Mississippi Valley Division, Regional Planning and Environment Division South

St. Tammany Parish, Louisiana Feasibility Study

Appendix I – Compensatory Mitigation Plan

February 2024

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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. A second draft of the mitigation plan was released for concurrent public, agency, technical and policy review in July 2023.

Please note that Mile Branch Channel improvements were removed from the RP after mitigation plan development. All Riparian and stream impacts were associated with the Mile Branch Channel Improvements, which is not part of the Final RP. Because Mile Branch would not be implemented, riparian and stream impacts will not need compensatory mitigation; discussion of planning and analysis to compensate for riparian and stream impacts is included for information purposes only. The Recommended Mitigation Project is discussed in Section 15.

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.

Through engineering and design, the CEMVN has made a concerted effort to avoid and minimize environmental impacts to the maximum extent practicable. However, unavoidable impacts will occur to fresh/intermediate marsh, riparian BLH and pine savannah habitats including impacts to pine savannah habitat on the BBNWR. Throughout the development of the levee alignment, multiple meetings were held with the BBNWR to identify an alignment that would avoid and minimize impacts to the NWR. The team worked with the BBNWR to consider alternate alignments that would avoid the refuge to the extent that we could while still meeting the project purpose and then identifying ways to minimize the impacts to the refuge. Examples of ways to avoid and minimize impacts included consideration of alignment changes in the vicinity of Bayou Paquet Road, north of Bayou Paquet Road and south along Bayou Liberty. Although this change in the alignment would be more efficient, it was rejected due to the additional direct impacts on the BBNWR. To avoid impacts to the BBNWR and reduce the number of structures required along waterways, the Optimized TSP alignment was moved further east thereby removing 824 ft of direct alignment on the BBNWR and another 5,280 ft that ran along the border of the refuge.

In addition to these avoidance and minimization measures in determining the optimized alignment, implementation of best management practices (BMP) during construction also help to

minimize impacts. BMP to reduce runoff and siltation of waterways includes the use of silt curtains and control of drainage to divert away from waterways.

To reduce impacts to Gulf sturgeon critical habitat, a cutterhead dredge would be utilized to remove borrow material from the designated borrow area. This equipment is slower moving and has not been identified as equipment that would impact Gulf sturgeon. CEMVN would also adhere to the Protected Species Construction Conditions.

The recommended plan represents the alignment reflective of these efforts to avoid and minimize impacts to significant resources and the refuge. Best management practices such as installing silt curtains and temporary barriers would be employed during construction to reduce impacts from earth moving equipment and dredging to minimize to the extent practicable sedimentation and turbidity within the waterways.

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	441 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.

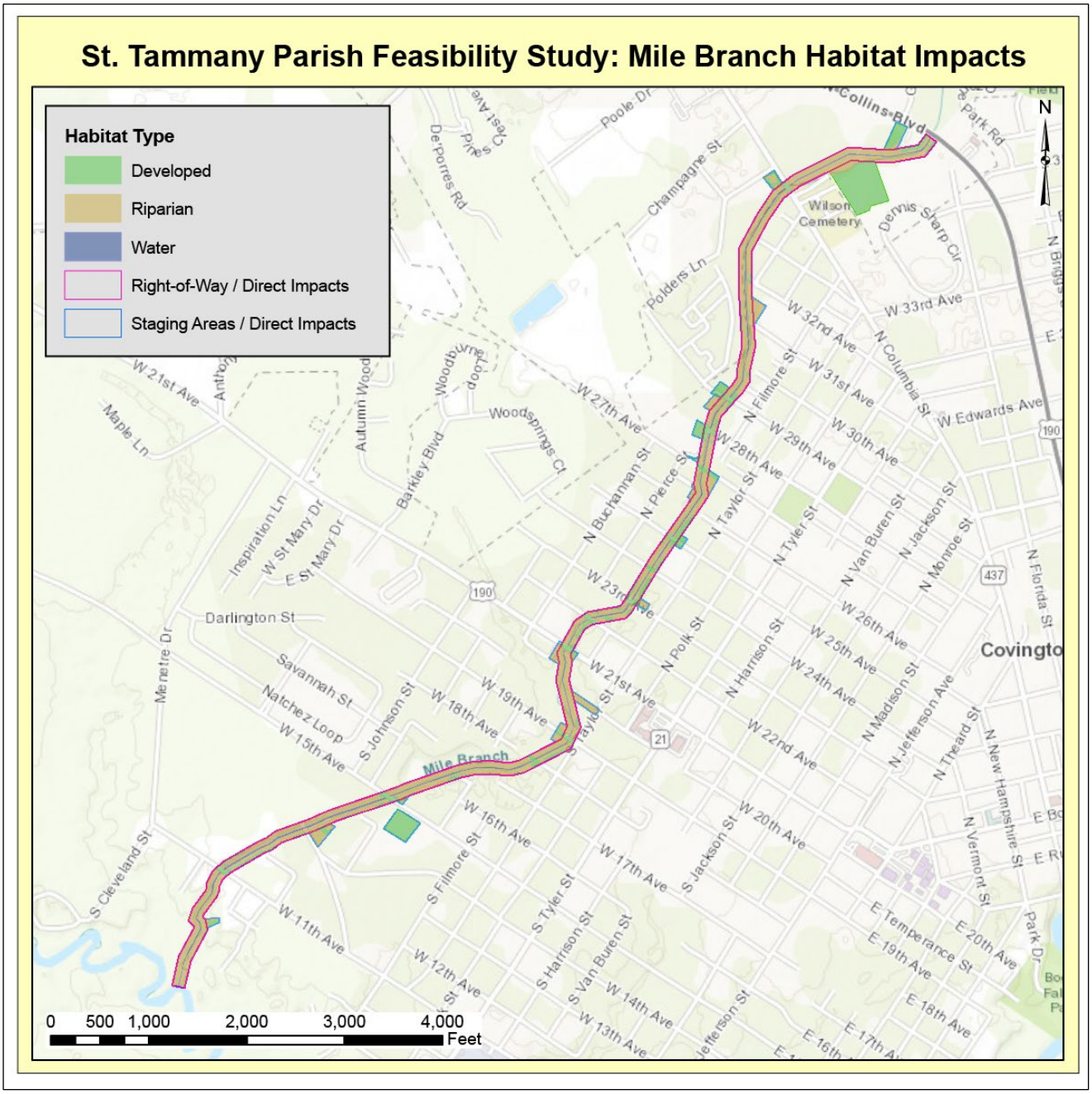

Figure I: 4-1. Habitat in the Mile Branch Project Area

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.

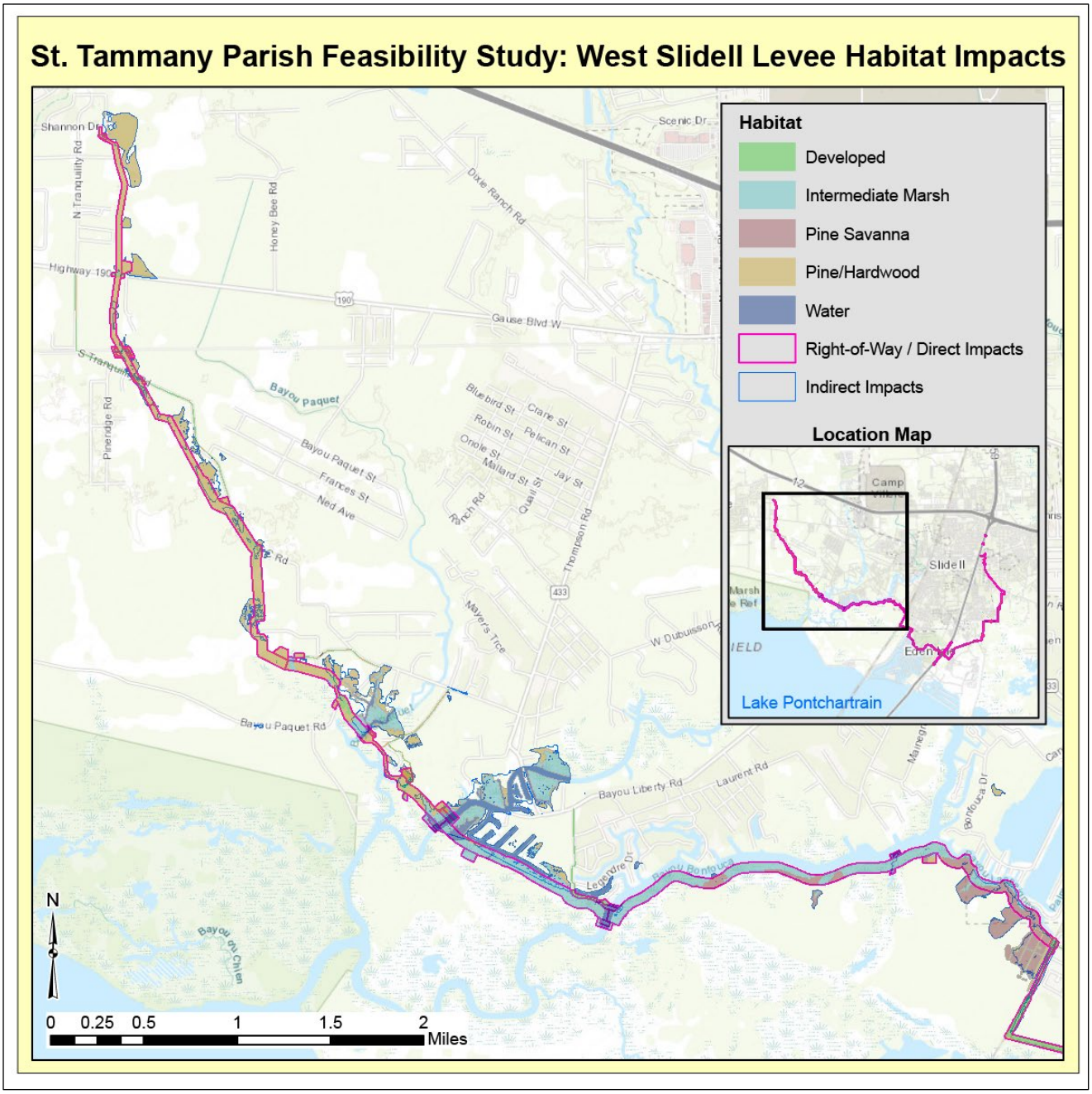

Figure I: 4-2. Habitat in the West and South Slidell Project Area (West Portion of the Alignment)

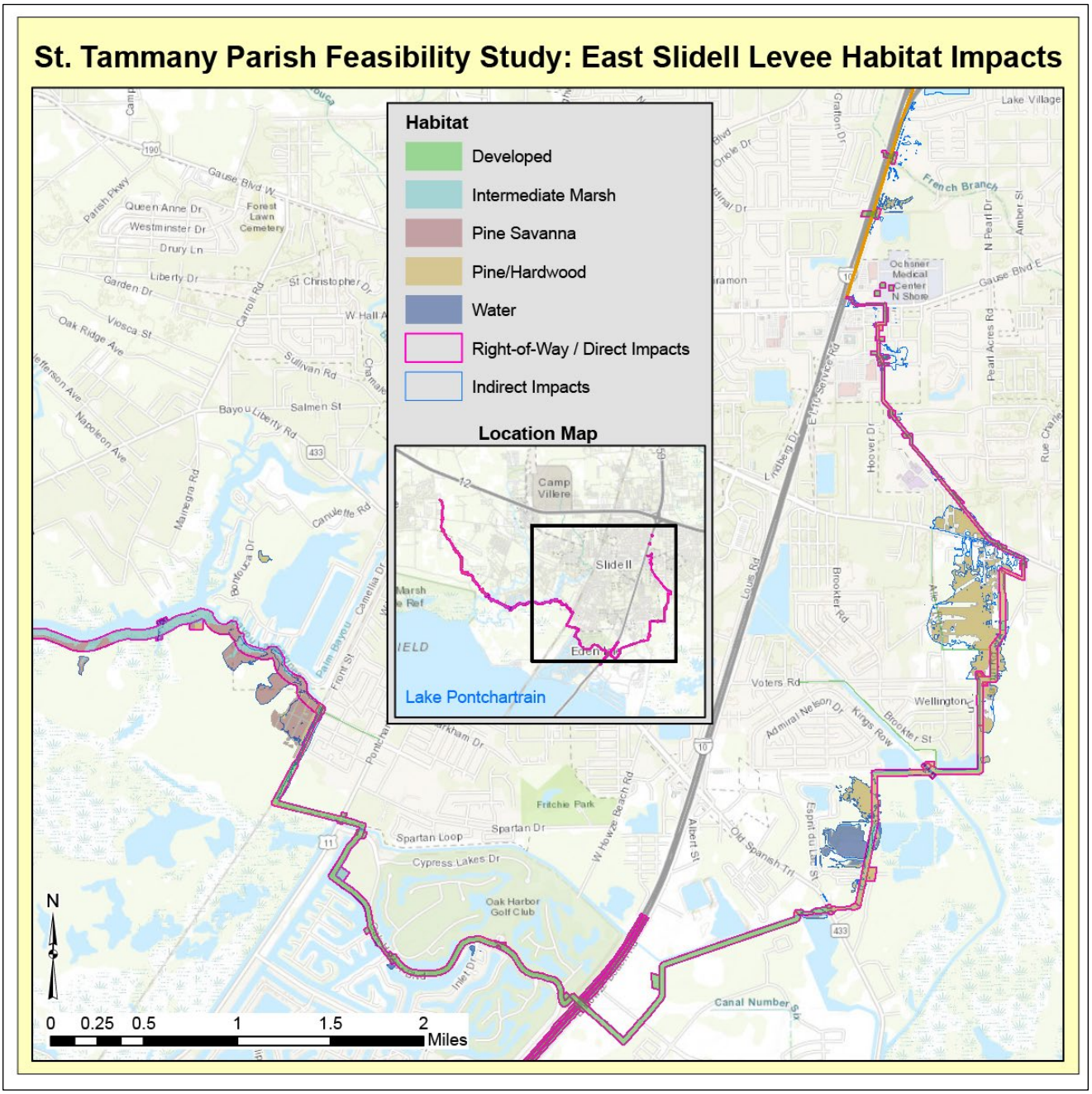

Figure I: 4-3. Habitat in the West and South Slidell Project Area (East Portion of the Alignment)

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 basin (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.

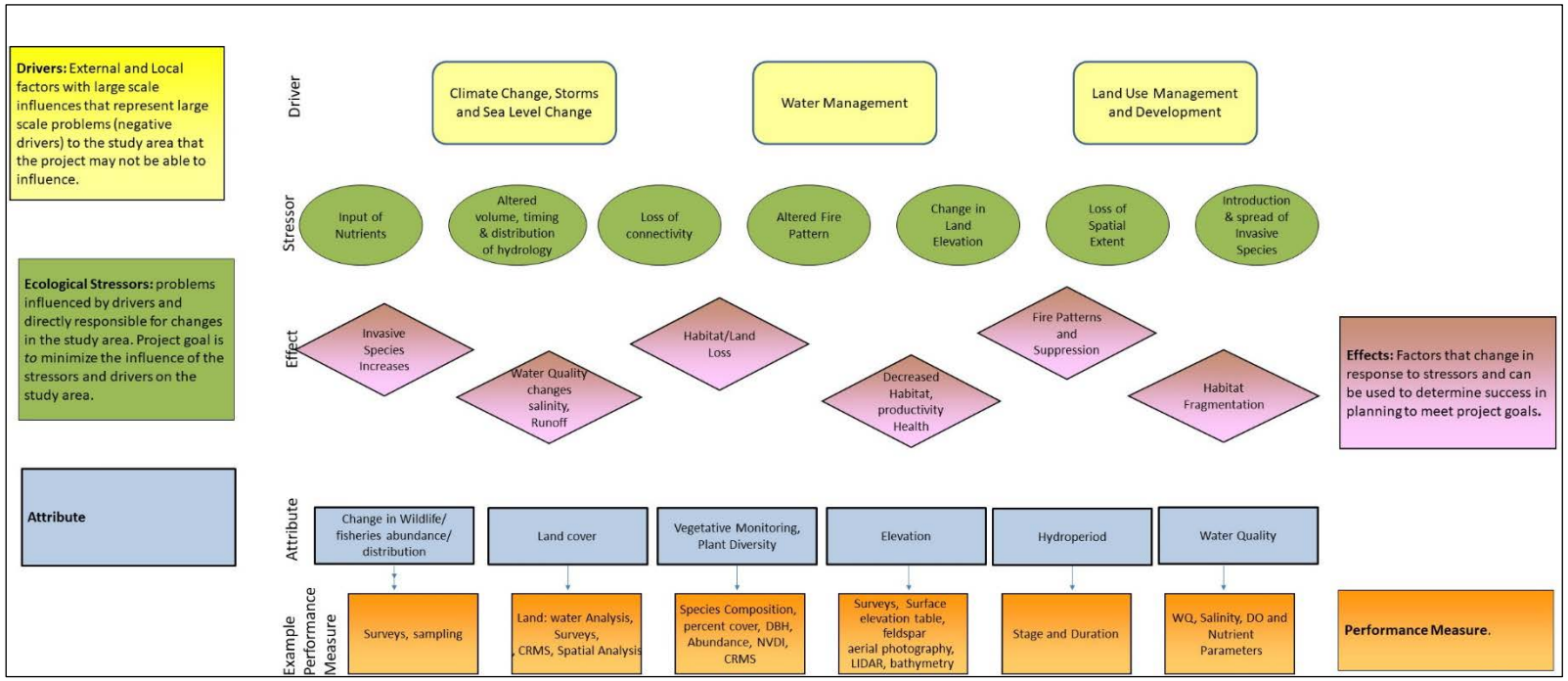

Figure I:5-1. Conceptual Model St. Tammany Parish Pine Savanna Habitat

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 was approved on 31 May 2023 prior to the FEIS publication. 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. 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 67 average annual habitat units (9.7 red-cockaded woodpecker AAHU; 57 pine warbler AAHU) of Pine Savanna habitat in the Lake Pontchartrain Basin.
- Compensate for the loss of 23 average annual habitat units of Riparian habitat in the Lake Pontchartrain Basin.
- 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 Basin.
- 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 areas					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, 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 Deltaic Plain were identified for marsh fresh and intermediate marsh and within the Basin for pine, bottom land hardwood, riparian and stream sites

To be considered for inclusion sites were required to:

- Be within Deltaic Plain for marsh
- Be within Basin 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.

- Sites with known real estate concerns were included in the potential sites list and noted.

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 10.1- 10.4.

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 Fountainebleau
- 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 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 48 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 48 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 - 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 48 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 48 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

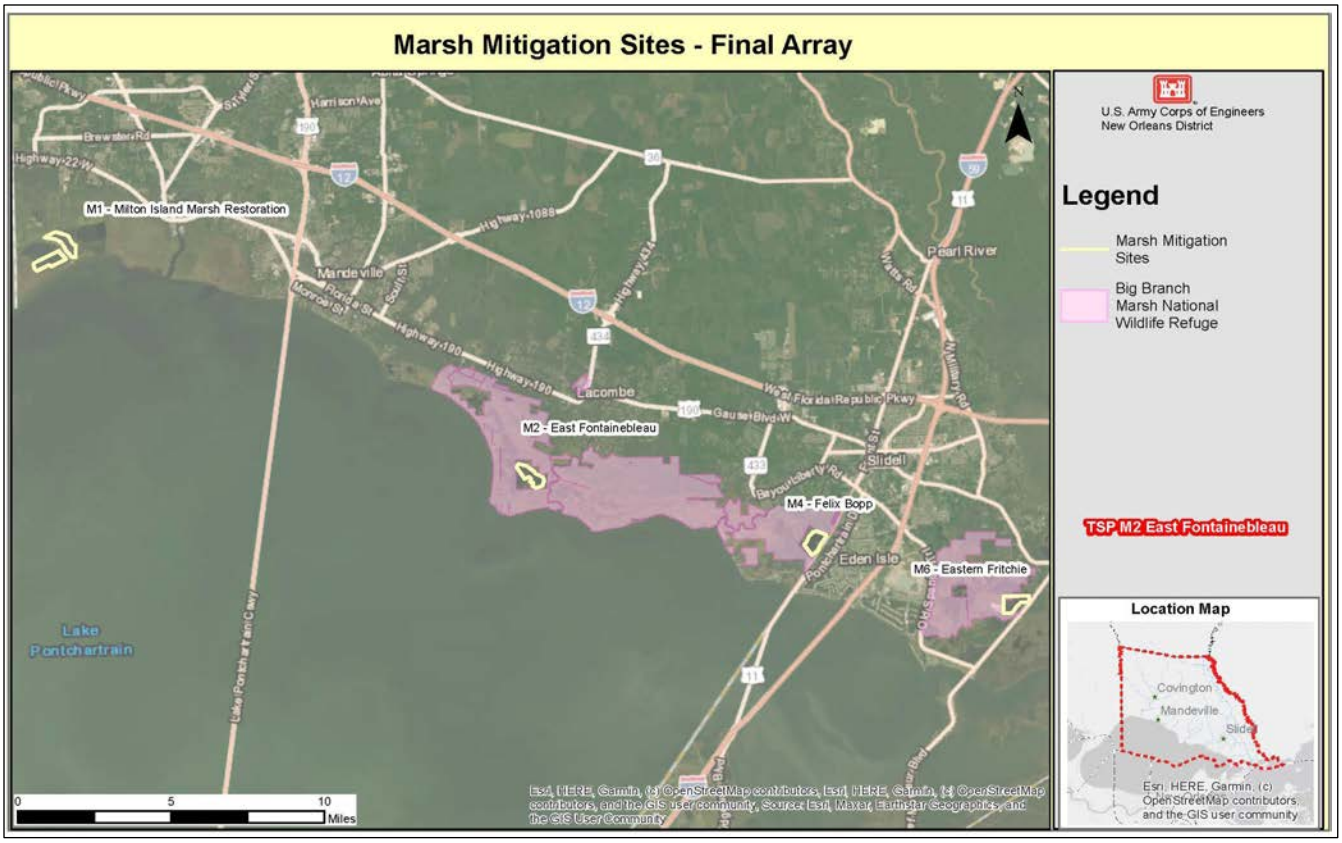

Figure I:11-1. Final Array of Marsh Constructed Marsh Mitigation Sites

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, 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

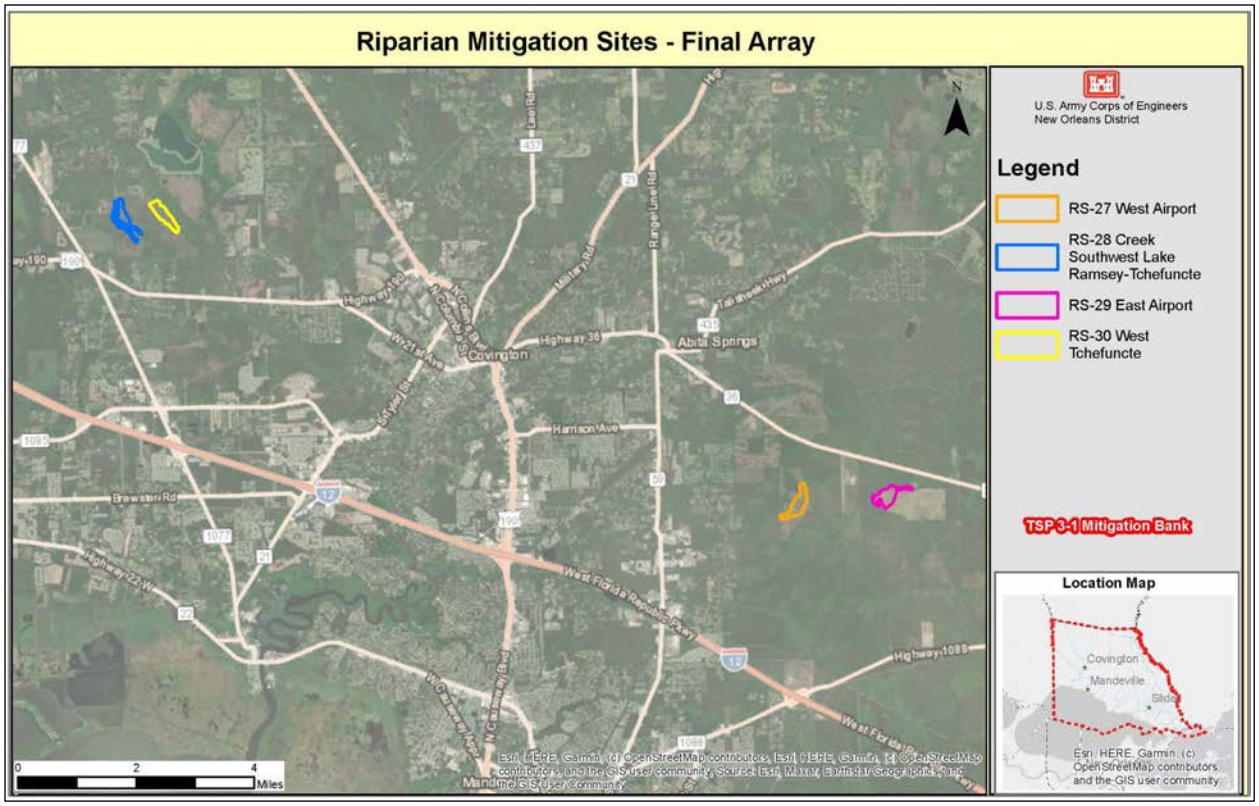

Figure I:11-2. Final Array of Riparian Constructed Marsh Mitigation Sites

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

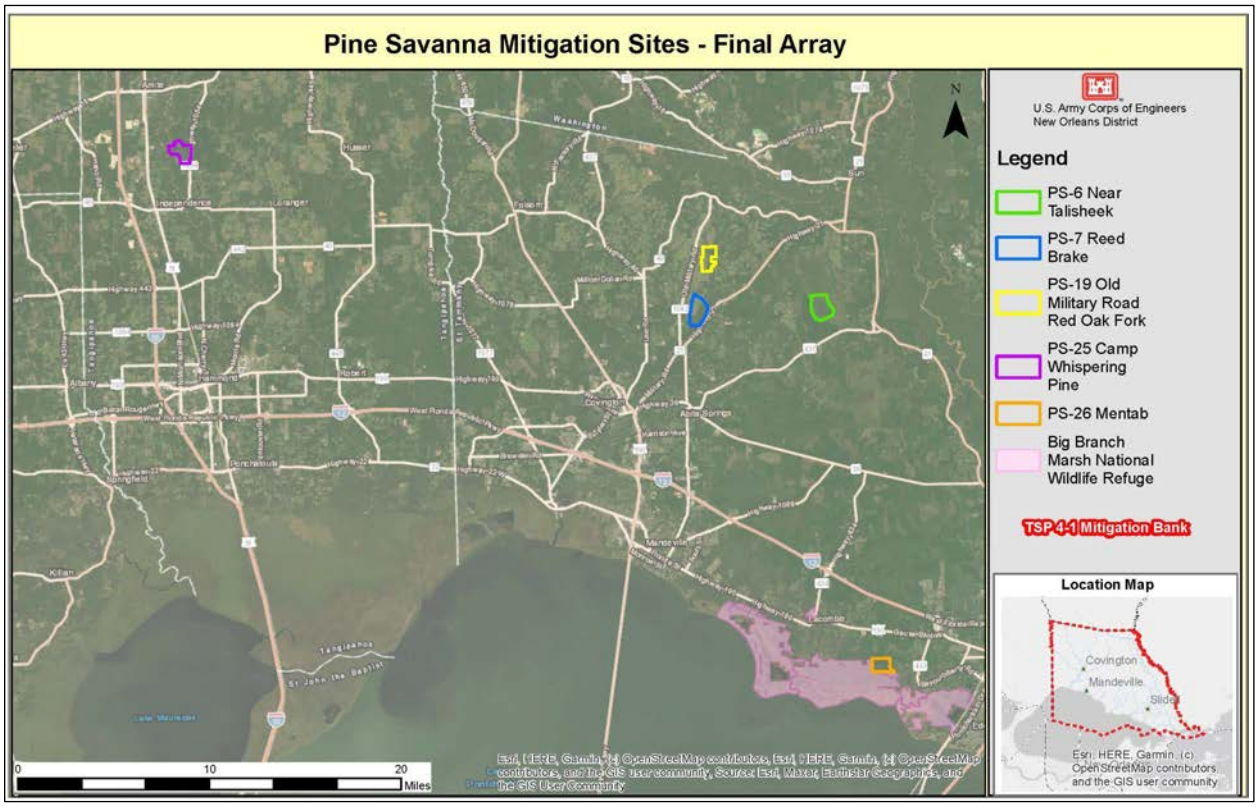

Figure I:11-3. Final Array of Pine Savanna Mitigation Sites

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.

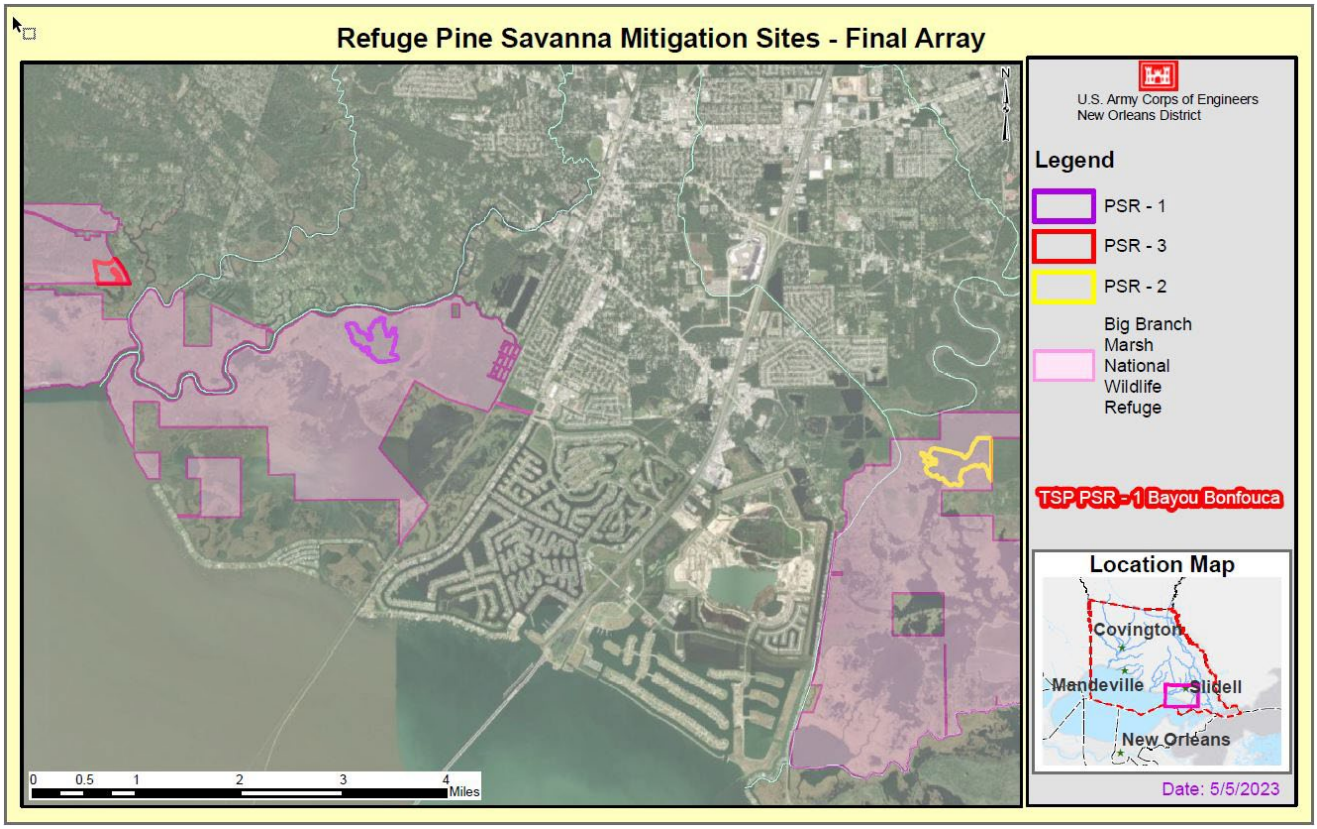

Figure I:11-4. Refuge Pine Savanna Mitigation Sites

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 of waterbottom habitat.

- 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.

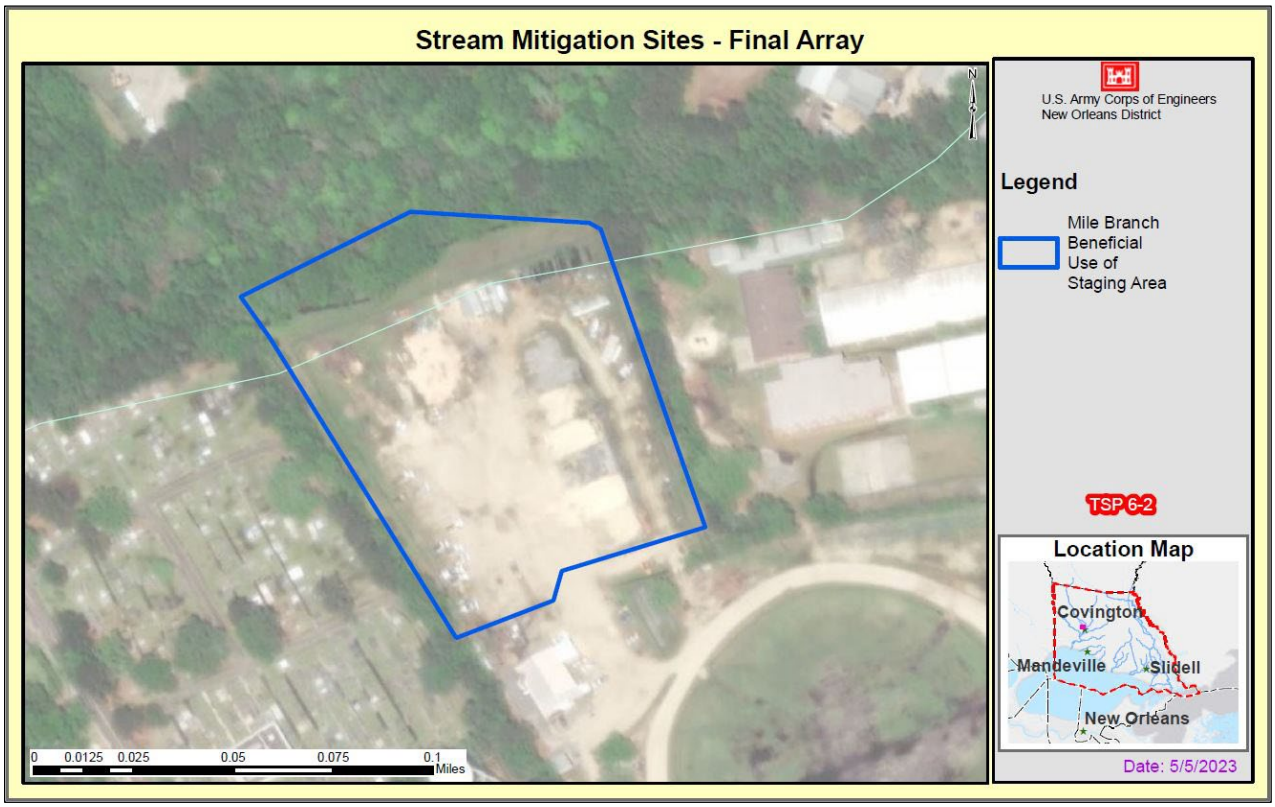

Figure I:11-5. Steam Water Bottom Mitigation Sites

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-Mitigation Bank 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

			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-Mitigation Bank 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
	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*
	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*

			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-Mitigation Bank 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
	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*
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	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

	Alternatives	Annual Cost	AAHU Needed	Total Cost	Plan Outputs
	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

	Alternatives	Annual Cost	AAHU Needed	Total Cost	Plan Outputs
	Alternative 2-14 - Combination of mitigation bank credits and MA 2-4 75% bank 25% constructed	$1,122,936	47.5	**$31,458,269.75**	47.5
	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

	Alternatives	Annual Cost	AAHU Needed	Total Cost	Plan Outputs
	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

	Alternatives	Annual Cost	AAHU Needed	Total Cost	Plan Outputs
	Alternative 3-11 - Combination of mitigation bank credits and MA 3-3 75% bank 25% constructed	$144,576	23.87	**$4,063,112.99**	23.87
	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%	$159,428	23.87	**$3,931,344.67**	23.87

	Alternatives	Annual Cost	AAHU Needed	Total Cost	Plan Outputs
	bank 50% constructed				
	Alternative 3-17 - Combination of mitigation bank credits and MA 3-5 75% bank 25% constructed	$159,659	23.87	**$3,937,802.99**	23.87
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	$564,197	66.79	**$12,929,621.34**	66.79

	Alternatives	Annual Cost	AAHU Needed	Total Cost	Plan Outputs
	and MA 4-2 50% bank 50% constructed				
	Alternative 4-9 -- Combination of mitigation bank credits and MA 4-2 75% bank 25% constructed	$596,920	66.79	**$12,528,779.53**	66.79
	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 -	$876,620	66.79	**$21,698,816.34**	66.79

	Alternatives	Annual Cost	AAHU Needed	Total Cost	Plan Outputs
	Combination of mitigation bank credits and MA 4-4 50% bank 50% constructed				
	Alternative 4-15 - Combination of mitigation bank credits and MA 4-4 75% bank 25% constructed	$909,785	66.79	**$21,301,880.78**	66.79
	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

	Alternatives	Annual Cost	AAHU Needed	Total Cost	Plan Outputs
	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% bank 25% constructed	$547,106	66.79	**$11,141,695.77**	66.79
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 con-	75% bank 25% constructed M1	$ 29,233,523	$ 363,163	$ 1,043,522	47.5	No

Name of Alternative	Mitigation Site Name	Types of Activities	First Cost	Interest During Construction	Average Annual Cost	AAHUs	Cost Effective
	structed mitigation						
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 constructed mitigation	75% bank 25% constructed M4	$ 31,458,270	$ 390,801	$ 1,122,936	47.5	No

Name of Alternative	Mitigation Site Name	Types of Activities	First Cost	Interest During Construction	Average Annual Cost	AAHUs	Cost Effective
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	25% bank 75% constructed RS-	$ 4,050,196	$ 50,315	$ 144,576	23.87	No

Name of Alternative	Mitigation Site Name	Types of Activities	First Cost	Interest During Construction	Average Annual Cost	AAHUs	Cost Effective
	credits and constructed mitigation	27					
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	50% bank 50% constructed RS-	$ 3,931,345	$ 48,838	$ 140,334	23.87	No

Name of Alter-native	Mitigation Site Name	Types of Activi-ties	First Cost	Interest During Construction	Average Annual Cost	AAHUs	Cost Effective
	credits and con-structed mitiga-tion	30					
3-17	Combination of mitigation bank credits and con-structed mitiga-tion	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 Mitiga-tion Bank**	**Purchase Miti-gation Bank**	**$ 11,687,041**	**$ 145,186**	**$ 417,181**	**66.79**	**Yes**
4-2	Old Whispering Pines	100% con-structed PS-25	$ 13,731,305	$ 170,582	$ 498,749	66.79	No
4-3	Near Talisheek	100% con-structed PS-6	$ 18,871,687	$ 234,440	$ 681,036	66.79	No
4-4	Reed Brake	100% con-structed PS-7	$ 22,492,687	$ 279,423	$ 810,292	66.79	No
4-5	Old Military Road Red Oak Fork	100% con-structed M6	$ 14,963,105	$ 185,884	$ 543,321	66.79	No

Name of Alternative	Mitigation Site Name	Types of Activities	First Cost	Interest During Construction	Average Annual Cost	AAHUs	Cost Effective
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 and constructed mitigation	75% bank 25% constructed PS-25	$ 16,662,107	$ 206,991	$ 596,920	66.79	No
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	25% bank 75% constructed PS-7	$ 23,473,528	$ 291,608	$ 843,456	66.79	No

Name of Alternative	Mitigation Site Name	Types of Activities	First Cost	Interest During Construction	Average Annual Cost	AAHUs	Cost Effective
	credits and constructed mitigation						
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	50% bank 50% constructed PS-	$ 14,796,005	$ 183,808	$ 531,855	66.79	No

Name of Alternative	Mitigation Site Name	Types of Activities	First Cost	Interest During Construction	Average Annual Cost	AAHUs	Cost Effective
	credits and constructed mitigation	26					
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 Construction	Average Annual Cost	AAHUs	Average Annual Cost Per Habitat Unit	Additional Output (AAHUs)	Additional Average Annual Cost	Incremental Cost (per AAHU)
No Action	-	-	$ -	$ -	$ -	-	$ -	-	$ -	$ -
2-3	East Fontainebleau	100% constructed 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 Savanna Mitigation 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.

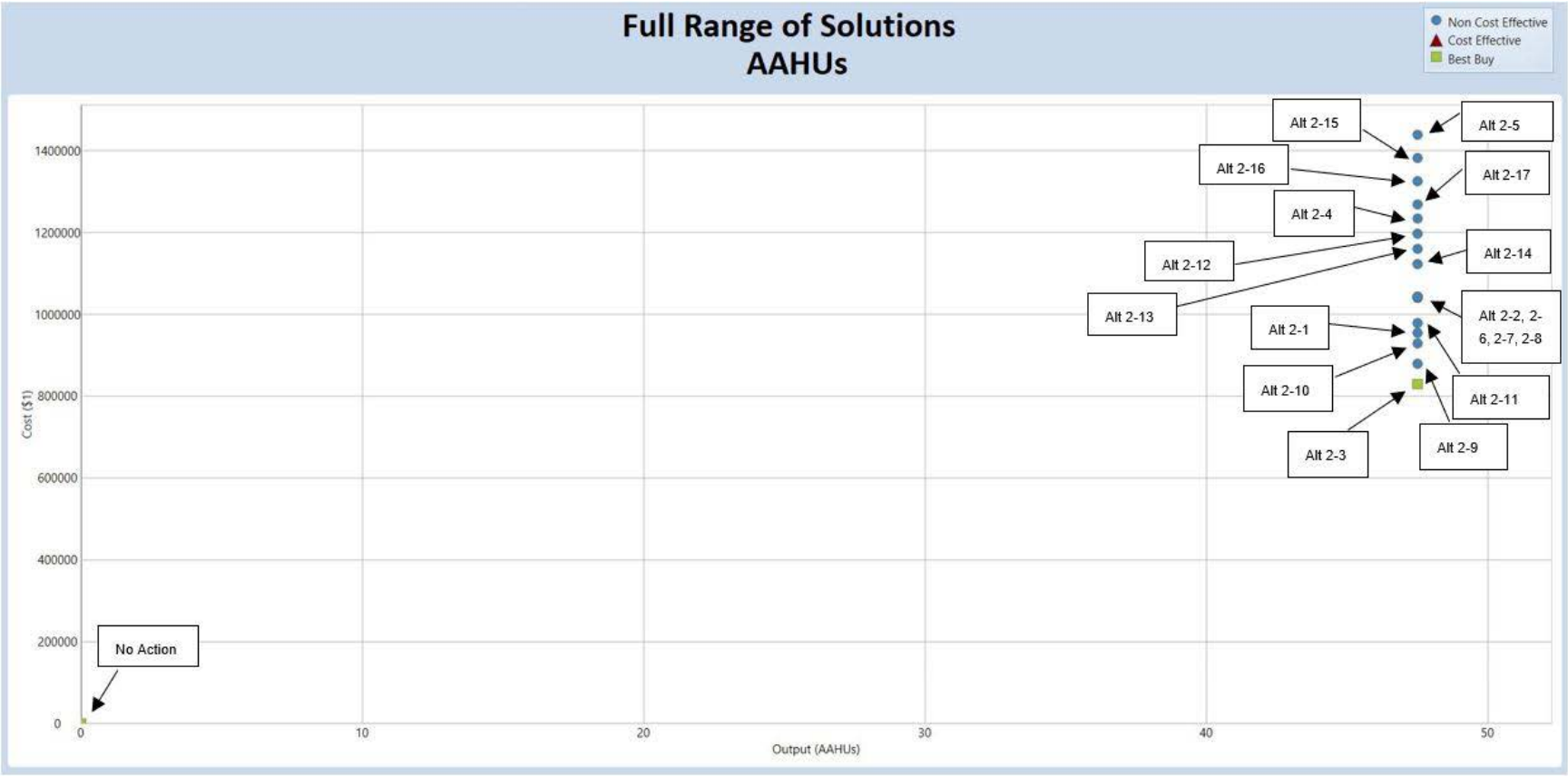

Figure I:14-1. Marsh Full Range of Solutions

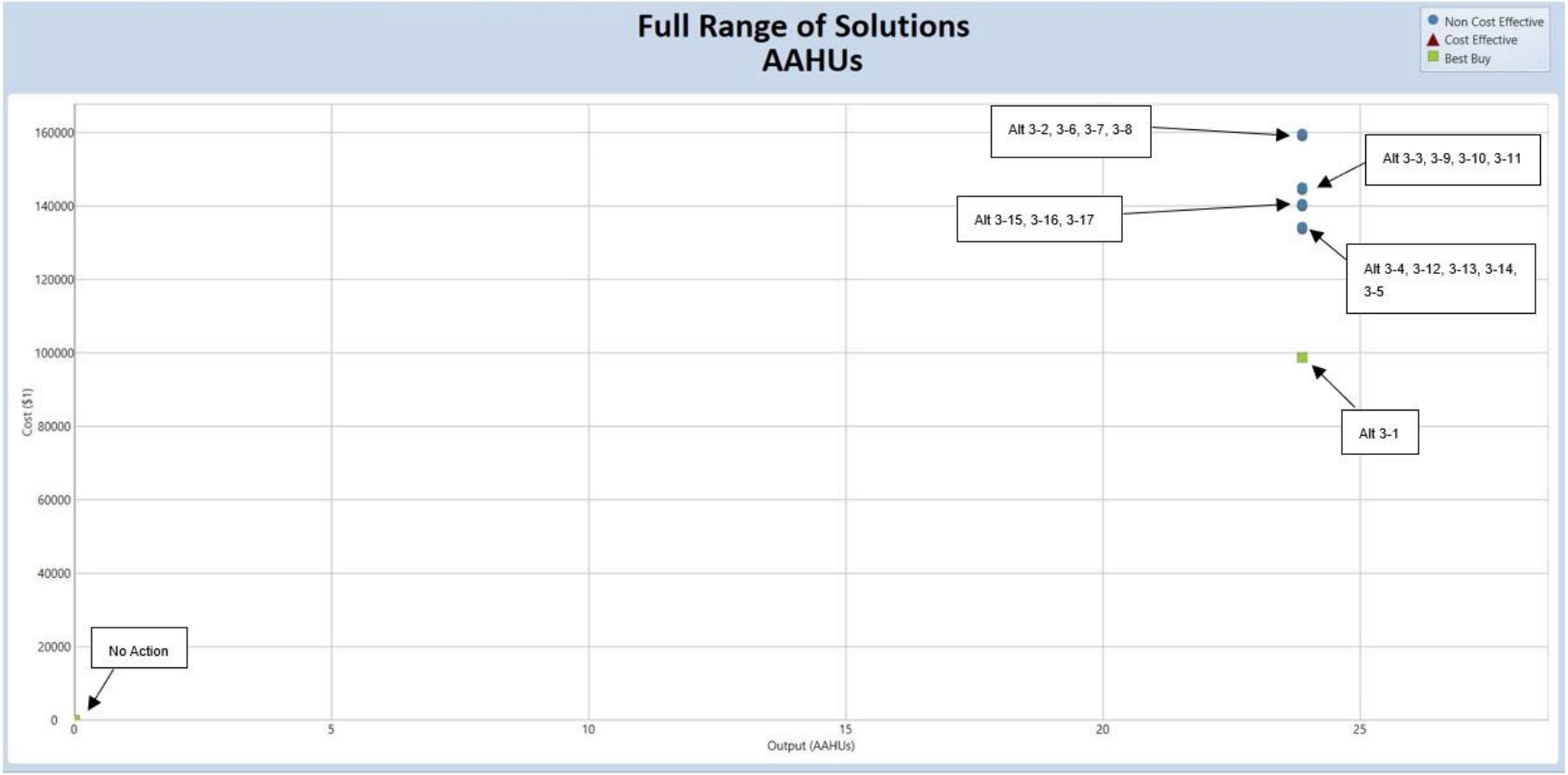

Figure I:14-2. Riparian Full Range of Solutions

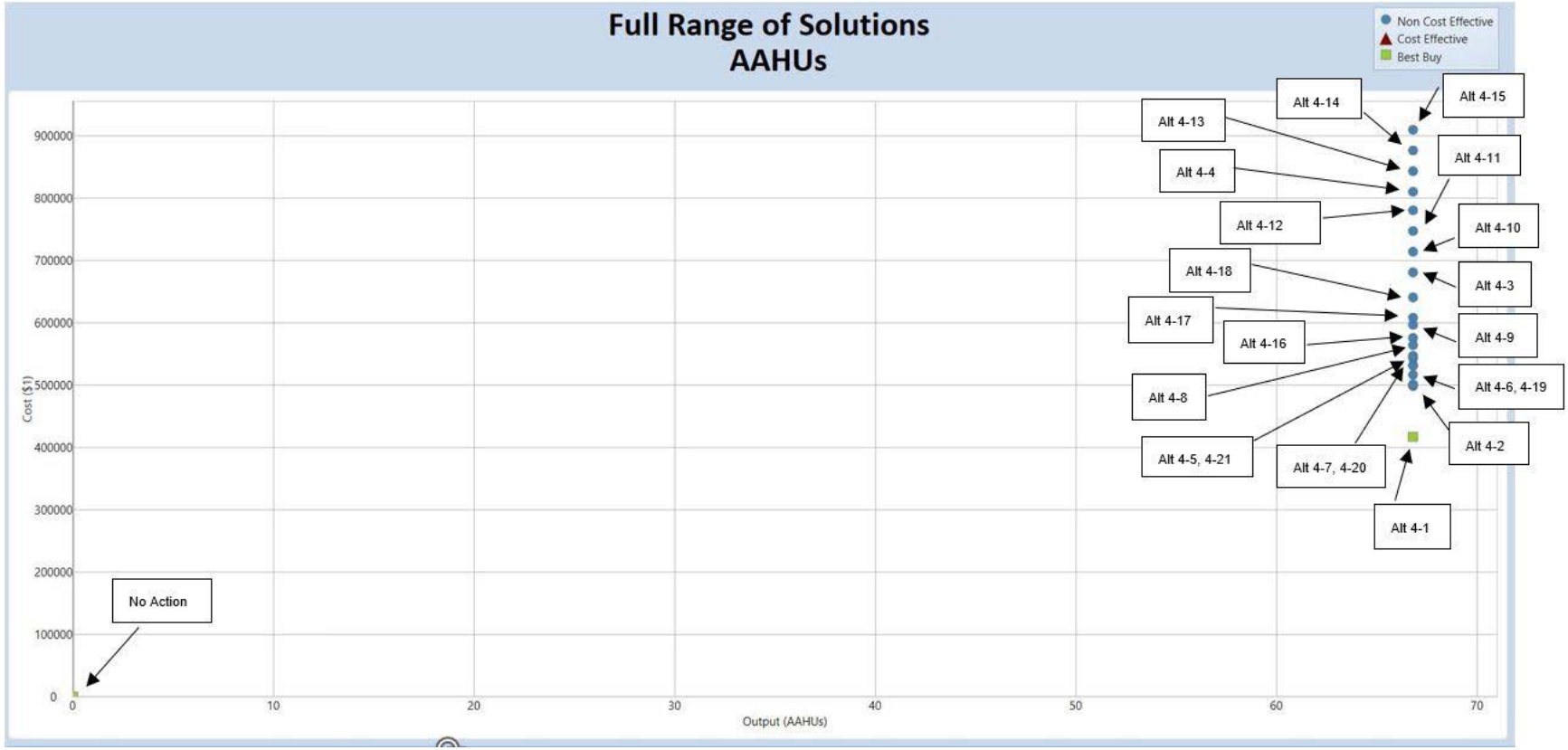

Figure I:14-3. Pine Savanna Full Range of Solutions

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

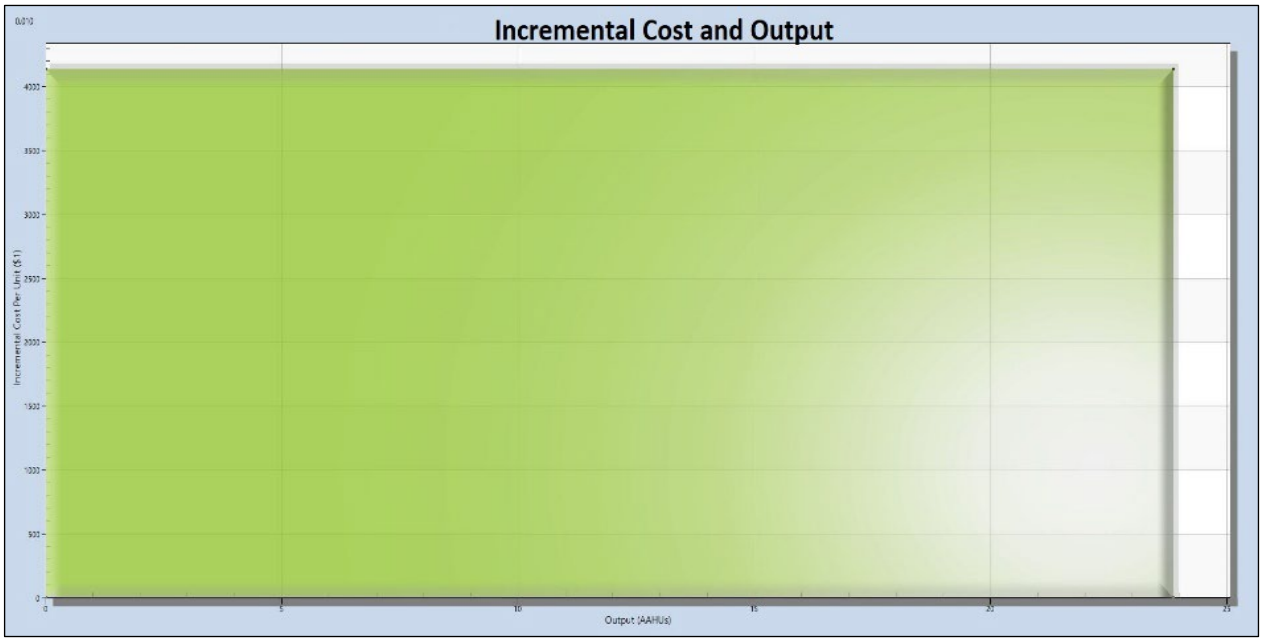

Figure I:14-5. Riparian- Best Buy Mitigation Bank

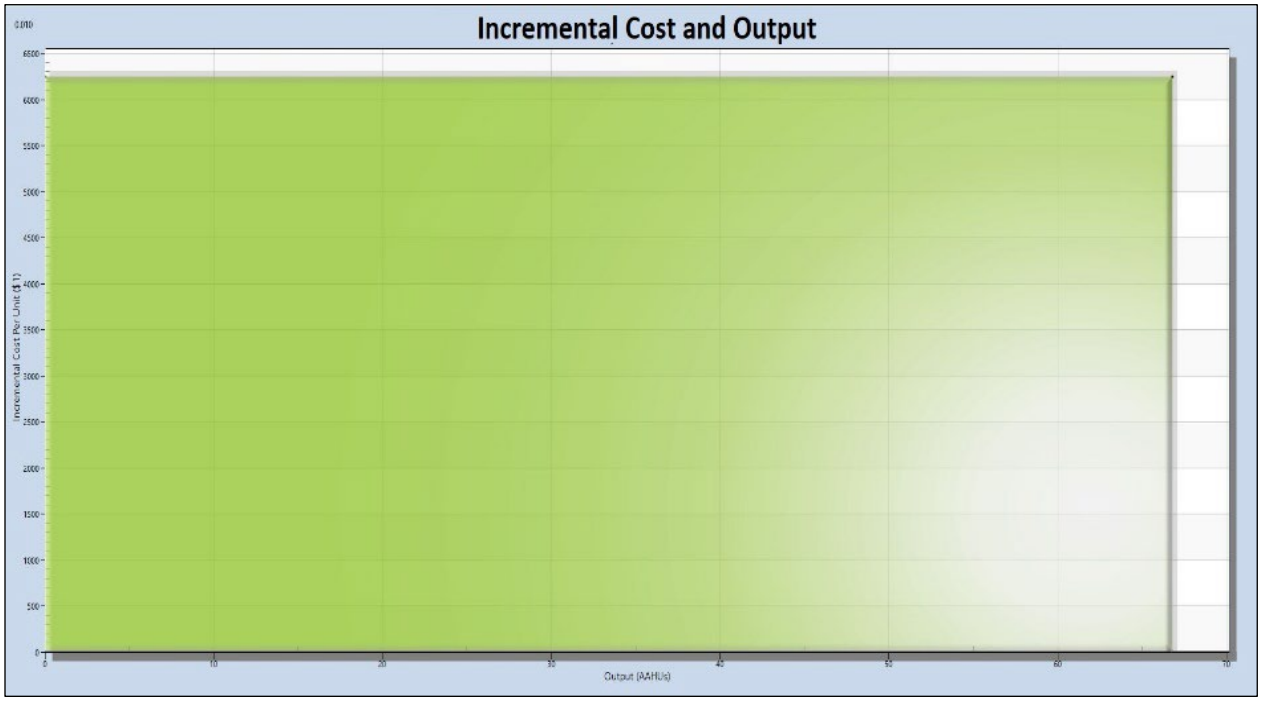

Figure I:14-6. Pine Savanna- Best Buy Mitigation Bank

SECTION 15

Recommended Compensatory Mitigation Plan

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

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

The Recommended Plan would be a combination of mitigation bank credit purchases and USACE constructed projects. Constructed projects are proposed for marsh and refuge pine savanna impacts and mitigation bank credits are proposed for non refuge pine savanna impacts.

Marsh - MA 2-3 Non refuge Fresh and Intermediate Marsh – Corps Constructed Project East Fontainebleau (Site M2), This alternative includes construction of a 220 acre 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 with dredged material to required elevation, 1 year after dewatering bringing down dikes, site should naturally vegetate, use external borrow if possible (Management Measure #3 and #10). There are 299 acres available. This site provides 48 AAHUS.

Pine Savanna - 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- PSR – 1 Refuge Pine Savanna-Corps Constructed Project- 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.

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

Table I:15-1. Mitigation Recommended Plan

Habitat Type	St Tammany Project Feature Impacts	Mitigation Site	AAHUs	Cost*
Non-Refuge Marsh	Levee and Floodwall System	M2 – East Fontainebleau	48	$25,566,938
Non-Refuge Pine Savanna	Levee and Floodwall System	Mitigation Bank	67	$11,687,041
Refuge Pine Savanna	Levee and Floodwall System	Pine Savanna BBNWR PSR-1	9	$2,719,533000
Total Mitigation Cost				**$39,973,512**

Purchase of mitigation bank credits for 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 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.

Timing of Implementation. In accordance with Section 906 of WRDA 1986, as amended, (33 U.S.C. 2283), for any water resources development project which requires mitigation for fish and wildlife losses, including the acquisition of lands or interests in lands to mitigate for fish and wildlife, such mitigation, including acquisition of the lands or interests in lands, shall be undertaken or acquired before the physical construction that causes the impacts for which mitigation is required. However, any physical construction required for the purpose of fish and wildlife mitigation may be undertaken prior to or concurrently with the physical construction of such project. For all water resources development projects which require mitigation for impacts to wetlands and for which the purchase of in-kind credits from mitigation banks is determined to be the appropriate form of mitigation, the Corps will purchase these credits concurrently with the physical construction that causes the impacts for which mitigation is required. However, where there are technical or cost-efficiencies or by request of the non-Federal sponsor, mitigation bank credits may be purchased prior to the physical construction that causes the impacts for which mitigation is required. Mitigation measures will be scheduled for accomplishment prior to or concurrently with other project features in the most efficient way.

Real Estate required for the Marsh Mitigation Project. The M2 marsh restoration site is planned for an area within the acquisition boundary of the BBNWR and consists of approximately 190 acres of mostly open water located west of Lake Road and north of Lake Pontchartrain in the Lacombe area of St. Tammany Parish. An estimated five (5) private ownerships and one public ownership will be impacted. This marsh creation work will require approximately 2,200,000 cubic yards of borrow material sourced from within Lake Pontchartrain approximately 2,000 feet off the northern shoreline southwest of the end of Lake Road. This is a State of Louisiana claimed water bottom which will be brought to the project without the benefit of credit. Therefore, there is no necessity to invoke the navigational servitude for this project feature.

A corridor containing approximately 6.75 acres (7,340-ft by 40-ft) located mostly within Lake Pontchartrain and the Lake Road borrow canal, will be used to pipe the needed borrow material to the marsh creation site area and for water access to the project areas. A temporary work area easement and/or pipeline easement will be required of the other affected ownerships for the corridor. The temporary work area/pipeline corridor will be accessible from the

west side of Lake Road. The M2 site is to be acquired by the NFS, as the NFS is responsible for acquiring all LERRDs.

Real Estate required for the Refuge Pine Savanna Mitigation Project. The proposed plan to satisfy mitigation requirements resulting from the construction of the two structural features of the RP includes restoration of degraded wet Long-leaf Pine Savanna Forest within the Big Branch National Wildlife Refuge (PSR-001), marsh restoration on private ownerships within the Refuge boundary (M2). The PSR-001 Pine Savanna Forest restoration is planned for an approximately 50-acre site within the Big Branch National Wildlife Refuge located near the south side of Bayou Bonfouca, approximately 1.25 miles west of the Norfolk Southern railway and Pontchartrain Drive (US Highway 11), and north of the Lake Pontchartrain shoreline in Slidell. The restoration includes eradication of invasive species, removal of undesirable hardwood species, and reintroduction of fire across the entire site. An access road would be established to the site either from Sun Valley Drive crossing the railway, or from US Highway 11 and the existing Slidell-Oak Harbor levee and across the railway. A 15-foot-wide perimeter access road around the site would also be constructed. Once across the railroad, access to the mitigation site will be via an existing dirt road generally traversing in a westerly direction approximately 1.8 miles. A staging area may be established within an existing gravel area just east of the railroad crossing, or in a location of lesser real estate or environmental impacts. An estimated one private ownership and two (2) public ownerships will be impacted. A special use permit from the USFWS would be needed for the work and access on the BBNWR. A road easement and a work area temporary easement would be required of the other affected ownerships.

Non-Federal sponsor shall be required to provide lands, easements, rights-of-way, relocations and disposal areas (LERRD) where this is a requirement of the purpose that necessitates the mitigation except where otherwise agreed for the Corps to accomplish with non-Federal funds. Construction costs for mitigation will be treated the same as other project construction costs for cost sharing purposes. The Non-Federal interests will be responsible for all costs of operation, maintenance, repair, rehabilitation, and replacement of mitigation features except for instances in which a mitigation bank is used to provide mitigation, the mitigation provider will be solely responsible for the OMRR&R of that mitigation, and the Corps and the non-Federal interest will have no responsibility for that portion of the mitigation.

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	Mediu m	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	Mediu m	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 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 Non Refuge Pine Savanna, specific ecological success criteria are not included for that habitat in accordance with Section 2036(c)(3)(A) of the Water Resources Development Act of 2007. 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 and State agencies. 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
Objective	67 average annual habitat units	9 average annual habitat unit	48 average annual habitat units
Proposed Action	Mitigation Bank	Constructed-Site	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.
Success Criteria –Hydraulic Conditions		Ground surface elevations must be conducive to establishment and support of hydrophytic vegetation	N/A
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.
Timber Management		One round of controlled burns, thinning of invasive and or unwanted species must have occurred throughout the site	N/A
Aquatic Invertebrate	N/A	N/A	N/A

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.

For mitigation bank credit purchases a specific monitoring and adaptive management plan is not needed (see Section 2036(c)(3)(A) of the Water Resources Development Act of 2007). 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. 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.

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

The adaptive management plan for the constructed fresh and intermediate marsh and refuge pine savanna 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 and pine savanna refuge.

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.

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
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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