FAC
VIFL	*Viola floridana*	common blue violet	FACW-
VICI	*Vitus cinerea*	graybark grape	FAC+
VIRO	*Vitus rotundifolia*	muscadine	FAC

4.3.3 **Invasive species**

The promotion of native vegetation, often requires control of invasive vegetative species. A list of invasive species that would be monitored for at the backwater sites that could trigger adaptive management actions will be developed and included in the monitoring and adaptive management plan during PED.

4.4 AQUATIC FAUNA SURVEYS

Sampling is proposed seasonally by seining, and possibly gillnets.

These surveys will provide information on fish and invertebrate species that utilize the backwater mudbottom area. Collected fish and invertebrate data will be used to compare species presence/absence, abundance, and richness before and after project construction.

Ponar/Ekman: The inaccessibility of floodplain waterbodies means these cannot be sampled with the boat pulled benthic sled. Floodplain waterbodies will be sampled with either a petite Ponar or Ekman grab sampler. These samplers are spring loaded catchment devices. They

are lowered to the waterbody bed and the spring released at which point the device snaps closed scooping up soft bed material. Three samples will be taken along each transect with the objective of acquiring samples from all substrates present. Upon retrieval, a standardized 8-L sample of the collected substrate will be processed. Sediments will be washed on-board and sieved to separate living organisms from inorganic particles and characterize substrate. Organisms will be returned to the laboratory in Vicksburg, MS, for counting and identification. Insects will be identified to genus when possible. Early instars and Chironomidae will likely be identified to family. Mollusks captured live will be identified to family and released (relict mollusks will not be identified). Aquatic worms will be identified to subclass or family if possible. Macroinvertebrates will be assigned into different functional groups (environment, habit, functional feeding group) using available taxonomic literature and professional opinion. The differences in abundance, richness and functional group will be compared pre and post project and between habitats.

Seining: Seining will be used to sample the mitigation site. A seine sample consists of ten seine hauls stratified among all apparent macrohabitats. A sample will be gathered in the upper, middle, and lower sections of the waterbody. Seines consist of a 10' long and 4' deep net tied to 6’ tall poles. The net consists of 3/16" mesh knotless 34lb test nylon with a 1/8" braided nylon top and bottom rope. A lead weight is placed every 12" on the bottom rope and SB3 floats occur every 18" on the top rope. Large fish will be identified to species, measured, and released. Small fish will be preserved in ethanol and transported to the lab for identification and measuring.

Vegetative monitoring would utilize established monitoring techniques and published scientific resources to 1) document increases in wetland functions as a result of the restoration activities, 2) identify data-driven success trajectories and milestones, 3) adaptively manage wetland conditions within the project area based upon observed data related to changes in wetland functional capacity over time, and 4) promote native species.

4.4.1 **Data Acquisition**

- tree density (e.g., tree basal area, density by coverage),
- vegetative speciation (e.g., overstory composition),
- sustainability (e.g., regeneration, species represented in vertical strata)
- soil conditions (e.g., O and A horizon)

4.4.2 **Native species**

To promote the native vegetation, with an emphasis on those hard mast species lacking in the study area, appropriate vegetation should be planted on sites designated for reforestation of bottomland hardwood (BLH) and riparian buffers. Only native plants should be planted (Table A9-3) depending on availability at nurseries. Typical planting densities were assumed to be on 10-ft centers; however, site specific determinations would be determined once a site and specific vegetation suite has been selected.

Table I6:4- 1. Native vegetation targeted for planting at mitigation site

Acer drummondii	Planera aquatica
Acer negundo	Platanus occidentalis
Acer rubrum	Populus heterophylla
Acer saccharinum	Quercus lyrata
Carya aquatica	Quercus nigra
Carya laciniosa	Quercus nuttallii
Celtis laevigata	Quercus pagoda
Diospyros virginiana	Quercus palustris
Forestiera acuminata	Quercus phellos
Fraxinus pennsylvanica	Salix nigra
Fraxinus tomentosa	Taxodium distichum
Gleditsia aquatica	Taxodium ascendens
Liquidambar styraciflua	Ulmus americana
Nyssa aquatica	Ulmus crassifolia
Nyssa sylvatica	Emergent Wetland Seed Mix

Since the mitigation site is within the active floodplain, monitoring would also be conducted to demonstrate that vegetation satisfies USACE hydrophytic vegetation criteria. The community would be monitored to ensure it exhibits characteristics and diversity indicative of a viable native forested wetland community, i.e. vegetation community where more than 50% of all dominant species are facultative (FAC), FAC wet and/or obligate. Table A9-4 shows the common wetland vegetation likely at the proposed site.

Table I6:4- 2. Common vegetation of the Lower Mississippi Valley.

Abbreviation	Scientific Name	Common Name	Status
ACNE	*Acer negundo*	box elder	FACW
ACRU	*Acer rubrum*	red maple	FACW
ACSA	*Acer saccharinum*	silver maple	FAC
ALPH	*Alteranthera philoxeroides*	alligator weed	OBL
AMTR	*Ambrosia trifida*	ragweed	FAC
AMAR	*Ampelopsis arborea*	pepper vine	FAC+
AMBR	*Amphicarpa bracteata*	hog peanut	FAC
ANVI	*Adropogon virginicus*	Broom sedge	FAC-
ANCA	*Anisostichus capreolata*	cross vine	Upland
ARGI	*Arundinaria gigantea*	river cane	FACW

ARTE	*Arundinaria tecta*	switch cane	FACW
ARTR	*Arisaema triphyllum*	Jack-in-the-pulpit	FACW-
ASPE	*Asclepias perenius*	milkweed	OBL
ASPA	*Asimina parviflora*	Paw Paw	FACU
BESC	*Berchemia scandens*	rattan vine	FACW
BICA	*Bignonia capreolata*	cross vine	FAC
BOCY	*Boehmeria cylindrica*	bog hemp	FACW+
BRCI	*Brunnichia cirrhosa*	redvine	FACW
CACAM	*Callicarpa americana*	beauty-berry	FACU-
CAFL	*Calycanthus floridus*	spicebush	FACU+
CARA	*Campsis radicans*	trumpet creeper	FAC
CACH	*Carex cherokeensis*	Cherokee sedge	FACW
CATA	*Chaerophyllum tainturieri*	Hairfruit chervil	FAC
CACA	*Carpinus caroliniana*	ironwood	FAC
CAAQ	*Carya aquatica*	bitter pecan	OBL
CAGL	*Carya glabra*	pignut hickory	FACU
CAIL	*Carya illinoinensis*	pecan	FACU
CATO	*Carya tomentosa*	mockernut hickory	Upland
CEOC	*Cephalanthus occidentalis*	buttonbush	OBL
CECA	*Cercis canadensis*	redbud	FACU
CELA	*Celtis laevigata*	sugarberry	FACW
COCA	*Cocculus carolina*	Caroline snailseed	FAC
COCO	*Commelina communis*	dayflower	FAC
COAM	*Cornus amomum*	swamp dogwood	FACW+
COFL	*Cornus florida*	flowering dogwood	FACU
COST	*Cornus foemina (stricta?)*	stiff dogwood	FACW-
CRSP	*Crataegus spathulata*	hawthorne	FAC
DEBA	*Decumaria barbara*	climbing hydrangea	FACW
DEIL	*Desmanthus illinoensis*	Illinois bundleflower	FAC
DIVI	*Diospyros virginiana*	persimmon	FAC
ECCR	*Echinochloa crus-galli*	American barnyard grass	FACW
ELUM	*Elaeagnus umbellata*	silverberry	FACU
ELCA	*Elephantopus carolinianus*	elephant's-foot	FAC
FIAU	*Fimbristylis autumnalis*	beak rush	OBL
FOAC	*Forestiera acuminata*	swamp privet	OBL
FRVI	*Fragaria virginiana*	wild strawberry	FAC-

FRAM	*Fraxinus americana*	white ash	FACU
FRPE	*Fraxinus pennsylvanica*	green ash	FACW
GECA	*Geum canadense*	white avens	FAC
GLTR	*Gleditsia triacanthos*	honey locust	FAC-
HACA	*Halesia carolina*	Carolina silverbell	FACU+
HIMI	*Hibiscus laevis (militaris)*	rose mallow	OBL
ILDE	*Ilex decidua*	deciduous holly	FACW-
IMCA	*Impatiens capensis*	jewel-weed	FACW
IVAN	*Iva annua*	Sump weed	FAC
JUNI	*Juglans nigra*	black walnut	FACU
JURE	*Juncus repens*	lesser creeping rush	OBL
JUTE	*Juncus tenuous*	path rush	FAC
LELE	*Leersia lenticularis*	catchfly cutgrass	OBL
LISI	*Ligustrum sinense*	privet	FAC
LIST	*Liquidambar styraciflua*	sweetgum	FAC+
LITU	*Liriodendron tulipifera*	yellow poplar	FAC
LOJA	*Lonicera japonica*	Japanese honeysuckle	FAC-
LUPA	*Ludwigia papilloides*	floating primrose-willow	OBL
MIVI	*Microstegium virmineum*	Microstegium	NL
MORU	*Morus rubra*	red mulberry	FAC
NYSY	*Nyssa sylvatica*	blackgum	FAC
OPHI	*Oplismenus hirtellus*	basket grass	FACU+
OSVI	*Ostrya virginiana*	hop hornbeam	FACU-
PAQU	*Parthenocissus quinquefolia*	Virginia creeper	FAC
PHAU	*Phyllostachys aurea*	Chinese bamboo	
PIPU	*Pilea pumila*	clearweed	FACW+
PITA	*Pinus taeda*	loblolly pine	FAC
PLAQ	*Planera aquatica*	water elm	OBL
PLOC	*Platanus occidentalis*	sycamore	FACW-
POAC	*Polystichum acrostichoides*	Christmas fern	FAC
PODE	*Populus deltoides*	cottonwood	FAC+
POHY	*Polygonum hydropiperoides*	swamp smartweed	OBL
POPU	*Polygonum punctatum*	knotweed	FACW+
POPE	*Polygonum pennsylvanica*	Pennsylvania Smartweed	FACW

PRSE	*Prunus serotina*	black cherry	FACU
PULO	*Pueraria lobata*	kudzu	Upland
QULY	*Quercus lyrata*	overcup oak	OBL
QUNI	*Quercus nigra*	water oak	FAC
QUNU	*Quercus nuttallii*	Nuttall oak	OBL
QUPA	*Quercus pagoda*	cherrybark oak	FAC
QUPH	*Quercus phellos*	willow oak	FACW-
QURU	*Quercus rubra*	red oak	FACU
RUAR	*Rubus argutus*	blackberry	FAC-
RUCR	*Rumex crispus*	Curly dock	FAC
SACE	*Saururus cernuus*	lizard's tail	OBL
SANI	*Salix nigra*	black willow	OBL
SACA	*Sambucus canadensis*	elderberry	FACW-
SEEX	*Sesbania exaltata*	bigpod sesbania	FACW
SMLA	*Smilax laurifolia*	green briar	FACW+
SMRO	*Smilax rotundifolia*	green briar	FAC
SOAL	*Solidago altisima*	Goldenrod	FACU
SOHA	*Sorghum halpense*	Johnson grass	FACU
TADI	*Taxodium distichum*	Cypress	OBL
TORA	*Toxicodendron radicans*	poison ivy	FAC
TRDE	*Treclospermum deforma*	climbing star-jasmine	FACW
TOVI	*Tovara virginiana*	jumpseed	FAC
ULAL	*Ulmus alata*	winged elm	FACU+
ULAM	*Ulmus americana*	American elm	FACW
UNLA	*Chasmanthium latifolium*	Spikegrass	FACU
VAST	*Vaccinium stamineum*	huckleberry	FACU
VEHA	*Verbena hastata*	swamp verbena	FAC
VIFL	*Viola floridana*	common blue violet	FACW-
VICI	*Vitus cinerea*	graybark grape	FAC+
VIRO	*Vitus rotundifolia*	muscadine	FAC

4.4.3 **Invasive species**

The promotion of native vegetation, often requires control of invasive vegetative species. A list of invasive species that would be monitored for at the backwater sites that could trigger adaptive management actions will be developed and included in the monitoring and adaptive management plan during PED.

Section 5
Monitoring Reports

5.1 BASELINE MONITORING REPORT (FIRST MONITORING REPORT)

A “baseline” monitoring report will be prepared upon completion of Final Construction Requirements 1.B. and upon any re-plantings associated with construction. Information provided will typically include the following:

- A detailed discussion of all mitigation activities completed.
- A plan view drawing of the mitigation site showing the approximate boundaries of the restored marsh, significant interspersion features established within the marsh features (as applicable), proposed monitoring transect locations, proposed sampling plot locations, photo station locations and water level survey locations.
- Initial and final construction surveys of all project features (including but not limited to the fill area, fish dips, weirs, culverts, etc.) and an analysis of the survey data will be provided addressing attainment of topographic success criteria. If a project is immediately adjacent to existing marsh habitat, the topographic survey will include spot elevations collected within the existing marsh habitat near the restored marsh.
- Photographs documenting conditions in the project area will be taken at the time of monitoring. Photos will be taken at permanent photo stations within the restored marsh. At least two photos will be taken at each station with the view of each photo always oriented in the same general direction from one monitoring event to the next. The number of photo stations required and the locations of these stations will vary depending on the mitigation site. The USACE will make this determination in coordination with the Interagency Team and will specify the requirements in the Mitigation Monitoring Plan. At a minimum, 4 photo stations will be established within each marsh cell.
- For planted marsh only -- A detailed inventory of all species planted, including the number of each species planted, the stock size planted, and where the species were planted will be documented. For mitigation sites that include more than one planted marsh cell/feature, provide a breakdown itemization indicating the number of each species planted in each feature and correlate this itemization to the marsh features depicted on the plan view drawing of the mitigation site.
- As part of the as-built/final construction survey, water level surveys will be taken inside and outside the marsh creation site at predetermined locations identified in coordination with the IET and NFS. Each interior water level elevation should have a corresponding exterior water level elevation taken consecutively and within close proximity. If there appears to be disparity in water levels within the marsh creation site, additional shots may be required. The baseline monitoring report will provide the surveyed water level data and will compare it to mean high and mean low water elevation data collected from a tidal elevation recording station in the general vicinity of the mitigation site. The report will further address estimated mean high and mean low water elevations at the mitigation site based on field indicators.

- Various qualitative observations will be made in the mitigation site to help assess the status and success of mitigation and maintenance activities. These observations will include: general estimate of the average percent cover by native plant species; general estimates of the average percent cover by invasive and nuisance plant species; general observations concerning colonization of the mitigation site by volunteer native plant species; general condition of native vegetation; trends in the composition of the plant community; wildlife utilization as observed during monitoring (including fish species and other aquatic organisms); the condition of interspersion features (tidal channels, trenasses, depressions, etc.) constructed within the marsh features, noting any excessive scouring and/or siltation occurring within such features; the natural formation of interspersion features within restored marshes; observations regarding general surface water flow characteristics within marsh interspersion features; the general condition of "gaps", "fish dips", or similar features constructed in permanent dikes; if present, the general condition of any armoring installed on permanent dikes. General observations made during the course of monitoring will also address potential problem zones and other factors deemed pertinent to the success of the mitigation project.
- A summary assessment of all data and observations along with recommendations as to actions necessary to help meet mitigation and management/maintenance goals and mitigation success criteria.
- A brief description of anticipated maintenance/management work to be conducted during the period from the current monitoring report to the next monitoring report.

5.2 ADDITIONAL MONITORING REPORTS

All monitoring reports generated after the Baseline Monitoring Report will be called either Initial, Intermediate or Long-Term Monitoring Reports and shall include the year in which the monitoring occurred (i.e. Monitoring Report 2019). All Monitoring Reports shall provide the following information unless otherwise noted:

- All items listed for the Baseline Monitoring Report with the exception of: (a) the topographic surveys, although additional topographic surveys are required for specific monitoring reports (see below); and (b) the inventory of species and location map for all planted species.
- Quantitative data for all plants in each stratum. Data will be collected from permanent sampling quadrats established at approximately equal intervals along permanent monitoring transects established within each marsh feature. Each sampling quadrat will be approximately 1 meter X 1 meter in size (although the dimensions of each quadrat may be increased, if necessary, to provide better data in planted marsh features). The number of monitoring transects and number of sampling quadrats per transect will vary depending on size of the mitigation site and will be determined by the IET during the final design phase of the project. The resulting requirements, including quadrat dimensions, will be specified in the Final Mitigation Monitoring Plan for the project. Data recorded from the sampling quadrats will include but not be limited to: average total percent cover by native plant species; average total percent cover by invasive plant species; average total percent cover by nuisance plant species; percent cover of each plant species; the wetland indicator

status of each species; and the average percent survival of each planted species (i.e. number of living planted species as a percentage of total number of plants installed), if discernable at the time of monitoring.

- One photograph shall be taken from the SE corner of each sampling plot to clearly capture the vegetation plot and must include a sign that indicates the plot number and sampling date.
- A brief description of maintenance and/or management work performed since the previous monitoring report along with a discussion of any other significant occurrences.
- Topographic surveys of each marsh restoration feature for initial and intermediate monitoring events (at approximately 2 years and 4 years following completion of final construction activities (General Construction 1.B.)). These surveys will cover the same components as described for the topographic survey conducted for the Baseline Monitoring Report. In addition to the surveys themselves, each of the two monitoring reports will include an analysis of the topographic data in regards to the attainment of applicable topographic success criteria. If the surveys indicate topographic success criteria have not been achieved and supplemental topographic alterations are necessary, then another topographic survey will be required following completion of the supplemental alterations. This determination will be made by USACE and the IET.

5.3 MONITORING REPORTS FOLLOWING PLANTING OR RE-PLANTING ACTIVITIES

Planting or re-planting of certain areas within restored marsh habitats may be necessary to ensure attainment of applicable native vegetation success criteria. Any monitoring report submitted following completion of a planting event must include an inventory of the number of each species planted, the stock size used, and the locations for each species planted. It must also include a depiction of the areas re-planted or those planted, as applicable, cross-referenced to a listing of the species and number of each species planted in each area. The perimeter of re-planted area should be documented with GPS coordinates. If single rows are replanted, then GPS coordinates should be taken at the end of the transect.

Section 6

Mitigation Monitoring Schedule and Responsibilities

Stream restoration is an evolving field and the urban stream environment presents the possibility for rapid, unpredicted changes in conditions that would affect the success of the project. It is expected that this site will be dynamic and evolve. To verify that project objectives are met, it will be necessary to monitor the restored stream backwater area following a multiple faceted cost-shared, post- construction monitoring plan. To evaluate the success of the stream restoration measures, collaborative monitoring efforts and information sharing would occur between the team, the non- Federal sponsor, and other organizations involved in assessing the health of the stream.

Monitoring is proposed pre-construction and at years 1,5,10, 20, 30 and 50. A five year cost shared monitoring period was selected because stream restoration is still a relatively new science, and it is uncertain how long it will take to gauge the ecological success of the project and to make necessary adjustments. Cost shared monitoring will be discontinued once ecological success is determined. It is expected that riparian plantings will be established within a five year period of time and that recolonization of fish and benthic organisms will occur within one year or less. All post- construction monitoring will be cost shared between USACE and the non-Federal sponsor.

Monitoring will typically take place in mid to late summer during the required years for monitoring, but may be delayed until later in the growing season due to site conditions or other unforeseen circumstances. Monitoring Reports will be submitted by December 31 of each year of monitoring to the USACE, NFS, and the IET. The various monitoring and reporting responsibilities addressed in this section are all subject to the provisions set forth in the previous sections.

The USACE and the NFS will be responsible for conducting the monitoring events and preparing the associated monitoring reports until such time that the following mitigation success criteria are achieved (criteria follow numbering system used in success criteria section):

1. General Construction
2. Topography
3. Hydrology
4. Native Vegetation (marsh and riparian/BLH)
5. Invasive & Nuisance Vegetation
6. Aquatic Fauna-Fish and Invertebrate

The USACE will be responsible for conducting Baseline and Initial Success Monitoring events and preparing the associated monitoring reports.

The NFS will be responsible for conducting the required monitoring events and preparing the associated monitoring reports for all other required years after the USACE has achieved the initial success criteria listed above. The responsibility for management, maintenance, and monitoring of the non-structural components of the mitigation project (i.e. vegetation) will typically be transferred to the NFS during the first quarter of the year immediately following submittal of the monitoring report that demonstrates attainment of the initial success criteria. Once monitoring responsibilities have been transferred to the NFS, the next monitoring event (Intermediate) should take place 2 growing seasons after Initial Success (Topography and Native Vegetation) has been met. After Intermediate Success Criteria (Topography and Native Vegetation) has been met, Long-Term Success Criteria monitoring will be conducted every 5 years throughout the remaining 50- year period of analysis.

In certain cases, it is possible that the mitigation features may be established along with other mitigation features, like swamp or bottomland hardwood habitats, at the same mitigation site. This scenario could require some adjustments to the typical monitoring schedule described above in order to develop a reasonable and efficient monitoring schedule that covers all the mitigation features. Such adjustments, if necessary, would be made at the time final mitigation plans are generated. This schedule must be in general accordance with the guidance provided above and will be prepared by the USACE and the IET.

If certain success criteria are not achieved, failure to attain these criteria would trigger the need for additional monitoring events not addressed in the preceding paragraphs. The USACE would be responsible for conducting such additional monitoring and preparing the associated monitoring reports in the following instances:

- If the initial vegetative cover success criteria are not achieved, a monitoring report will be required for each consecutive year until two sequential annual reports indicate that the applicable vegetative cover criteria have been satisfied. This requirement only exists if planting the marsh mitigation feature is required to meet the success criteria, the USACE would be responsible for the purchase and installation of the required plants.
- If initial topographic success criteria are not achieved, the IET would convene to determine whether corrective actions are necessary. If corrective actions are necessary additional surveys and a monitoring report will be required to indicate whether applicable criteria have been satisfied. The USACE would also be responsible for performing the necessary corrective actions.
- If initial invasive and nuisance species criteria are not achieved a monitoring report will be required for each consecutive year until two sequential annual reports indicate that the applicable criteria have been satisfied. The USACE would be responsible for the irradiation activities needed to attain the success criteria.
- If initial aquatic fish and invertebrate species criteria are not achieved a monitoring report will be required for each consecutive year until two sequential annual reports indicate that the applicable criteria have been satisfied. The USACE would be responsible for the irradiation activities needed to attain the success criteria.

There could also be cases where failure to attain certain success criteria would trigger the need for additional monitoring events for which the NFS would be responsible:

- If the native vegetation intermediate success criteria are not achieved, a monitoring report will be required for each consecutive year until two sequential annual reports indicate that the success criteria have been satisfied. The Sponsor would also be responsible for the purchase and installation of supplemental plants needed to attain the success criteria.
- If the topographic intermediate success criteria (are not achieved, the IET would convene to determine whether corrective actions are necessary. If corrective actions are necessary, additional surveys and a monitoring report will be required to indicate whether applicable criteria have been satisfied. The NFS would also be responsible for performing the necessary corrective actions if the IET determines such corrective actions are necessary.
- If the intermediate and long term aquatic fish and invertebrate species criteria are not achieved a monitoring report will be required for each consecutive year until two sequential annual reports indicate that the applicable criteria have been satisfied. The NFS would be responsible for the irradiation activities needed to attain the success criteria.
- If the native vegetation long term success criteria are not achieved, the IET would convene to discuss whether corrective actions would be necessary. If corrective actions are necessary, a monitoring report will be required for each consecutive year following completion of the corrective actions until two sequential annual reports indicate that the native vegetative cover criteria have been attained. The NFS would be responsible for performing the corrective actions, conducting the additional monitoring events, and preparing the associated monitoring reports.
- If the intermediate and long term invasive and nuisance species criteria are not achieved a monitoring report will be required for each consecutive year until two sequential annual reports indicate that the applicable criteria have been satisfied. The NFS would be responsible for the irradiation activities needed to attain the success criteria.

Once monitoring responsibilities have been transferred to the NFS, the NFS will retain the ability to modify the monitoring plan and the monitoring schedule should this become necessary due to unforeseen events or to improve the information provided through monitoring. Fifteen years following achievement of Long Term Success Criteria, the number of monitoring transects and/or quadrats that must be sampled during monitoring events may be reduced substantially if it is clear that mitigation success is proceeding as anticipated. Any significant modifications to the monitoring plan or the monitoring schedule must first be approved by the USACE and the IET.

Section 7
Adaptive Management

Adaptive Management prescribes a process wherein management actions can be changed in response to monitored system response, as to maximize restoration efficacy or achieve a desired ecological state. For this project Adaptive Management will be used to ensure that the required AAHUs needed for compensatory mitigation are met. The basic steps include:

- Plan: Defining the desired goals and objectives, evaluating alternative actions, and selecting a preferred strategy with recognition of sources of uncertainty.
- Design: Identifying or designing a flexible management action to address the challenge.
- Implement: Implementing the selected action according to its design.
- Monitor: Monitoring the results or outcomes of the management action.
- Evaluate: Evaluating the system response in relation to specified goals and objectives.
- Adjust: Adjusting (adapting) the action if necessary to achieve the stated goals and objectives.

Figure I6:7-1. Adaptive Management Process

7.1 ADAPTIVE MANAGEMENT PLANNING

Adaptive management planning elements included: 1) development of a Conceptual Ecological Model (CEM), 2) identification of key project uncertainties and associated risks, 3) evaluation of the mitigation projects as a candidate for adaptive management and 4) the identification of potential adaptive management actions (contingency plan) to better ensure the mitigation projectmeets identified success criteria. The adaptive management plan is a living document and will be refined as necessary as new mitigation project information becomes available.

7.2 CONCEPTUAL ECOLOGICAL MODEL

A CEM was developed to identify the major stressors and drivers affecting the proposed mitigation project (see Table 1). The CEM does not attempt to explain all possible relationships of potential factors influencing the mitigation site; rather, the CEM presents only those relationships and factors deemed most relevant to obtaining the required acres/average annual habitat units (AAHUs). Furthermore, this CEM represents the current understanding of these factors and will be updated and modified, as necessary, as new information becomes available.

A Conceptual Ecological Model (CEM) was developed to identify the major stressors and drivers affecting the proposed project.

Table I6:7-1. Stream Conceptual Ecological Model (adapted from ERDC/EL Sr-20-6)

Alternatives/Issues/Drivers	Mile Branch and Backwater Habitat
Channel Stability-Cross Section	+
Hydrologic Alteration	+
Riparian Zone	+
Bank Stability	+
Fish Cover	+
Nutrient Enrichment	N/A
Pools	+
Canopy	+
Embeddedness (substrate)	+
Hydrology (water table; wet/dry days; soil inundation)	+
Topography (elevation)	+

Key to Cell Codes: - = Negative Impact/Decrease
+ = Positive Impact/Increase
+/- = Duration Dependent

7.3 SOURCES OF UNCERTAINTY AND ASSOCIATED RISKS

A fundamental tenet underlying adaptive management is decision making and achieving desired project outcomes in the face of uncertainties. There are many uncertainties associated with restoration of the coastal systems. The project delivery team identified the following uncertainties during the planning process.

- Climate change, such as relative sea level rise, drought conditions, and variability of tropicalstorm frequency, intensity, and timing
- Subsidence and water level trends at the mitigation sites
- Uncertainty Relative to Achieving Ecological Success:
    - Water, sediment, and nutrient requirements for Riparian/BLH and backwater shallow water habitat
    - Magnitude and duration of wet/dry cycles
    - Nutrients required for desired productivity
    - Growth curves based on hydroperiod and nutrient application
    - Tree litter production based on nutrient and water levels
    - Tree propagation in relation to management/regulation of hydroperiod

- Loss rate of vegetative plantings
- Long-Term Sustainability of Project Benefits

7.4 ADAPTIVE MANAGEMENT EVALUATION

The project site was evaluated and planned to develop a project with minimal risk and uncertainty. The items listed below will be incorporated into the mitigation project implementation plan and Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) plan to minimize project risks.

- Specified success criteria (i.e., mitigation targets)
- Detailed planting guidelines for BLH
- Invasive species control
- Supplementary plantings as necessary (contingency)
- Corrective actions to meet topographic and hydrologic success as required (contingency)

Adaptive Management Evaluation

Subsequently, as part of the adaptive management planning effort the mitigation project features were re-evaluated against the CEM and sources of uncertainty and risk were identified to determine if there was any need for additional actions and costs under the adaptive management plan to ensure that the project meets the required success criteria. Based on the uncertainties and risks associated with the project implementation the following contingency actions have been identified to be implemented if needed to ensure the required AAHUs are met.

Table I6:7-2. Adaptive Management Actions- Stream Backwater

Element	Expected Condition	Potential Issue	Potential Corrective Action
Landscape characteristics	Bathymetry appropriate for water bottoms and the sustainable growth of targeted riparian vegetation	Water that is deeper or shallower than ideal conditions Water spills out of backwater area during high flow events.	Modify water depth. Add perimeter features or pumps to control water levels.
Stream connectivity	Water exchange during Flow event.	Limited flow exchange or excessive flooding.	Resize culverts or move feature to control water during non-storm conditions.
Vegetation community composition	Healthy vegetative communities free of invasive species.	Invasive species dominance,	Invasive species control Vegetative plantings

The CEMVN would be responsible for the proposed mitigation construction and monitoring until the initial success criteria are met. Initial construction and monitoring would be funded in accordance with all applicable cost-share agreements with the NFS. The CEMVN would

monitor (on a cost-shared basis) the completed mitigation to determine whether additional construction, invasive/nuisance plant species control, and/or plantings are necessary to achieve initial mitigation success criteria. Once the CEMVN determines that the mitigation has met the initial success criteria, monitoring would be performed by the NFS as part of its OMRR&R obligations. If after meeting initial success criteria, the mitigation fails to meet its intermediate and/or long- term ecological success criteria, the CEMVN would consult with other agencies and the NFS to determine the appropriate management or remedial actions required to achieve ecological success. The CEMVN would retain the final decision on whether or not the project's required mitigation benefits are being achieved and whether or not remedial actions are required. If structural changes are deemed necessary to achieve ecological success, the CEMVN would implement appropriate adaptive management measures in accordance with the contingency plan and subject to cost-sharing requirements, availability of funding, and current budgetary and other guidance.