Integrated Feasibility Report and Environmental Assessment

POLK SWAMP CONTINUING AUTHORITIES PROGRAM (CAP) SECTION 206
AQUATIC ECOSYSTEM RESTORATION PROJECT
DORCHESTER COUNTY, SOUTH CAROLINA

Prepared by:
United States Army Corps of Engineers
Charleston District
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Finding of No Significant Impact (FONSI)

POLK SWAMP CONTINUING AUTHORITIES PROGRAM (CAP) SECTION 206 AQUATIC ECOSYSTEM RESTORATION PROJECT

DORCHESTER COUNTY, SOUTH CAROLINA

September 2015

The National Environmental Policy Act (NEPA) requires the U.S. Army Corps of Engineers, Charleston District (the Corps) to evaluate the effect of proposed projects on both the environment and human health and welfare. This Finding of No Significant Impact (FONSI) summarizes the results of the Corps' evaluation and documents the Corps' conclusions.

Polk Swamp is about 38,000 acres in size and is located in coastal plain of Dorchester and Orangeburg Counties South Carolina. The project area is located west of the Town of St. George in Dorchester County, SC. The project area begins just south of Polk Swamp's intersection with Interstate 95 and follows Polk Swamp for approximately 5 miles to the swamp's intersection with US Highway 15 (Figure 1).

The Polk Swamp study is being conducted under Section 206, Aquatic Ecosystem Restoration, of the Water Resources Development Act (WRDA) of 1996 (P. L. 104-303), as amended. Section 206 authorizes the Corps of Engineers to initiate investigations and implement projects for aquatic ecosystem restoration with the objective of restoring degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition considering the ecosystem's natural integrity, productivity, stability, and biological diversity.

The goals of this study are to restore the natural hydro-period of Polk Swamp, remove invasive vegetation and prevent reestablishment, and restore the cypress-tupelo and bottomland hardwood forest that historically existed there. A number of conceptual plans were evaluated based on established criteria that considered engineering feasibility, cost effectiveness, environmental impacts, and socioeconomic benefits. Feasible conceptual plans were further refined into viable alternatives consisting of viable restoration measures as described below.

Alternative 1:
Alternative 1 consists only of the removal of blockages measure and the placement of material taken from blockages both on and off site. This measure involves the physical removal of blockages within the historic channel throughout the project area. These blockages are primarily comprised of fallen timber; plant growth; choke points where debris has collected; and impoundments created by beaver. The removal of these blockages would allow for the restoration of hydrology, including flood and low water periods. The removal process would include both mechanical and hand clearing. The mechanical removal would be performed using floating mechanized equipment (likely an amphibious track-hoe) to clear blockages within at

least a 21-foot wide path within the historic channel. Work would start at the downstream end of the project and work upstream. If additional blockages require removal after the initial pass through the project area, that work would be performed working back downstream.

Components of the blockages consisting of inorganic material would be taken off site for upland use or disposal using a small barge. Expansion of the historic channel would be avoided to the extent practical to minimize the amount of material that is required to be transported out of the project area. Organic debris would be placed on higher ground adjacent to blockages to create topographic relief within the floodplain of Polk Swamp and promote the development of micro habitats and greater diversity within the restoration area. When feasible, large components of blockages consisting of trees and other organic material would be taken off site along with the inorganic material for upland use or disposal. In areas where significant impoundments exist, the blockages would be removed slowly to avoid large and sudden changes in water quality downstream of the work. Care would be taken to minimize the amount of debris that is allowed to leave the immediate area. Screens would be placed in the channel downstream of the work to capture and collect debris that is released into the channel.

Alternative 2:
Alternative 2 is identical to Alternative 1 except that it adds an initial application of herbicides measure. This measure includes an initial herbicide application to approximately 290 acres of project area that have been overtaken by cattails, alligator weed, and smart weed. Due to the size of the area and the difficulty of the terrain, application would be made by helicopter spraying. Through discussions with SCDNR Aquatic Invasive Species Staff, the Corps has determined that the preferred herbicide to be used for the initial spraying is Habitat™ (or a similar herbicide) mixed with a glyphosate (or a similar herbicide). The application rate would be 15-20 gallons/acre. Below is a brief description of the herbicides to be used:

> Habitat™ works by affecting enzymes only found in plants. It is absorbed through leaves, stems and roots and causes the plant to cease growing and exhaust its nutrient supply. Habitat™ is approved by the USEPA and has a history of effective herbicide use. This or a similar product would be applied in accordance with the agricultural pesticide standards. For product information please see: http://www.sepro.com/documents/Habitat_Label.pdf.
>
> Glyphosate is one of the most common, widely used products for weed control and is commonly used in household and commercial weed control products. It is the active ingredient in Round Up™, Ranger Pro™, and Strike Out™. Glyphosates are absorbed in the leaves, travel to the roots, and prevent plants from gathering nutrients. Glyphosates are broken down in the plants that absorb them and do not travel to be absorbed by other plants. Glyphosates have been long used for aquatic plant control. This or a similar product would be applied in accordance with agricultural pesticide standards. For product information please see: http://npic.orst.edu/factsheets/glyphotech.html.

Alternative 3:
Alternative 3 is identical to Alternative 2 except that it adds a targeted maintenance application of herbicides measure. After the initial application of herbicide, the project area would be spot-treated with herbicides to prevent the reintroduction of invasive species (from either germinated seeds or outside sources), for two years. Following that the project area would receive additional spot treatments with herbicides for up to an additional two years if the criteria of the adaptive management are triggered. The preferred herbicide to be used for the targeted herbicide application is Clearcast™ (or a similar herbicide) mixed with a glyphosate (or a similar herbicide). Application rate would be 15-20 gallons/acre with backpack spraying being the preferred method of application.

> Clearcast™ herbicide is an aqueous formulation that may be applied either directly to water for the control/suppression of certain submerged aquatic vegetation, broadcasted, or used for targeted application on floating and emergent vegetation. Like Habitat™, it attacks plant enzymes and inhibits nutrient uptake, growth, and subsequent survival. It is approved by the USEPA and has a history of use for aquatic plant control.

Alternative 4:
Alternative 4 is identical to Alternative 3 except that it adds a controlled burning measure. While the herbicide application would be fatal to *Typha sp.* and other invasive emergent aquatics, the cattails would still reside in the project area due to the fact that their root systems are well embedded and the plants would not be transported downstream, nor would they break down in any reasonable amount of time. The dead plant material must be removed, either by physical means or controlled burn. Conducting a controlled burn would be the most efficient means of removing the dead material and would have the benefit of releasing stored nutrients and carbon back into the system.

Alternative 5:
Alternative 5 is identical to Alternative 4 except that it adds replanting and post planting maintenance measures, outlined below. Replanting would be carried out to supplement natural regeneration. Specific species mix would include at a minimum bald cypress, willow oak, and water oak. After the planting, targeted maintenance application of herbicides, outlined in alternative 3, would occur. Seedlings would be protected with biodegradable sleeves and monitored to ensure success. Diseased seedlings would be removed and replaced.

No Action Alternative:
A basic alternative to any proposed plan of improvement is the "No Action" alternative. The No Action Alternative is the most probable future condition if no action is taken. The No Action Alternative would not remove the permanently impounded water, restore the climax palustrine forested ecosystem, or improve water quality throughout the watercourse. Although the area may recover naturally over hundreds of years, the area would remain only minimally productive for both fish and wildlife resources that are indigenous to this type of environment for the foreseeable future.

Alternative 5 was selected as the Preferred Alternative because it is the only alternative that meets all of the project objectives. None of the other alternatives considered addressed variables present in Polk Swamp that have been found, in several scientific studies, to have a strong negative impact on the restoration of cypress-tupelo swamps.

The Corps criteria for evaluating the effect of the proposed project included the following:

- Prime and Unique Farmland – This project would not result in the unnecessary and irreversible conversion of any farmland to nonagricultural uses

- Formally Classified Lands – no significant impacts to formally classified lands are expected as a result of implementing the proposed project.

- Wetlands– No practical non-wetland alternative exists. Material would be excavated to remove blockages from the channel and be used to create habitat within the project area. The proposed project primarily involves the removal of accumulated organic debris and the removal of invasive species. The removal of excavated inorganic debris, with the exception of incidental removal, is not anticipated. Any significant quantities of organic debris would be removed from the project area and stored outside of waters of the US. Anticipated quantities of fill material are minimal. Organic debris collected to open blockages would be selectively placed within the project area (but not within the channel) to create micro topography and habitat refuge for a variety of species. Over time, this organic material would break down.

- Floodplains - No practical non-floodplain alternative exists. The considered actions do not conflict with applicable state and local standards concerning floodplain protection. The considered action would improve the natural and beneficial values of the floodplain

- Water Quality – Construction of the proposed project would require work to take place in and around Polk Swamp. The 404(b)(1), included as Appendix I, provides a detailed analysis of impacts to waters of the US and wetlands from construction of the proposed project. No significant negative impacts are expected from construction of the proposed project. Upon completion of the proposed project, the invasive cattails that now dominate the project area would be converted to cypress-tupelo swamp and bottomland hardwood forest and more natural flows would be restored in the swamp. Temporary and minor sedimentation may occur during construction. However, significant movement of materials from the wetlands is not expected to occur.

- Cultural Resources – no effects on cultural resources are expected as a result of implementing the proposed project.

- Threatened and Endangered Species – no effects on threatened and endangered species are expected as a result of implementing the proposed project.

- Noise – a short term increase in noise is expected during construction; however, these impacts would be temporary. No additional effects are anticipated as a result of implementing the proposed project.

- Air Quality – A short term decrease in air quality in the vicinity of the controlled burns, and construction area is expected as a result of implementing the proposed project; however, these impacts would be temporary and localized. No additional effects are anticipated as a result of implementing the proposed project

- Environmental Justice – no disproportionately high and adverse human health or environmental effects on minority and low-income populations are expected as a result of implementing the proposed project because the proposed project is expected to have no adverse effects on these populations.

- Cumulative Impacts – no significant adverse cumulative impacts are expected as a result of implementing the proposed project. Construction of the proposed project would have a long term positive impact to the Polk Swamp Watershed.

The draft EA and FONSI were distributed in August 2015 for a 30 day comment and review period. The Final EA addresses comments received during this review period. No significant comments were received. Since the Corps' findings demonstrate that the project would not significantly adversely affect environmental resources or human health, the preparation of an Environmental Impact Statement is not warranted. The full Environmental Assessment can be downloaded from the internet at
http://www.sac.usace.army.mil/Missions/CivilWorks/NEPADocuments.aspx

Date July 1, 2016

MATTHEW W. LUZZATTO
Lieutenant Colonel, Engineer
Commander, U.S. Army Engineer District,
Charleston

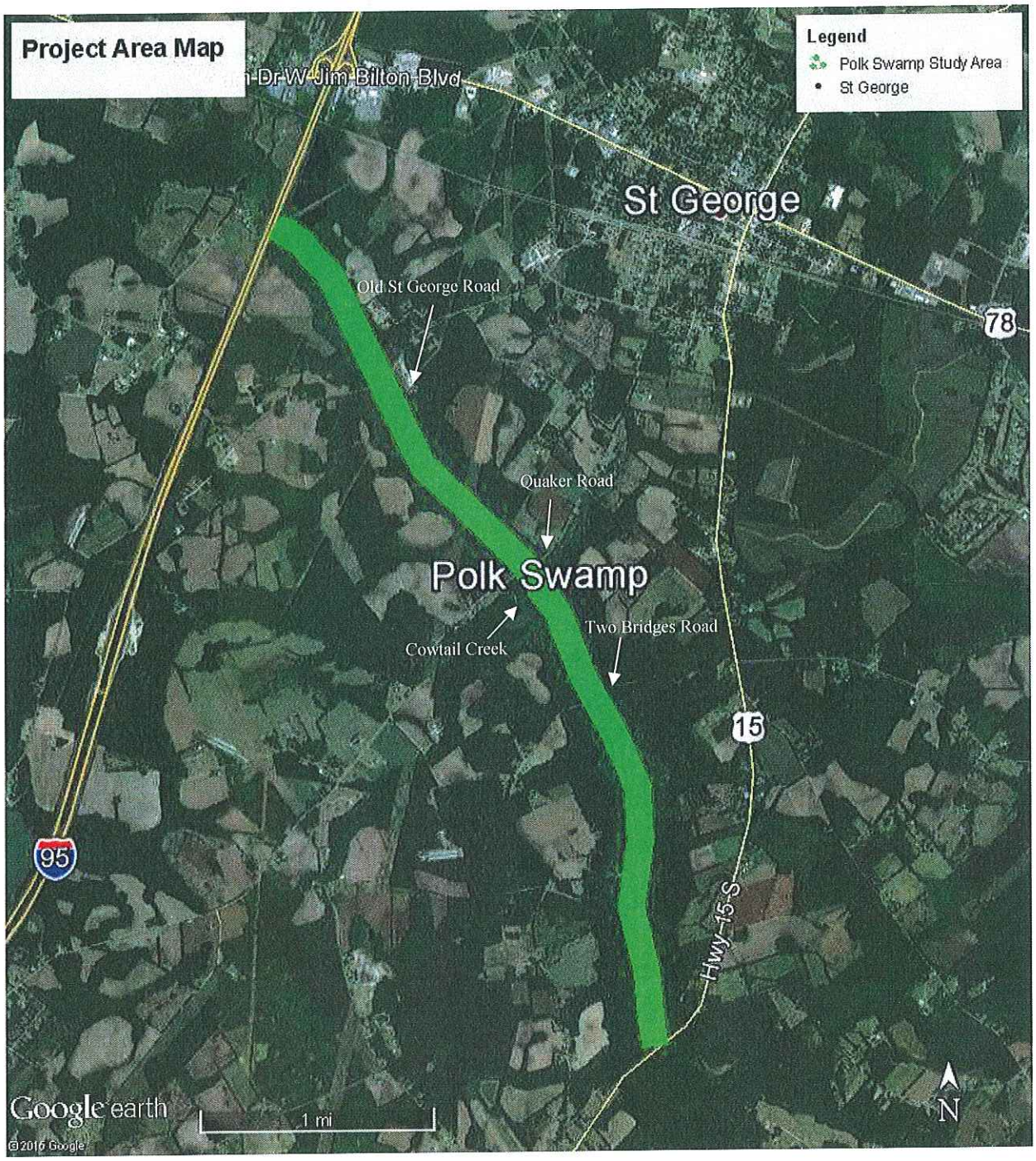

Figure 1: Project area. General location of Polk Swamp study area highlighted bright green. Edisto River is not shown but is located to the south of Highway 15 South. All areas shown on this figure are within Dorchester County.

Executive Summary

This report presents the results of a U.S. Army Corps of Engineers (Corps) and Dorchester County Feasibility Study undertaken to identify and evaluate alternatives for restoring cypress-tupelo and bottomland hardwood forest in Polk Swamp. It is an integrated feasibility report and environmental assessment (FR/EA) and documents the environmental, planning, engineering, and construction details of the recommended restoration plan, which could allow final design and construction to proceed following approval of this report. The Environmental Assessment (EA) was prepared by the U.S. Army Corps of Engineers, Charleston District (Corps) in compliance with the National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321- 4370f, and its implementing regulations, 40 C.F.R. §§ 1500-1508, and 33 C.F.R. Part 230, to evaluate the proposed Aquatic Ecosystem Restoration Project at Polk Swamp.

The Polk Swamp study was conducted under the authority of Section 206, Aquatic Ecosystem Restoration, of the Water Resources Development Act (WRDA) of 1996 (P. L. 104-303), as amended. Section 206 authorizes the Corps of Engineers to initiate investigations and implement projects for aquatic ecosystem restoration with the objective of restoring degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition considering the ecosystem's natural integrity, productivity, stability, and biological diversity.

The aquatic ecosystem of Polk Swamp has been severely degraded by a substantial loss of bottomland hardwood forest habitat. This degradation is characterized by losses of bottomland hardwood trees, defined stream channels, and the tree canopy (which provided shade and contributed to diversity of habitat types) and the increased presence of less desirable invasive species.

The objectives of the study were to:

1) Restore and enhance the aquatic environment by restoring natural hydrology and flows and connectivity;
2) Restore and enhance the riparian corridor through the removal of invasive species; and
3) Reforest the project area with keystone species thereby expanding existing riparian corridors, reducing fragmentation, and diversifying both habitat and wildlife.

The Recommended Plan would restore an estimated 290 acres of bottomland hardwood forest that has died off since the late 1980s. It would also connect high functioning bottomland hardwood forests located in adjacent upstream and downstream reaches. The proposed project includes the physical removal of blockages in the main channel, a two-step herbicide application process that would eliminate the dominant emergent vegetation and prevent its reestablishment, a controlled burn to physically remove remaining emergent vegetation, and replanting of select keystone tree species to accelerate the reestablishment of hardwood forest habitat.

Construction and implementation of adaptive management for the selected Recommended Plan would take approximately 5 years. . The project first cost for the Selected Plan is estimated to be $2,468,000 for the initial construction and $400,000 for the study. Future inspection and

maintenance would be performed by the non-Federal sponsor and is estimated to have a first cost of $1,853,000 over the 50 year evaluation period.

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CHAPTER 1 INTRODUCTION

1.1. Purpose of the Report

The purpose of this report is to present the results of a U.S. Army Corps of Engineers (Corps) Section 206 Aquatic Ecosystem Restoration Feasibility Study undertaken to identify and evaluate alternatives for restoring cypress-tupelo and bottomland hardwood forest in Polk Swamp. This report is an integrated feasibility report and environmental assessment and documents the environmental, planning, engineering, and construction details of the recommended restoration plan, which could allow final design and construction to proceed following approval of this report. This Environmental Assessment (EA) has been prepared by the U.S. Army Corps of Engineers, Charleston District (Corps) in compliance with the National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321- 4370f, and its implementing regulations, 40 C.F.R. §§ 1500-1508, and 33 C.F.R. Part 230, to evaluate the proposed Aquatic Ecosystem Restoration Project in Polk Swamp Dorchester County, SC.

1.2. Project Authority and Guidance

The Polk Swamp study is being conducted under the authority of Section 206, Aquatic Ecosystem Restoration, of the Water Resources Development Act (WRDA) of 1996 (P. L. 104-303), as amended. Section 206 authorizes the Corps of Engineers to initiate investigations and implement projects for aquatic ecosystem restoration with the objective of restoring degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition considering the ecosystem's natural integrity, productivity, stability, and biological diversity.

The Water Resources Reform and Development Act (WRRDA) (Public Law 113-121) of 2014, Section 1030, modified the Federal cost-sharing limits of the Section 206 program; each project in the Section 206 program is now limited to a Federal cost share of not more than $10 million (previous limit was $5 million). This Feasibility Study has been prepared according to the procedures for the Continuing Authorities Program, as described in Appendix F of Engineer Regulation (ER) 1105-2-100 for projects under Section 206 of the WRDA of 1996, as amended and the South Atlantic Division's Continuing Authorities Program Management Plan.

1.3. Study and Project Area

Polk Swamp is about 38,000 acres in size and is located in Dorchester and Orangeburg Counties within the Coastal Plain of South Carolina (Figure 1.1). It is joined by Cowtail Creek and Bear Branch within the project area, and joins with Indian Field Swamp before it empties into the Edisto River. The project area is located southwest of the Town of St. George in Dorchester County, SC. St. George is located approximately 50 miles northwest of Charleston, SC. The project area begins just south of Polk Swamp's intersection with Interstate 95 and follows Polk Swamp for approximately 5 miles to the swamp's intersection with US Highway 15 (Figure 1.2). The initial study area extended upstream and downstream from the project area. However those upstream and downstream areas were eliminated after field reconnaissance documented that those areas were not significantly degraded and would not substantially benefit from a restoration project.

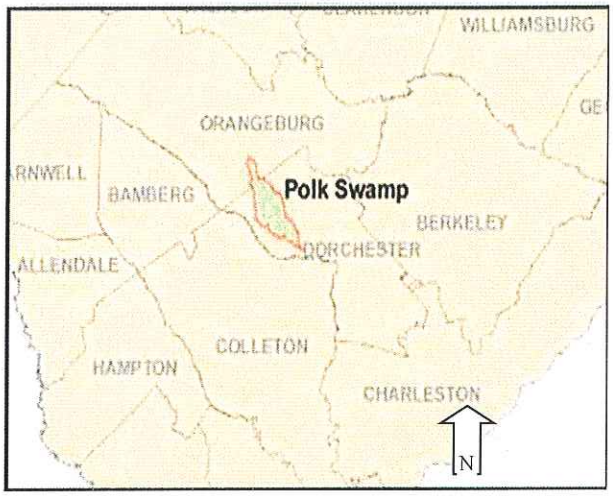

Figure 1.1: Location of Polk Swamp within the South Carolina Coastal Plain *not to scale.

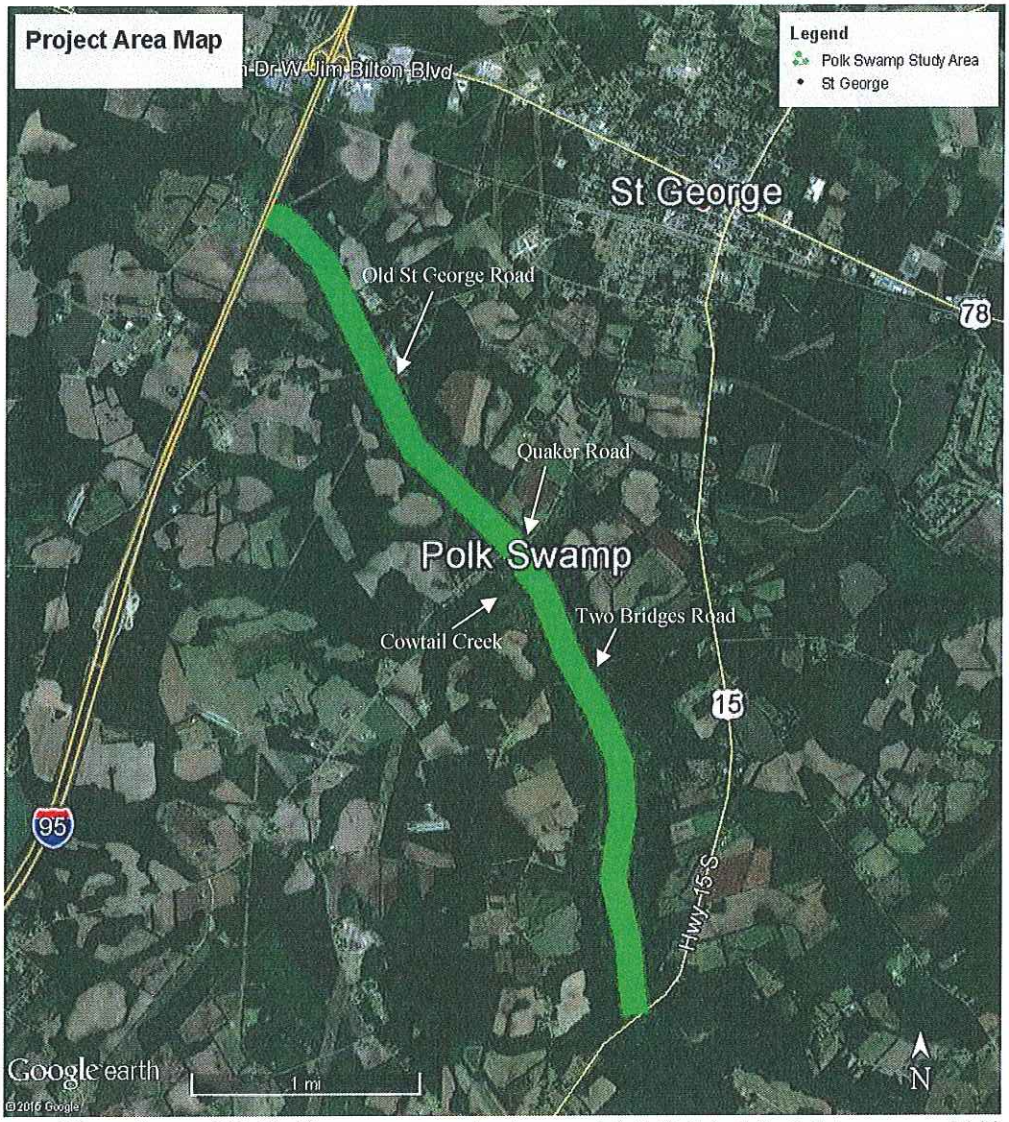

Figure 1.2: General location of Polk Swamp - project area highlighted bright green. Edisto River is not shown but is located to the south of Highway 15 South. All areas shown on this figure are within Dorchester County. A map of tributaries and sub-watersheds of Polk Swamp is located in Appendix C.

1.4.Purpose and Need

The aquatic ecosystem of Polk Swamp has been severely degraded by a substantial loss of bottomland hardwood forest habitat. This degradation is characterized by losses of bottomland hardwood trees, defined stream channels, and the tree canopy (which provided shade and contributed to diversity of habitat types). At the same time, it experienced an explosion of invasive aquatic species, persistent flooding of areas that were only periodically inundated in the past, and a significant increase in stagnant water during non-flood periods. The degradation has been attributed to the restriction of flow through the swamp's stream channel. The Corps has determined that anthropogenic watershed changes such as flow blockages from road fill at bridges, and rail road crossings and natural and weather phenomenon (debris left over from Hurricane Hugo (1989), debris from the winter storms of 2014 and beaver colonization as a result of conditions in the swamp after Hurricane Hugo) are among the primary causes of the flow changes. The large number of downed trees in the channels following Hurricane Hugo started a process that increasingly slowed flows, captured debris, and persistently elevated water levels causing the remaining trees and canopy to die out. Without the canopy, the area was exposed to elevated levels of sunlight, resulting in an explosion of invasive and nuisance aquatic vegetation, which further restricted flows, degraded habitat and reduced the diversity of both plant and animal species (Appendix A).

An estimated 290 acres of bottomland hardwood forest within the project area has died off. The most impacted reach is an approximately 5 mile reach located between Interstate-95 and US Highway 15 (Figure 1.2). A series of aerial images showing the bottomland hardwood forest that once dominated the project area in comparison to current conditions is provided in Appendix B.

1.5.History

Dorchester County requested initiation of this study through the submittal of a letter request to the Corps on December 1, 2010. As a result of this letter, a Federal Interest Determination (FID) was undertaken (approved April 02, 2014) by the Corps and a Feasibility Study began at the beginning of the feasibility phase (August 15, 2016). This integrated feasibility study and environmental assessment (EA) addresses the proposed re-establishment of the historic channel through a reach of the Polk Swamp, followed by the planting of cypress, tupelo, and other bottomland hardwood trees as appropriate. Dorchester County would be responsible for maintaining the reach in a free-flowing condition after the restoration work is complete.

1.6.Other Planning Studies, Reports or Efforts

No other USACE planning studies reports or efforts exist within the Polk Swamp watershed. However, USACE constructed a similar Section 206 Aquatic Ecosystem Restoration in Pocotaligo River and Swamp. That project has many similarities with Polk Swamp and was highly successful. The Pocotaligo River and Swamp Section 206 Aquatic Ecosystem Restoration is described below. The state of South Carolina and the US Department of Agriculture-Natural Resource Conservation Service (USDA-NRCS) have also conducted studies regarding Polk Swamp, which are described below.

Pocotaligo River and Swamp Section 206 Aquatic Ecosystem Restoration
The Pocotaligo River and Swamp is a tributary of the Black River. It flows approximately 55 miles downstream in a southeasterly direction from Sumter, South Carolina, through Manning, South Carolina, to its confluence with the Black River. Prior to 1950, the upper reaches of this river-swamp ecosystem were characterized by numerous, well-defined braided stream channels, frequently-flooded wooded areas, and a dense swamp hardwood forest community consisting of black gum, water tupelo, bald cypress, sweet gum, maple, and, to a lesser extent, oak, water oak, ash, poplar, and pine. The forest canopy provided closure over all but the wider stream channels.

From the 1950s to the early 2000s, Pocotaligo River and Swamp was impacted by both manmade influences and natural storm events. Highway construction, power line and other utility line installation, construction of logging roads, and logging operations within the Pocotaligo River and Swamp had all contributed to the degradation of this ecosystem. Seasonal die-back of nuisance aquatic vegetation has contributed to low dissolved oxygen levels. Hurricane Hugo in 1989 and other such storms during this period have further impacted the ecosystem by creating large quantities of downed timber. These various contributions to the degradation of the ecosystem had created blockages of the natural drainage channels within the swamp, contributing to poor drainage, reduced water flow, elevated, stagnant water levels, and suppressed tree regeneration and growth. Additionally, the lack of significant tree canopy had exacerbated the nuisance aquatic plant growth, which served to further reduce the flow of water through the swamp and sustain the elevated water levels.

In order to restore Pocotaligo River and Swamp, two flow paths approximately 20 -25 feet wide were cleared through the project area, one on each side of the swamp, to allow water to flow downstream. Within each flow path, downed timber and stumps were removed and placed away from the flow paths. On a limited basis, trees were removed from the flow paths to accommodate equipment movement and to eliminate potential future obstructions. Nuisance aquatic vegetation was removed and similarly placed away from the flow paths. Where necessary, on a limited basis, sand, soil, and sediment mounds that existed within the proposed flow paths were excavated to the relative depth of the surrounding stream and moved away from the flow path. Construction was completed in 2009. Maintenance of the Recommended Plan has been and continues to be the responsibility of the local sponsor. The Pocotaligo River and Swamp restoration has been a resounding success. The restored channels are functioning as designed, nuisance plant species have been mostly eliminated and replanted vegetation is thriving. The area is now home to a rich variety of native wildlife and provides improved ecological services within the watershed.

The following is a summation of other studies and efforts to address environmental issues in the Polk Swamp Watershed.

SCDHEC Technical Report Number: 018-06 Total Maximum Daily Load-Polk Swamp (Hydrologic Unit Code 030502060206) Stations E-016 and E-109 Fecal Coliform Bacteria
The South Carolina Department of Health and Environmental Control developed a Total Maximum Daily Load (TMDL) for fecal coliform bacteria excursions in the Polk Swamp Watershed. The TMDL called for a reduction of bacteria loading by 52% for station E-106 and 43% for station E-109. The TMDL also stated that this goal was achievable through nonpoint source education and the implementation of agricultural BMPs.

US Department of Agriculture-Natural Resource Conservation Service (USDA-NRCS) National Water Quality Initiative
In 2014, USDA-NRCS identified Polk Swamp as one of the South Carolina Priority Watersheds for their National Water Quality Initiative. Under this initiative, USDA-NRCS would target technical and financial assistance to agricultural producers to improve habitat and water quality through improving animal waste management in the watershed.

1.7.Planning Process

Development of this Feasibility Study followed the Corps' six-step planning process specified in ER 1105-2-100. This process identifies and responds to problems and opportunities associated with the Federal objective, as well as specified state and local concerns. The process provides a flexible, systematic, and rational framework to make determinations and decisions at each step. This allows the interested public and decision-

makers to be fully aware of the basic assumptions employed and the data and information analyzed as well as the areas of risk and uncertainty, and the significant implications of each alternative plan.

As part of identifying the recommended plan, a number of alternative plans were developed and compared with the "No Action" alternative, allowing for the ultimate identification of the National Ecosystem Restoration (NER) Plan. The NER plan reasonably maximizes ecosystem restoration benefits compared to costs, considering the cost effectiveness and incremental cost of implementing other restoration options.

CHAPTER 2 BASELINE ENVIRONMENTAL SETTING AND EXISTING CONDITION

2.1.Hydrology

Polk Swamp is a tributary to the Edisto River and is located within the upper Coastal Plain of South Carolina. Within the project area, the main channel of Polk Swamp contains blockages and dense vegetation in the stream. The floodplain contains dense concentrations of cattails (*Typha spp.*) that further restrict flows within the broader floodplain. The cattails are dense enough to make access to the swamp difficult over most of the project area.

Flood events fill the swamp and the floodplain remains inundated for months after rain events. Reaches upstream and downstream of the project area flow and drain well and do not contain similar concentrations of cattails. Survey results indicate that the historic channel still exists under the debris, vegetation, and blockages. However, flow through the entire project area is severely restricted relative to the reaches upstream and downstream. Additional information regarding the hydrology of Polk Swamp can be found in Appendix C, Hydraulics and Hydrology.

2.2.Land Use

The primary land use within the watershed is a mix of forested and row crops (SCDHEC 2006) (Table 2.1). Cotton, feed corn, hay, and soybeans are the most common commercial crops within the project area. The majority of the farmland is considered prime farmland or farmland of statewide importance (USDA 2010). USDA defines prime farmland as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and which is available for these uses. Prime farmland can be cropland, pastureland, range land, forest land, or other open vegetated lands, but cannot be urban built-up land or water.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation. It also has favorable temperature and growing season, acceptable acidity or alkalinity. It has few or no rocks and is permeable to water and air. Prime farmland is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent.

Table 2.1: Estimated Land Use Summary in the Polk Swamp Watershed

Land Use	Area(^{mi2})	Percent
Row Crops	19351	33.00
Pasture	3.30	5.59
Forested	21.68	36.68
Woody Wetlands	11.47	19.41
Emergent Herbaceous Wetlands	.25	.43
Developed (Residential and	.85	1.45

Commercial)		
Other (Bar, Recreation Grass, Transitional)	2.05	3.46

USDA defines unique farmland as land other than prime farmland used for the production of specific high value food and other fiber crops. Unique farmlands can economically produce sustained high quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods.

With respect to larger considerations, Polk Swamp is a part of the Edisto River watershed. The U.S. Department of Agriculture, Soil Conservation Service has classified 63% of the Edisto Basin as either Prime Farmland (24%) or statewide important farmland (39%). A majority of the farmland adjacent to the project area also falls within these two classifications (NRCS 2010). However, no part of the project footprint is designated as prime, or unique farmland.

There are no urbanized areas within the project area. However, the towns of Reevesville and St. George are nearby. The land adjacent to the project area is mainly a mix of farmland and forests. A small number of houses are located in the vicinity of Polk Swamp well outside of the project area and the project area floodplain of Polk Swamp. The only heavy land use or commercial developments proximate to the project are the St. George Wastewater Treatment Plant and a South Carolina Department of Transportation Storage area.

2.3. Climate

The climate in the region consists of long hot summers and cool winters. Summers are warm and humid (average July high and low temperatures are 92°F and 71°F, respectively). Winters are relatively mild (average January high and low temperatures are 58°F and 35°F, respectively). Precipitation occurs chiefly as rainfall and averages about 49.5 inches per year with approximately one-third of that total occurring during the months of June, July, and August.

2.4. Water Resources and Aquatic Habitat

Polk Swamp ultimately flows into the Edisto River and is located within the upper Coastal Plain of South Carolina. The Coastal Plain of South Carolina sits atop marine deposits of limestones and sands (SCDNR 1985). Shallow aquifers, including the Floridian and Tertiary, are extensively used for water supply (SCDNR 2009). The groundwater supply potential of the Edisto Basin is considered healthy and groundwater quality is not an issue (SCDNR 2009). There are no permanent manmade impoundments on Polk Swamp.

The State of South Carolina has designated the Polk Swamp as "Freshwater" (FW). FW waterbodies are considered suitable for primary and secondary contact recreation, industrial and agricultural uses, and drinking water supply after conventional treatment (SCDHEC 2012). From 1998 to 2006, however, Polk Swamp was on South Carolina's 303(d) list for not fully supporting recreational uses due to the exceedance of the South Carolina's fecal coliform bacteria standards. A Total Maximum Daily Load (TMDL) developed for Polk Swamp by the State of South Carolina concluded that the primary sources of fecal coliform bacteria were nonpoint source in nature (wildlife, waterfowl, livestock, and waste application to cropland) and concluded that load reductions would be achieved through the implementation of a nonpoint source pollution education program and the implementation of better agricultural best management practices (BMPs) (SCDHEC 2006).

The Town of St. George has a permitted National Pollutant Discharge Elimination System (NPDES) discharge for treated wastewater within the project area. This discharge is considered by SCDHEC to be minor, with a permitted discharge of 0.8 million gallons of water per day (mgd). (For comparison, the modeled low flow discharge for Polk Swamp was approximately 103 mgd.) Since 1989, there have been 6 reported violations of

the facility's permitted limits for fecal coliform bacteria, with most fecal discharges being less than 1 fecal count per 100 ml of water. This facility is not considered to be a source of impairment to the watershed (SCDHEC, 2006).

The aquatic habitat of the project area consists of a heavily herbaceous community structure, with invasive cattail as the dominant species. A low density of scattered dead trees are still standing within the area and little to no living cypress, tupelo or bottomland hardwood tree species are present. This monotypic habitat provides little habitat value for most native aquatic fish, wading birds, or invertebrates found in other parts of the watershed.

Field reconnaissance identified 58 obstructions in the project area and revealed very few areas where channel reestablishment outside of the blockages would be necessary to restore historic flow patterns. Throughout the project area, water depth varies from 6 inches to 6 to 8 feet. Natural seasonal periods of flooding and drying do not occur within the project area. Much of the area is inundated with stagnant water year round. Based on the American Fisheries Society's Stream obstruction guidelines, most of the project area is in condition 4. Steams in condition 4 have major blockages that have caused severe and unacceptable flow conditions that can likely only be correct with the use of heavy machinery (McConnell et al., 1983).

The existing fishery of the project area consists largely of invasive mosquito fish (*Gambusia spp.*) and low densities of native fish such as *Bowfin* (*Amia calva*), redbreast sunfish (*Lepomis auritus*), and redfin pickerel (*Esox americanus americanus*). In comparison to reaches of Polk Swamp downstream of the project area, densities of native fishes were lower within and above the project area (SCDNR, pers. Comm.). The existing community of benthic organisms within the project area is limited to organisms that can persist in a mono-crop of cattails in stagnant water.

2.5. Wetlands, Stream Crossings and Floodplains

Polk Swamp is categorized as a riparian wetland. Generally, the greatest source of water for these wetlands is from riverine flood flows, usually following flooding events. Flooding may be infrequent; however, flood frequency and duration have a direct impact on the type of vegetation that occurs within the wetland. Since the early 1990's the reach of Polk Swamp located between Interstate 95 and US Highway 15 (Figure 1.2) has become permanently inundated and the dominant vegetation has converted from bottomland hardwoods to cattails (*Typha sp.*) and other herbaceous plants.

Flood duration tolerances for typical bottomland hardwood swamps species are presented in Table 2.2. As evidenced by the standing and downed timber within the project area, the reach of Polk Swamp within the project area has long been inundated beyond the trees' tolerance levels.

Table 2.2: Flood Duration Tolerance of Common Bottomland Hardwood Trees

Species	Flood Duration tolerance (in months)
Cypress/Tupelo	6-8
Overcup Oak/Red Maple	4-6
Pin Oak/Sweet Gum	1-6
Cherrybark Oak/Willow Oak	1-3
	(Fredrickson and Heitmeyer 1988)

2.6. Terrestrial Resources and Wildlife

The project area consists of a heavily herbaceous community structure, with invasive cattail as the dominant species. A low density of scattered dead trees are still standing within the area and little to no living cypress, tupelo or bottomland hardwood tree species are present. More typical, natural areas within Polk Swamp consist of bottomland hardwood swamps, bordered by a combination of planted pine stands, mixed hardwoods, and managed agricultural fields. The flora and fauna observed are consistent with those found in the Southeastern Coastal Plains Region of South Carolina.

Furbearers are an important component of these wetlands and include beaver, mink, otter, bobcat, gray fox, raccoon, and opossum. Deer, turkey, bobcat, and feral hogs are important large mammals that frequent both the swamp and adjacent uplands. Other small mammals, such as gray squirrels, rabbits, and several small rodent species, are also found within the vicinity of the project area. Mammals expanding their range (such as coyotes and armadillos) have also been observed.

Polk Swamp is part of the Atlantic Flyway, and forested wetlands provide important wintering habitat for many waterfowl species and nesting habitat for wood ducks. Bottomland forests provide breeding refuges for multiple migrant species including the Acadian flycatcher, various warbler species, and the northern parula (SCDNR, 2005; Cely, 2003). The adjacent uplands are foraging and breeding grounds for sparrows, buntings, and nuthatches. Predatory birds such as hawks and ospreys use both the uplands and swamps. Wading birds, including the great blue heron, the green-backed heron, and the ibis, forage within the swamp.

South Carolina Coastal Plain wetlands are very important, supporting a variety of reptiles and amphibians. Wetland habitats support many kinds of frogs, including the bullfrog, bronze frog, southern leopard frog, and several species of tree frogs, cricket frogs, and chorus frogs. Turtles found in these wetlands include river cooter, Florida cooter, pond slider, eastern chicken turtle, snapping turtle, mud turtle, and stinkpot. Snakes found in the wetlands include red-bellied water snake, banded water snake, brown water snake, eastern mud snake, rainbow snake, and eastern cottonmouth. The American alligator has been observed in the project area.

Based on information obtained from the National Marine Fisheries Service, the project area is upstream of any designated EFH or Habitat Areas of Particular Concern (HAPC).

2.7. Endangered Species

Table 2.3 identifies the species that have been listed by the U.S. Fish and Wildlife Service as occurring or possibly occurring in Dorchester County (last updated October 23, 2013) (USFWS 2014). A review of the South Carolina Heritage Trust's Threatened and Endangered Species database revealed no known occurrence of any state or federally listed species within the project area.

Table 2.3: Federally threatened species (T), federally endangered species (E), federal candidate species (C) and species protected under the Bald and Golden Eagle Protection Act (BGEPA) for Dorchester County

Category	Common Name	Scientific Name	Federal Status
Bird	Bald eagle	*Haliaeetus leucocephalus*	BGEPA
Bird	Red-cockaded woodpecker	*Picoides borealis*	E
Bird	Wood stork	*Mycteria americana*	T
Fish	Atlantic sturgeon	*Acipenser oxyrinchus*	E
Fish	Shortnose sturgeon	*Acipenser brevirostrum*	E
Plant	Canby's dropwort	*Oxypolis canbyi*	E

Plant	Pondberry	*Lindera melissifolia*	E
Plant	Bog Asphodel	*Narthecium americanum*	C
Reptile	Gopher tortoise	*Gopherus polyphemus*	C

2.8. Air Quality and Noise

The Clean Air Act (CAA), which was last significantly amended in 1990, requires the U.S. Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The CAA established two types of national ambient air quality standards- primary and secondary. Primary standards are levels established by the EPA to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards are levels established to protect the public welfare, including protection from decreased visibility and damage to animals, crops, vegetation, and buildings.

The EPA Office of Air Quality Planning and Standards has set NAAQS for six principal pollutants which are called "criteria" pollutants. Those pollutants are Carbon Monoxide, Lead, Nitrogen Dioxide, Particulate Matter (PM_{10}), Particulate Matter ($PM_{2.5}$), Ozone and Sulfur Dioxide. All air pollutants are listed as in attainment for Dorchester County (EPA 2012).

The project area is rural. Generally the area is not densely populated or heavily industrialized, though agricultural and silviculture practices are employed adjacent to the project area. Noises associated with traffic and agriculture and silviculture practices are the predominant sources of noise in the project area. Naturally occurring noises (buzzing of insects, bird calls, etc.) are also common within the project area.

2.9. Cultural Resources

ArchSite is a tool provided by the South Carolina Institute of Archaeology and Anthropology and South Carolina department of Archives and History (http://archsite.cas.sc.edu/ArchSite). A search of ArchSite revealed no cultural resources with the project area (Appendix D). Architectural reconnaissance identified no buildings of any kind or landscapes within or immediately adjacent to the footprint of the proposed project.

2.10. Socioeconomic Resources

Table 2.4 summarizes the population statistics for the Town of St. George, South Carolina from the US Census Bureau's 2010 Census. The socioeconomic conditions of the area are typical for rural areas within the Coastal South Carolina.

Table 2.4: Select U.S. Census Bureau statistics for the town of St George, SC. Estimates are from 2010 Census Data unless otherwise noted.

Subject	Estimate
Population estimate	2,084
Percent of total population that is a minority	48.8%
Median household income	$17,634
Percent of total population with a High School Diploma or GED	69.3%
Percent of total population with a College degree	11.9%
Percent of total population below the Poverty level	34.2%
Unemployment rate	18.7%

2.11. Hazardous Toxic and Radioactive Waste (HTRW)

A site inspection of the project area was conducted by USACE staff. The inspection revealed no signs of HTRW within the project area. Additionally the Environmental Protection Agency (EPA) EnviroMapper was queried on June 21, 2015 (EPA 2015). No immediate sources of Hazardous, Toxic or Radioactive Waste were shown to occur within the vicinity of the project area.

2.12. Recreation

There are no designated boat launches within the project area; however, small boats (such as canoes, kayaks, and john boats) can be launched at multiple locations throughout the project area. The project area is used for recreational fishing and hunting, as evidenced by the number of deer hunting stands and fishing tackle remnants observed while performing surveys and investigations of the swamp.

2.13. Resource Significance

2.13.1. Institutional Significance

Bottomland Hardwoods serve a critical role in the watershed by reducing the risk and severity of flooding to downstream communities by providing areas to store floodwater. In addition, these wetlands improve water quality by filtering and flushing nutrients, processing organic wastes, and reducing sediment before it reaches open water. Impacts to these resources are regulated through state and federal statutes (Sections 402 and 404 of the Federal Water Protection Act), and the management and restoration of such resources has been well researched and documented. The importance and public desire for bottomland hardwood forests is reflected in Dorchester County's willingness to cost share in this project and spend already stretched county resources. In addition, the US Department of Agriculture-Natural Resource Conservation District has identified Polk Swamp for National Targeted Initiative funding in 2014. (The Corps proposed project is independent of the NRCS's projects. The NRCS is attempting to improve water quality throughout the entire watershed primarily through improving animal waste management.)

2.13.2. Public Significance

The proposed project would restore the natural conditions of a significant tributary to Edisto River. The Edisto River is significant in that it is one of the largest free flowing blackwater rivers in North America (NRCS 2010). Public groups such as the Friends of the Edisto River are active in the watershed. The Edisto was listed by the American Rivers group as the Number Five Most Endangered River in 2015 for the second consecutive year. Major threats to the Edisto included loss of fish and wildlife habitat and water quality concerns (American Rivers, 2015). Polk Swamp joins the Edisto a few miles upstream of the junction of Four Hole Swamp and the Edisto River. Four Hole Swamp, home to the Francis Beidler Forest Audubon Sanctuary, contains the world's largest virgin (never logged) cypress-tupelo swamp forest (The Nature Conservancy, 2015). Considerable volunteer hours and public and private funds are expended to protect and manage both the Edisto River and Francis Beidler Forest. Restoring Polk Swamp would provide direct and indirect ecological benefits to the fish and wildlife of the Edisto River, Four Hole Swamp, and the Francis Beidler Forest. Dorchester County invests considerable funds into protecting, managing and restoring Polk Swamp and other areas like it. The County is also actively investing in equipment and manpower to conduct similar restorations and maintenance, on a smaller scale throughout Dorchester County.

Polk Swamp has significant recreational and cultural value to local communities. Support for the restoration of Polk Swamp from local communities is strong and there is a desire to see the swamp restored to conditions that reflect those that were once present within the swamp.

2.13.3. Technical Significance

The Environmental Protection Agency estimates that at one time there were almost thirty million acres of bottomland forests in the Southeastern United States. Out of that original thirty million acres, approximately 60% has been lost, primarily through the conversion to croplands (EPA, 2012). In the 1980's South Carolina lost an estimated 3,000 acres each year. Historical estimates put the State's wetland loss at 27% from pre-colonial times. Bottomland hardwood forests perform many important ecological functions including acting as a source of aquifer recharge, capturing and dispersing sedimentation, filtering agricultural runoff, and minimizing flood damage by providing storage (Brinson 1990; Taylor, Cardamone, and Mitsch 1990; Fischer et al. 1999, Guilfoyle 2001). Bottomland hardwood forests are also important as refugia for area-sensitive species both locally and regionally. Approximately 30 percent of threatened and endangered species in the Southeast depend on bottomland hardwoods during some portion of the year (Brinson et al. 1981, Ernst and Brown 1989, Guilfoyle 2001). Many species of migratory birds breed exclusively in bottomland hardwood forest or have highest densities and/or reproductive success in these areas. Several species of migratory birds currently in decline are considered wetland specialist and rely heavily on bottomland hardwood forest (Guilfoyle 2001). Current restoration bottomland hardwood restoration efforts are insufficient to offset losses of bottomland hardwoods forest and wetlands. Therefore, restoration efforts should be increased to compensate for continued loss and degradation of bottomland hardwood forest (King and Keeland 1999, Guilfoyle 2001). Restoration of the Polk Swamp project area would restore approximately 290 acres of bottomland hardwood forest.

CHAPTER 3 FORMULATION OF ALTERNATIVES

This chapter summarizes the plan formulation process used to develop and screen measures and alternatives for the study. The process was used to develop alternative plans comprised of combinations of measures to address the study's goals and objectives and to screen and compare those plans to each other and to the "no action" plan in order to potentially recommend a plan for implementation or determine that no action should be taken.

The Corps planning process follows a six-step process. This process is structured to provide a rational framework for sound decision making. The six steps are:

Step 1 - Identifying problems and opportunities
Step 2 - Inventorying and forecasting conditions
Step 3 - Formulating alternative plans
Step 4 - Evaluating alternative plans
Step 5 - Comparing alternative plans
Step 6 - Selecting a plan

3.1. Problems, Opportunities, Constraints, and Objectives

This section identifies the problems, opportunities, objectives, and constraints based on an assessment of existing and expected future without-project conditions in the project area. For planning purposes, a problem is an undesirable condition that exists or will exist in the future. An opportunity is a chance to create a future, more desirable condition. Problems and opportunities can be viewed as local and regional resource conditions that could be modified in response to public concerns. Constraints are resource, legal, or policy considerations that limit the range or types of actions that could be implemented. Objectives are generated to describe how the problems could be addressed by capitalizing on the opportunities available.

3.1.1. Problems

Since the late 1980s, the ecosystem associated with the reach of Polk Swamp between I-95 and US Hwy 15 (Figure 2) has been degraded through a substantial loss of bottomland hardwood forest habitat. This degradation is characterized by the loss of bottomland hardwood trees, defined stream channels, tree

canopy, and an explosion of invasive aquatic species that thrive in areas that are persistently flooded with stagnant water. A total of about 290 acres of high functioning bottomland hardwood forest habitat has been converted to a persistently flooded stand of cattails (*Typha sp.)*. A series of aerial images showing the bottomland hardwood forest that once dominated the project area in comparison to current conditions is provided in Appendix B.

The degradation process began shortly after Hurricane Hugo struck the area in 1989. The storm downed large numbers of trees within this reach and left large amounts of woody debris in the adjacent floodplain. The presence of fallen trees in the channels slowed flows and overall drainage rates causing elevated water levels and persistent flooding in areas that were historically only occasionally inundated. The changes in the hydrologic conditions caused the remaining trees and canopy to die out exposing the area to elevated sunlight that resulted in an explosion of invasive and nuisance aquatic vegetation, and increased beaver populations. This further restricted flow within the channels, further degraded the habitat and reduced diversity of both plant and animal species. Eventually, the blockages and the associated changes in water quality also limited the ability of fish to live in and migrate through the project area.

In addition to the habitat losses described above, the system has a reduced ability to provide temporary storage during flood events and fishing, hunting, hiking, and other recreational uses of the floodplain have been greatly diminished in terms of both quality and availability.

3.1.2. Opportunities

Based on an evaluation of the existing and historical conditions within the project area and the underlying causes of the degradation that has been observed, a wide range of improvements to ecosystem functions is possible. The primary ecosystem restoration opportunities include:

- restoring more natural flow and water quality conditions within the main channel;
- restoring more natural wetland hydrology within the floodplain;
- removing invasive plant species and restoring bottomland hardwood species;
- removing obstructions to fish passage;
- restoring historical levels of biodiversity in aquatic species and habitat;
- restoring historical levels of biodiversity in terrestrial species and habitat; and
- restoring historical recreational (fishing, hunting, hiking, etc.) opportunities.

3.1.3. Constraints

Constraints limit the range of measures that could be implemented to meet the study objectives based on resource, legal, or policy considerations. The planning process strives to efficiently meet the study objectives without violating the constraints. Only two project-specific constraints were identified for the study.

- Based on resource and policy considerations, significant infrastructure within the project area (five bridges and two power-line crossings) would not be modified as part of the project.
- Based on policy considerations, actions with adverse environmental impacts requiring mitigation would not be included in the project.

3.1.4. Objectives

Based on the suite of problems, opportunities, and constraints described above, the following objectives statement was developed for the project within the 50 year period of analysis from 2017 to 2067:

- Restore and enhance the aquatic environment by restoring natural hydrology and flows and connectivity,

- Restore and enhance the riparian corridor through the removal of invasive species, and
- Reforest the project area with keystone bottomland hardwood species thereby expanding existing riparian corridors, reducing fragmentation, and diversifying both habitat and wildlife.

3.1.5. Assumptions

Assumptions related to the formulation and evaluation of alternatives include:

1. The St. George Wastewater Treatment Plant will continue to operate in compliance with current discharge requirements.

2. If no action is taken, the bottomland hardwood forest could recover naturally. However, the natural recovery process would be very slow taking 100-200 years.

3. If not eliminated, cattails will persist after construction and significantly impede growth and propagation of native species. There is minimal risk that herbicides, used to remove invasive species, would flow offsite. All herbicides used break down relatively quickly in the environment.

3.2. Identification of Screening of Alternative Measures

3.2.1. Screening Criteria

Based on the objectives for habitat restoration at Polk Swamp, a number of potential restoration measures were identified and are listed in sections 3.2.2 and 3.2.3 of this report. Many of the measures address particular opportunities, while others provide means of addressing multiple issues within the project area. A total of 16 restoration measures were identified. These measures are designed to meet the study objectives above. Because no individual measure fully addresses all project objectives, the alternatives will be a combination of measures.

The following criteria were used to screen restoration measures:

- Constructability- How feasible is it to construct the measure?
- Risk- How high is the risk that the measures may not succeed in restoring Polk Swamp in the long term?
- Effectiveness- How effectively would the measure fulfill the study objectives?
- Relationship to Corps' mission- Restoration that primarily benefits uplands was deemed not to be within the Corps' mission area.

3.2.2. Measures Considered but Screened from Detailed Study

This section describes measures that were initially considered but eliminated from detailed study. During the plan formulation process, several measures were considered to help restore or improve the aquatic and terrestrial habitat in the project area. Several of these measures were removed from consideration after further review and evaluation by the project delivery team and NFS.

Measures that restored only portions of the project area were not considered due to an unacceptable risk of project failure. A partial restoration would not eliminate either the persistent flooding or the dominant emergent vegetation, nor would it result in conditions that would allow for the reestablishment of bottomland hardwood swamp. Only measures that addressed ecosystem degradation throughout were carried forward for screening.

Measures that were considered but were screened out before final formulation of alternatives are discussed below.

Modifying Existing Bridges and Crossings:
The project area is defined by road crossings (Interstate 95 to US Highway 15), with an additional 3 other crossings in between. These (and the other crossings outside of the project area) have had an impact to the hydrology of Polk Swamp, and modifying the bridges and road crossing within and adjacent to the project area would improve hydrologic flow rates and periodicity of flood storage.

This measure was eliminated because the current degraded condition of the project area did not occur until long after all the crossings were established.

Modification of the St. George Wastewater Treatment Plant:
The Town of St. George's wastewater treatment plant discharges into the Polk Swamp at the upper end of the project area just below Interstate 95. The current NPDES permit for this facility allows the treatment plant to discharge 1.24 cfs daily. Improvement or changes to discharges for the water treatment plant may improve the water quality within the project area and lead to decreased nutrients being available to fuel invasive plant growth.

This measure was eliminated after a review of the plant's operations and compliance history revealed that the plant has a minimal impact to the swamp. The current NPDES permit for this facility allows for a monthly average discharge of 0.8 million gallons of water per day (approximately 0.8% of the modeled low flow for Polk Swamp). The facility had consistently met permit limits since 1999. This fact, combined with significantly decreasing trends in biochemical oxygen demand, turbidity, and total nitrogen levels in the water indicate that the treatment plant is not a source of impact to the project area.

Complete Removal of Blockages from the Floodplain:
Blockages are primarily comprised of fallen timber, plant growth, choke points where debris has collected, and impoundments created by beaver. The removal of these blockages from the floodplain in their entirety would allow for the restoration of hydrology, including flood and low water periods. The removal process would include both mechanical and hand clearing. The mechanical removal would be performed using floating mechanized equipment (likely an amphibious track-hoe) in addition to standard tracked equipment to clear blockages.

This measure was eliminated after it was determined that when compared to the partial removal of blockages measure, there was no significant difference in ecological outcomes between the two measures. Additionally, when compared to other similar measures, this measure would be capital and labor intensive, requiring extensive work with heavy equipment in the channel and floodplain to execute, with no apparent increase in ecological outcomes.

Off Site Disposal of Material Taken From Blockages Off Site:
All material removed for flow blockages would be taken off site for disposal. In areas where significant impoundments exist, the blockages would be removed slowly to avoid large and sudden changes in water quality downstream of the work. Care would be taken to minimize the amount of debris that is allowed to leave the immediate area, and screens would be placed in the channel downstream of the work to capture and collect debris that is released into the channel.

This measure was eliminated after it was determined that hauling all material removed from blockages off site served no appreciable ecological benefit to the swamp and would cost more without contributing to habitat diversity.

Create a New Channel for Polk Swamp:
The channel would be cleared of blockages following the simplest and most direct path through the swamp. No consideration would be given to historical flow paths.

This measure was eliminated after it was determined that following the historic channel of Polk Swamp would more closely align with the project objective of restoring the natural hydrology of the swamp than would creating a new channel by following the simplest and most direct path through the swamp.

3.2.3. Measures Used for Formulation of Alternatives

Partial Removal of Blockages:
Blockages are primarily comprised of fallen timber, plant growth, choke points where debris has collected, and impoundments created by beaver. Blockages would be removed to the extent needed to restore flow through the project area. The removal process would include both mechanical and hand clearing. The mechanical removal would be performed using floating mechanized equipment (likely an amphibious track-hoe) to clear blockages within at least a 21-foot wide path within the historic channel. The dimension of at least 21 feet was provided by the non-Federal Sponsor as the bottom width required for their equipment to clear/maintain the flow path of the stream. Work would start at the downstream end of the project and work upstream. If additional blockages require removal after the initial pass through the Study area, that work would be performed working back downstream.

On and Off Site Disposal of Material Taken From Blockages:
Organic debris would be placed on higher ground adjacent to blockages to create topographic relief within the floodplain of Polk Swamp and promote the development of micro habitats and greater diversity within the restoration area. When feasible, large components of blockages consisting of trees and other organic material would be taken off site along with the inorganic material for upland use or disposal. In areas where significant impoundments exist, the blockages would be removed slowly to avoid large and sudden changes in water quality downstream of the work. Care would be taken to minimize the amount of debris that is allowed to leave the immediate area and screens would be placed in the channel downstream of the work to capture and collect debris that is released into the channel.

Conduct an Initial Application of Herbicide:
The initial herbicide application would be applied to approximately 290 acres of the project area that have been converted from bottomland hardwood forest to *Typha sp.* dominated marsh. Due to the size of the area and the difficulty of the terrain, application would be made by helicopter spraying. Through discussions with SCDNR Aquatic Invasive Species Staff, the Corps has determined that the preferred herbicide to be used for the initial spraying is Habitat™ (or a similar herbicide) mixed with a glyphosate (or a similar herbicide).

Targeted Secondary Herbicide Application:
The area would be spot-treated with herbicides to prevent the reintroduction of invasive species (from either germinated seeds or outside sources) that would prevent the successful reestablishment of bottomland hardwood forests. The preferred herbicide to be used for the targeted herbicide application is Clearcast™ (or a similar herbicide) mixed with a glyphosate (or a similar herbicide).

Controlled Burn:
While herbicide application would be fatal to *Typha sp.* and other emergent aquatics, the cattails would still reside in the project area due to the fact that their root systems are well embedded and the plants would not be

transported downstream, nor would they break down in any reasonable amount of time. The dead plant material would be removed by conducting a controlled burn of the project area.

Replant With Native Tree Species:
Replanting would include a mix of trees found in bottomland hardwood forests. While the specific species mix will be determined by what is available at the time of replanting, bald cypress, willow oak, and water oak are common and readily obtainable. (Other species will also be included if available at time of planting.)

Rely on Natural Regeneration of Desirable Tree Species:
Restoration of native hardwood spices would solely depend on natural regeneration. No replanting or augmentation to the existing seed bank would occur.

Post Planting Invasive Species Management by Targeted Spraying:
After planting, targeted spraying with Clearcast™ would be conducted to prevent the reintroduction of emergent vegetation and allow the seedlings to grow. Seedlings would be monitored to ensure success.

Post Planting Invasive Management by Hand Removal:
After invasive species are initially removed, no additionally application of herbicide would occur. Instead invasive species that colonize the area would be removed by hand. No maintenance spraying would be carried out to manage invasive species that may outcompete with naturally regenerated or planted hardwoods.

Restore the Historical Channel of Polk Swamp:
Expansion or deviation from the historic channel would be avoided to the extent practical to minimize the amount of material that is required to be transported out of or moved within the project area. Using historical maps and evidence from the field, the historical channel of Polk Swamp would be followed as closely as possible during removal of the blockages.

CHAPTER 4 EVALUATION AND COMPARISON OF ALTERNATIVES

Alternative Plans were formulated using combinations of the measures described, above. Evaluation of the alternative plans was accomplished through the calculation of the environmental outputs (habitat evaluation) and cost analysis.

Alternatives were compared based on their ability to address the objectives based on the four criteria from the Principles and Guidelines:

- **Completeness.** Extent to which the alternative provides and accounts for all necessary investments or actions to ensure realization of the planning objectives
- **Effectiveness.** Extent to which the alternative contributes to achieving the planning objectives
- **Efficiency.** Extent to which the plan is the most cost-effective means of addressing the specified problems and realizing the specified opportunities, consistent with protecting the nation's environment

- **Acceptability.** Workability and viability of the alternative with respect to acceptance by Federal and non-Federal entities and the public, and compatibility with existing laws, regulations, and public policies

The outputs of an ecosystem restoration project are not readily convertible to actual monetary units as is required for traditional benefit-cost analysis. Ultimately, the recommended restoration plan will be the plan that provides the best set of habitat benefits for the least relative cost. This process requires the following steps, which are further described below:

1. **Assessment of Habitat Benefits for Each Alternative**. Assessment of habitat benefits calculated for each restoration alternative based on best scientific data and field studies.

2. **Cost Estimates for Each Alternative**. Development of cost estimates for each restoration alternative based on preliminary designs.

3. **Cost Effectiveness and Incremental Cost Analysis**. Identification of the cost effective and incrementally justified restoration alternatives based on comparison of habitat outputs and cost estimates.

4. **Selection of the Recommended Plan**. Identification of the recommended plan, which includes the combination of restoration measures that provides the greatest incremental habitat benefit for lowest relative cost, and is acceptable, complete, effective, and efficient.

4.1. Alternative Formulation Process

The management measures outlined in the previous section were combined, using best scientific judgment, in order to form alternatives that meet the project's objectives. During the screening process, it became evident no individual measure would fully address all project objectives. For example, removing the blockages would restore hydrology to the project area; however, that measure alone would neither facilitate the removal of the invasive species nor the reintroduction of bottomland hardwood forest. Likewise, the application of herbicides would not physically remove invasive species nor likely allow for reintroduction of bottomland hardwood forest.

The alternatives were formulated based on the project's objectives, plan formulation constraints, and professional judgment regarding the effectiveness of each measure. It was determined that physical removal of blockages through the entire reach was essential for restoring the historical hydrology which would dictate the long term success of any attempts to restore vegetation. Similarly, measures that remove and prevent reestablishment of invasive species or restore bottomland hardwoods for only a portion of the project area were not considered due to an unacceptable risk that invasive species remaining within the project area would re-colonize treated areas and outcompete seedling hardwoods. Additionally, if the planting keystone species was limited to part of the project area, the considerable amount of time (30 years or more) required for bottomland hard tree species to reach sexual maturity would prevent those species from naturally spreading through the entire project area within the period of analysis.

The planning process started with removal of blockages measure being initially evaluated as Alternative 1. Restoration of flow by removal of blockages is the first required measure of any alternative addressed at ecosystem restoration: i.e., the "keystone" in this system. Other management measures were added to Alternative 1 to create additional alternatives. This process was repeated to create multiple alternatives that met the project objectives with varying degrees of success. In this case, the measures are additive and each alternative was built upon the previous alternative by adding measures to better address the project objectives.

Different combinations of alternatives were not considered because, other than natural regeneration, the success of each measure is dependent on the previously added measure or measures. The array of alternatives considered is presented in Table 4.1. They are also described in the subsequent text. All of the alternatives were carried forward and compared with respect to costs and benefits.

Table 4.1: Management Measures Combined to Form Evaluated Alternatives

Alternative	Physical Removal of Blockages	Initial Herbicide Application	Maintenance Herbicide Application	Burning	Natural Regeneration	Replanting
No Action					X	
1	X				X	
2	X	X			X	
3	X	X	X		X	
4	X	X	X	X	X	
5	X	X	X	X	X	X

4.2. Alternatives

4.2.1. Alternative 1:

Alternative 1 consists only of the Removal of Blockages measure and the placement of material taken from blockages both on and off site. This measure involves the physical removal of blockages within the historic channel throughout the project area. These blockages are primarily comprised of fallen timber, choke points where debris has collected, and impoundments created by beaver. The removal of these blockages would allow for the restoration of hydrology, including flood and low water periods. The removal process would include both mechanical and hand clearing. The mechanical removal would be performed using floating mechanized equipment (likely an amphibious track-hoe) to clear blockages within at least a 21-foot wide path within the historic channel. Work would start at the downstream end of the project and work upstream. If additional blockages require removal after the initial pass through the project area that work would be performed working back downstream.

Components of the blockages consisting of inorganic material would be taken off site for upland use or disposal using a small barge. Expansion of the historic channel would be avoided to the extent practical to minimize the amount of material that is required to be transported out of the project area. Organic debris would be placed on higher ground adjacent to blockages to create topographic relief within the floodplain of Polk Swamp and promote the development of micro habitats and greater diversity within the restoration area. When feasible, large components of blockages consisting of trees and other organic material would be taken off site along with the inorganic material for upland use or disposal. In areas where significant impoundments exist, the blockages would be removed slowly to avoid large and sudden changes in water quality downstream of the work. Care would be taken to minimize the amount of debris that is allowed to leave the immediate area and screens would be placed in the channel downstream of the work to capture and collect debris that is released into the channel.

4.2.2. Alternative 2:

Alternative 2 is identical to Alternative 1 except that it adds the initial application of herbicides measure. This measure includes an initial herbicide application of herbicide to approximately 290 acres that have been overtaken by cattails, alligator weed and smart weed. Due to the size of the area and the difficulty of the

terrain, application would be made by helicopter spraying. Through discussions with SCDNR Aquatic Invasive Species Staff, the Corps has determined that the preferred herbicide to be used for the initial spraying is Habitat™ (or a similar herbicide) mixed with a glyphosate (or a similar herbicide). The application rate would be 15-20 gallons/acre. Below is a brief description of the herbicides to be used:

> Habitat™ works by affecting enzymes only found in plants. It is absorbed through leaves, stems, and roots and causes the plant to cease growing and exhaust its nutrient supply. Habitat™ is approved by the USEPA and has a history of effective herbicide use. This or a similar product would be applied in accordance with the agricultural pesticide standards. For product information please see: http://www.sepro.com/documents/Habitat_Label.pdf.
>
> Glyphosate is one of the most common, widely used products for weed control and is commonly used in household and commercial weed control products. It is the active ingredient in Round Up™, Ranger Pro™, and Strike Out™. Glyphosates are absorbed in the leaves, travel to the roots, and prevent plants from gathering nutrients. Glyphosates are broken down in the plants that absorb them and do not travel to be absorbed by other plants. Glyphosates have been long used for aquatic plant control. This or a similar product would be applied in accordance with agricultural pesticide standards. For product information please see: http://npic.orst.edu/factsheets/glyphotech.html.

4.2.3. Alternative 3:

Alternative 3 is identical to Alternative 2 except that it adds targeted maintenance application of herbicides. After the initial application of herbicide, the project area would be spot-treated with herbicides to prevent the reintroduction of invasive species (from either germinated seeds or outside sources) for two years. Following that the project area would receive additional spot treatments with herbicides for up to an additional two years if the criteria of the adaptive management are triggered. The preferred herbicide to be used for the targeted herbicide application is Clearcast™ (or a similar herbicide) mixed with a glyphosate (or a similar herbicide). Application rate would be 15-20 gallons/acre with backpack spraying being the preferred method of application.

> Clearcast™ herbicide is an aqueous formulation that may be applied either directly to water for the control/suppression of certain submerged aquatic vegetation, broadcasted, or used for targeted application on floating and emergent vegetation. Like Habitat™, it attacks plant enzymes and inhibits nutrient uptake, growth, and subsequent survival. It is approved by the USEPA and has a history of use for aquatic plant control.

4.2.4. Alternative 4:

Alternative 4 is identical to Alternative 3 except that it adds the controlled burning measure. While the herbicide application would be fatal to *Typha sp.* and other invasive emergent aquatics, the cattails would still reside in the project area due to the fact that their root systems are well embedded and the plants would not be transported downstream, nor would they break down in any reasonable amount of time. The dead plant material must be removed, either by physical means or controlled burn. Conducting a controlled burn would be the most efficient means of removing the dead material and would have the benefit of releasing stored nutrients and carbon back into the system.

4.2.5. Alternative 5:

Alternative 5 is identical to Alternative 4 except that it adds the replanting and post planting maintenance measures. Replanting would be carried out to supplement natural regeneration. Specific species mix would include at a minimum bald cypress, willow oak, and water oak. After the planting, targeted maintenance

application of herbicides, outlined in alternative 3, would occur. . Seedlings would be protected with biodegradable sleeves and monitored to ensure success. Diseased seedlings would be removed and replaced.

4.2.6. No Action Alternative and Future Without Project Condition

A basic alternative to any proposed plan of improvement is the "No Action" alternative. The No Action Alternative is the most probable future condition if no action is taken. The No Action Alternative would not remove the permanently impounded water, restore the climax palustrine forested ecosystem, or improve water quality throughout the watercourse. Although the area may eventually recover naturally, the area would remain only minimally productive for both fish and wildlife resources that are indigenous to this type of environment for the foreseeable future. Though natural recovery may eventually occur, the most likely future is the continued degradation of the swamp.

The Future without project condition would be very similar to the current condition of Polk Swamp. Additional degradation would occur and what little quality habitat remains in the project area would be lost. In this report, for all modeling and comparisons between alternatives the future without project condition is used.

4.3. Assessment of Habitat Outputs for Each Alternative

4.3.1. Uniform Mitigation Assessment Method (UMAM)

In order to select the most cost effective restoration plan, it is necessary to assign a quantitative numeric value to the habitat benefits for each measure. These habitat benefits are compared with costs to determine cost effective and incrementally justified alternatives.

The Uniform Mitigation Assessment Method (UMAM), as defined in Florida Administrative Code (FAC) 62-345, was used to calculate habitat units generated by each alternative. UMAM, designed by the Florida Department of Environmental Protection (FDEP) for CWA Section 401 regulatory purposes, is a functional assessment that accounts for the biological, physical, and ecological characteristics of a habitat (and adjacent areas) to be impacted or used as mitigation and incorporates the size of the area (typically in acres) to yield a number representing "functional units." Scores are determined, through calculations, to yield functional losses (usually associated with impacts) or functional gains (usually associated with mitigation or restoration). The categories for evaluation include location and landscape support, water environment, and community structure.

UMAM was used for this study due to the detail it provides for evaluation of mitigation and restoration areas/actions, and its flexibility in application. There are no parameters or specifications that make UMAM specific to any geographic region. The UMAM training manual states, "The UMAM is designed to assess any type of impact and mitigation, including the preservation, enhancement, restoration, and creation of wetlands, as well as the evaluation and use of mitigation banks...." Importantly, UMAM guidance states that areas are scored according to what natural areas are "supposed to be," which makes the method a very powerful tool, unlike many other geographic- or habitat-specific methods. From the scientific perspective, UMAM is able to capture and quantify the relative restoration outputs. From the USACE policy perspective, the UMAM tool has been used for other USACE projects in the past, including the Charleston Harbor Post 45 Deepening Study which used UMAM to determine the wetland mitigation requirements in areas similar to Polk Swamp. Table 4.2 shows the UMAM scores. For each alternative detailed information regarding calculation of scores can be found in Appendix E.

Table 4.2: UMAM Scores for Alternatives

	No Action/ (Current)	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Location and Landscape Support	5	6	6	6	7	7
Water Environment	2	6	7	7	7	9
Community Structure	2	4	5	5	6	9
Totals	9	16	18	18	20	25
Wetland Credits*	**0**	**59.35**	**76.3**	**76.3**	**93.38**	**135.6**

*The results reflect the sum of improvements over a large number of variables related to the proposed project; however, they do not reflect a consistent distribution of improvement related to all objectives.

4.4. Cost Estimates for Each Measure

Selecting the best alternative requires that each alternative be assessed for its total cost of implementation, operation, and maintenance. The cost estimate for each measure is based on preliminary design plans and includes the total construction cost plus a contingency on the construction costs and design costs. These costs are then annualized over the course of the 50-year period of analysis and reported as average annual costs. The average annual costs are used in the incremental cost analysis and compared against the Average Annualized Habitat Improvement Units to determine which measures and sets of measures provide the greatest benefit for the least cost. Detailed preliminary cost estimates for each measure are provided in Appendix F. The price level was for FY2016.

It is expected that if the recommended alternative is selected and detailed design and analysis work is performed, the cost estimates may change. However, this is not expected to affect the overall plan selection because all of the alternatives were initially compared against each other using the same unit costs.

4.5. Lands, Easements, Rights-of-Way, Relocations, and Disposal (LERRDs)

The requirements for lands, easements, rights-of-way,relocations, and disposal/borrow areas should include the rights to construct, maintain, repair, operate, and replace ecosystem restoration measures. All components of the project can be constructed under the Non Standard Aquatic Ecosystem Restoration Easement. Based on GIS Data provided by Dorchester County, there are approximately 35 properties within the footprint of the proposed project area. Dorchester County will be required to purchase the Non Standard Aquatic Ecosystem Restoration Easement from each of the 35 land owners. Approximately 290 acres will be impacted by project construction. As of the date of this report, the need for temporary and/or perpetual access across private property has not been determined, nor have staging areas been identified. Should the need to acquire access or staging areas be identified during the Pre-construction, Engineering and Design (PED) Phase, the sponsor will be required to use the Standard Road Easement and/or Temporary Work Area estates for acquisition of these rights. See Appendix G for more details on real estate requirements for the project.

4.6. Cost Effectiveness Analysis

Traditional benefit-cost analysis is not possible for planning ecosystem restoration projects because the costs and benefits are expressed in different terms, with costs in dollars and benefits evaluated by the presence of

appropriate habitat or ecosystem function. However, cost effectiveness and incremental cost analyses can provide decision makers with relative benefit-cost relationships of the various alternatives. While these analyses are not intended to lead to a single best solution, they improve the quality of decision-making by ensuring that a rational, supportable, focused, and traceable approach is used for considering and selecting alternatives to produce ecosystem outputs.

Corps guidance (ER 1105-2-100 & IWR Report 95-R-1) requires cost effectiveness and incremental cost analyses (CEICA) for ecosystem restoration projects. First, a cost effectiveness analysis was conducted to ensure that the most appropriate solution is identified for each possible level of ecosystem output. The CEICA was conducted using the IWR Planning Suite. The IWR Planning Suited is a water resources investment decision support tool originally built for the formulation and evaluation of ecosystem restoration alternative plans; however, it is now more widely used by all USACE business lines for evaluation of actions involving monetary and non-monetary cost and benefits. Cost effectiveness means that no plan can provide the same benefits for less cost, or more benefits for the same cost. Costs were annualized over a 50-year period of analysis using the Fiscal Year 2016 the discount rate of 3.125%. Cost used in screening analysis did not differ from those found in the Cost Appendix (Appendix F). Table 4.3 provides a summary of the average annual costs, average annual outputs, and cost effectiveness analysis. The no action plan was included for comparison ($0 cost and 0 outputs).

It is important to note that while similarities between the Pocotaligo River and Swamp Section 206 Aquatic Ecosystem Restoration and the Polk Swamp Section 206 Aquatic Ecosystem Restoration Project exists many key differences between restoration measures exists between the two projects. The types of invasive aquatic vegetation that is present varies between the two projects and Polk Swamp has little standing live hardwoods to provide a seed bank. In contrast Pocotaligo River and Swamp had invasive species that were more easily managed and live standing hardwoods for seed stock. The main measure in common between these two studies was the restoration of the flow path. The Best Buy Alternative for the Polk Swamp Section 206 Aquatic Ecosystem Restoration Project has significant components that involve management of invasive cattail species and the replanting of native tree species. These aspects of the project are costly and were not a part of the Pocotaligo River and Swamp Section 206 Aquatic Ecosystem Restoration Project or were a smaller component of the Pocotaligo River and Swamp Section 206 Aquatic Ecosystem Restoration Project, but are vital to the success of the Polk Swamp Section 206 Aquatic Ecosystem Restoration Project. These differences have resulted in the cost per unit effort being greater for the Polk Swamp Section 206 Aquatic Ecosystem Restoration Project than it was for the Pocotaligo River and Swamp Section 206 Aquatic Ecosystem Restoration Project.

Table 4.3 Average annual costs, outputs, and cost effectiveness summary.

Alternative	Average Annual Cost	Average Annual Habitat Units	Cost Effective
No Action	0	0	Best Buy
Alternative 1	29,160	47	Yes
Alternative 2	41,621	57	Yes
Alternative 3	74,930	59	Yes
Alternative 4	75,420	70	Yes
Alternative 5	87,886	98	Best Buy

All of the Alternatives analyzed were cost effective. The No Action Alternative and Alternative 5 were identified as best buy plans. Figures 4.1-4.5 illustrate the costs and outputs for Alternatives 1- 5, respectively. Figure 4.6 presents a graphical comparison of the results of the cost effectiveness analysis for each alternative.

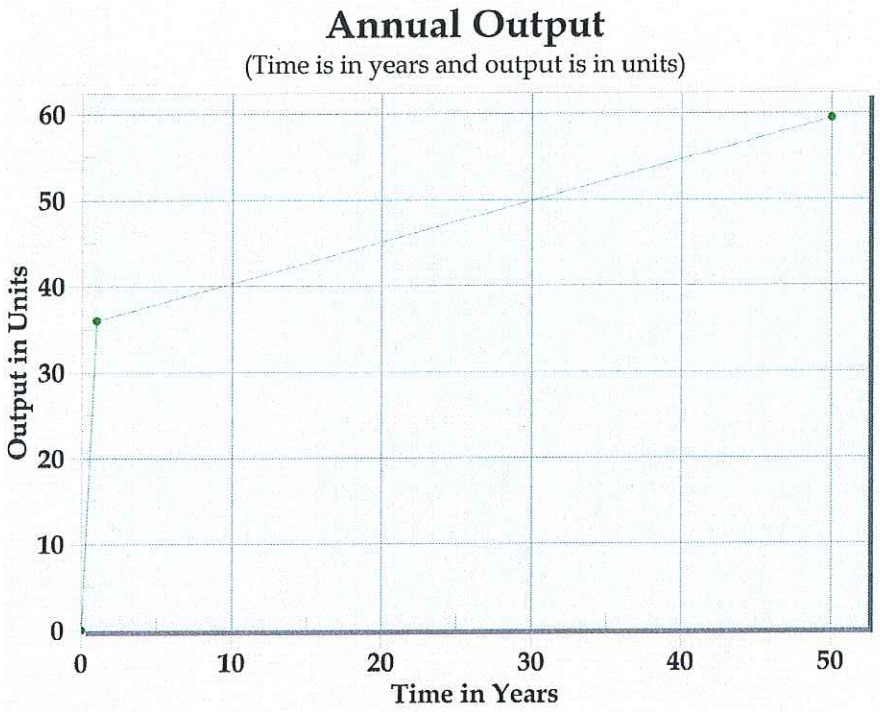

Figure 4.1 Average annual outputs over the period of analysis for Alternative 1

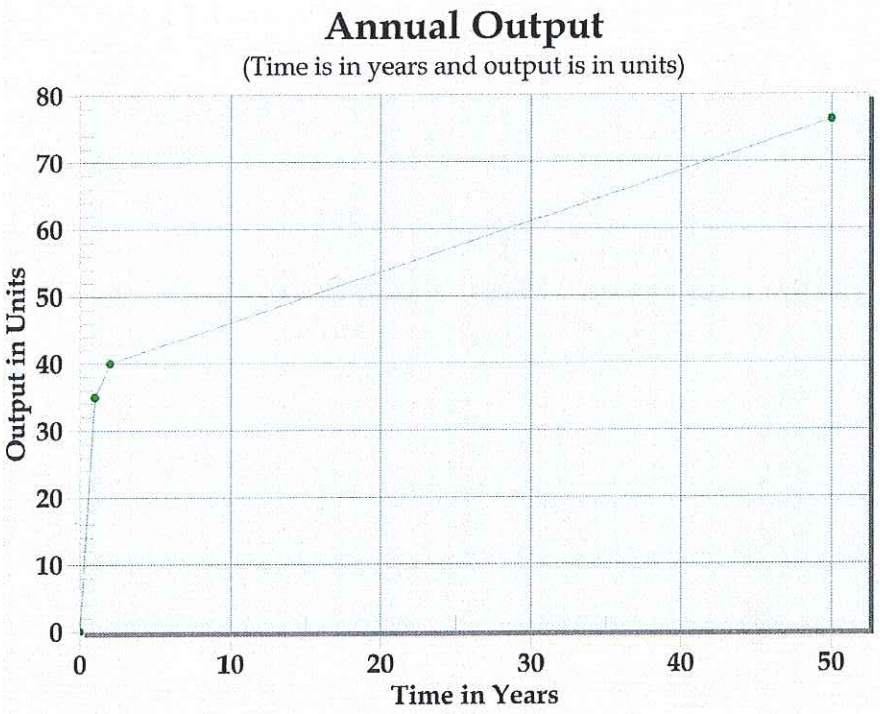

Figure 4.2 Average annual outputs over the period of analysis for Alternative 2

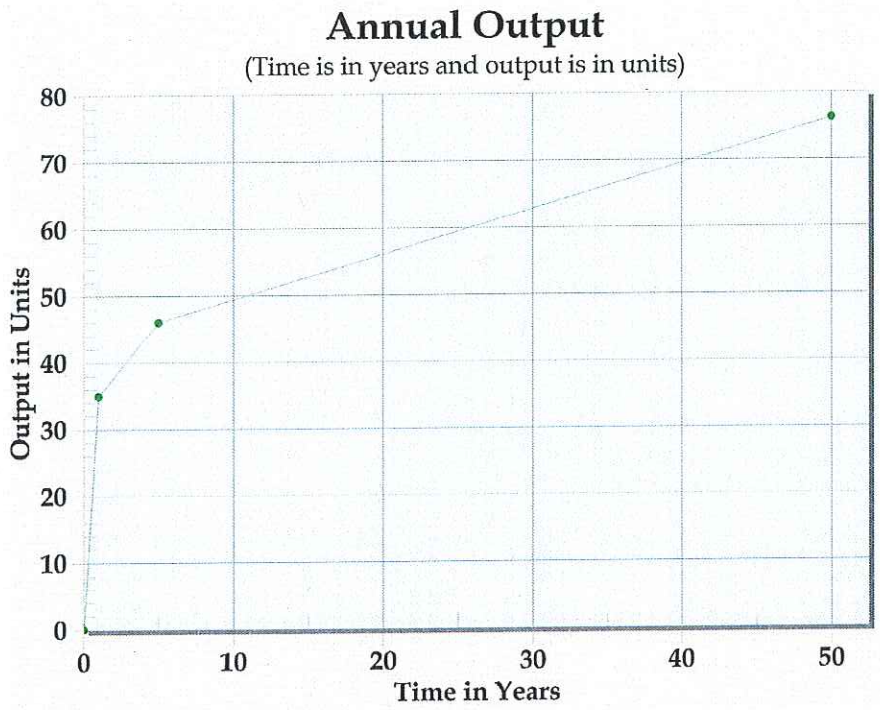

Figure 4.3 Average annual outputs over the period of analysis for Alternative 3

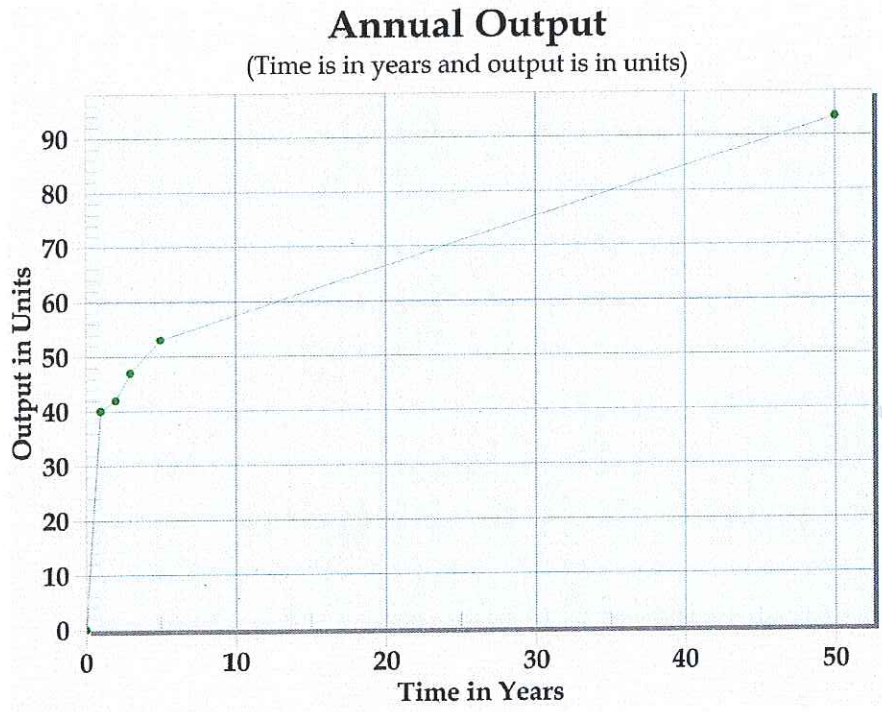

Figure 4.4 Average annual outputs over the period of analysis for Alternative 4

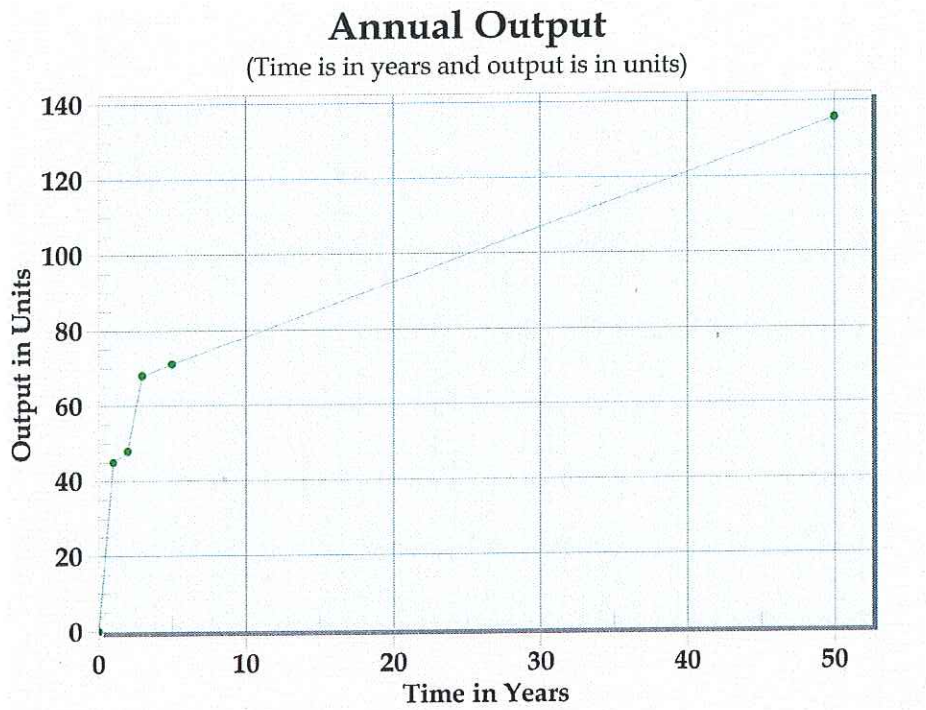

Figure 4.5 Average annual outputs over the period of analysis for Alternative 5

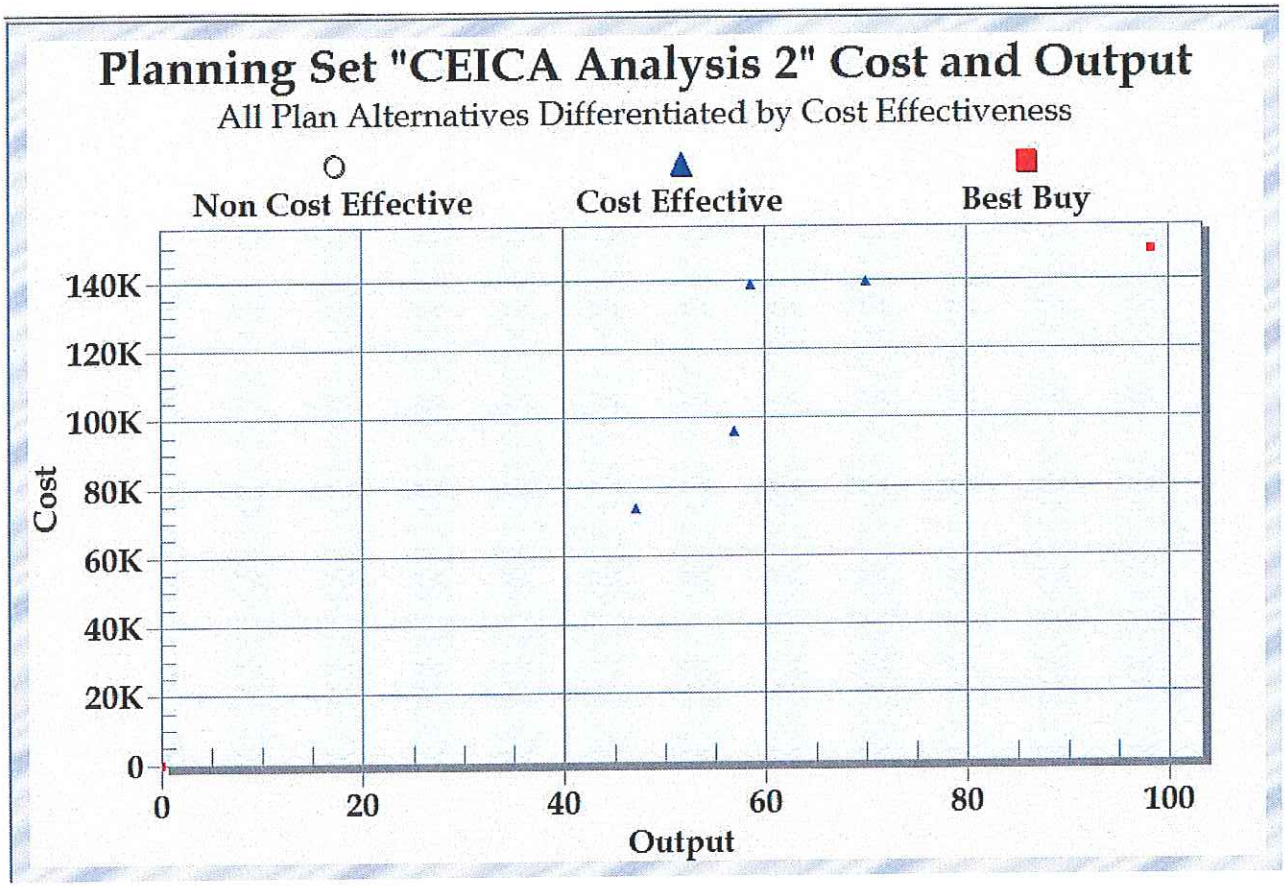

Figure 4.6 Relationship between average annual cost (Cost) and average annual habitat units (outputs) for each alternative.

4.7.Plan Selection

Based on the results of comparative analysis, the "Best Buy" alternatives (No Action and Alternative 5) were carried forward as the final array for more detailed analysis based on acceptability, efficiency, effectiveness and completeness.

The objectives of this study, which the best buy alternatives will be weighed against, are:

- Restore and enhance the aquatic environment by restoring natural hydrology and flows and connectivity;
- Restore and enhance the riparian corridor through the removal of invasive species; and
- Reforest the project area with keystone bottomland hardwood species thereby expanding existing riparian corridors, reducing fragmentation, and diversifying both habitat and wildlife.

Table 4.5 summarizes each alternative's ability to at least minimally address each of the project objectives within the 50-year period of analysis.

Table 4.5: Comparison of the Alternatives at Meeting Project Objectives

Alternative	Restore Natural Hydrology and flows	Remove Invasive Vegetation	Limit Reestablishment of Invasive Vegetation	Restore Bottomland Hardwood Forest	Promote Natural Regeneration
No Action					
5	X	X	X	X	X

The no action alternative was eliminated due to its failure to meet any of the project objectives within the period of analysis. The action alternative was further evaluated to carefully consider ecological and scientific variables present within the project area that may impact the alternatives success. In order to accomplish this, Alternative 5 was evaluated against existing scientific literature to determine its likelihood of successfully meeting project objectives.

Several scientific studies have examined regeneration and restoration of cypress-tupelo swamps. Salt water intrusion has been shown to have a strong negative impact to the successful reestablishment of cypress-tupelo swamps; however, due to the location of Polk Swamp, salt water intrusion is not a risk factor for this restoration effort. Other variables that inhibit successful restoration of cypress-tupelo swamps and are risk factors for this proposed restoration effort include: herbivory, shading, aggressive weed growth, inadequate seed banks, and altered hydrology (Middleton 2000, Middleton 1998, Conner 1995, Myers, et.al. 1995 and Conner and Flynn1989).

Natural regeneration of cypress does not occur in areas that are permanently flooded due to the inability of their seeds to germinate underwater. Optimal conditions for natural germination of cypress are flooded winters with dry summers for seed germination and growth (Middleton 1998). Alternative 5 would allow the floodplain to undergo natural flooding which could allow for the natural germination and growth of cypress. During a typical year, the physical removal of blockages would result in base flows being constrained to the channel frequently

enough to allow bottomland hardwoods, cypress and tupelo to persist, once established, and reduce habitat for invasive emergent aquatic vegetation.

Myers et.al. (1995) found that weeds can cause cypress to exhibit a spindly growth habit or in some cases lead to mortality. Additionally, Conner (1995) examined cypress-tupelo swamp regeneration after Hurricane Hugo. In areas where growth and recruitment were poor, he concluded it was likely due to intense shading and flooding. Though the weed species in Myers, et.al. (1995) were vines, parallels can still be drawn with Polk Swamp. Cattails share some characteristics with vines including rapid and aggressive growth. Without removal of cattails from the project area, they would quickly envelop any seedling cypress that germinated naturally or were planted, greatly reducing the amount of light reaching the seedling. Due to the aggressive growth and strong shading produced by cattails, it can be concluded that without the removal of cattails the restoration of any cypress-tupelo swamp would be very difficult.

Middleton (2000) found that cypress seeds had limited dispersal ranges within a swamp. Few to no mature cypress or tupelo exist in the study reach (Appendix B) and healthy upstream reaches of the swamp likely only provide few seeds this far downstream. The seed bank within the five mile project area is also limited. Middleton (2003) determined that the seeds of cypress trees and other swamp hardwoods remain viable in the environment for only a short time (as briefly as a year), which makes natural re-colonization difficult in cypress-tupelo swamps. This reach of Polk Swamp has lacked a healthy population of swamp hardwoods for seed stock since sometime between 1994 and 2012 (Appendix B). Based on available literature there is reasonable doubt that Polk Swamp would restore itself to a cypress-tupelo swamp and bottomland hardwood forest within the period of analysis with only improved flow regimes and/or removal of invasive vegetation. The seed bank in the swamp is inadequate, and only small numbers of seeds would be expected to arrive in the area from upstream reaches.

Based on the considerations and analysis presented, above, Alternative 5 was selected as the Recommended Plan. Alternative 5 meets all of the project objectives with an acceptably high degree of confidence. Alternative 5 is the "Best Buy" plan that addresses all of the project objectives. None of the other alternatives considered addressed variables present in Polk Swamp that have been found, in several scientific studies, to have a strong negative impact on the restoration of cypress-tupelo swamps. Although Alternative 5 is the most expensive plan, it is the sole Best Buy plan and it is likely to succeed at restoring the project area. Myers, et.al. (1995) concluded that management techniques (such as weed management and herbivory control), though labor intensive in the short term, were important to long-term success of cypress plantings. The cost of Alternative 5 is justifiable because it meets all of the project objectives and realizes substantial benefits to fish and wildlife species. Therefore, Alternative 5 is selected as the Recommended Plan and the NER plan for its ability to meet project objectives, provide notable benefits, and be cost effective.

Alternative 5 consists of several measures listed and described below.

Measure 1: removal of blockages and placement of material taken from blockages both on and off site. This measure involves the physical removal of blockages within the historic channel throughout the project area. These blockages are primarily comprised of fallen timber, plant growth, choke points where debris has collected, and impoundments created by beaver. The removal of these blockages would allow for the restoration of hydrology, including flood and low water periods. The removal process would include both mechanical and hand clearing. The mechanical removal would be performed using floating mechanized equipment (likely an amphibious track-hoe) to clear blockages within at least a 21-foot wide path within the historic channel. Work would start at the downstream end of the project and work upstream. If additional blockages require removal after the initial pass through the project area that work would be performed working back downstream.

Components of the blockages consisting of inorganic material would be taken off site for upland use or disposal using a small barge. Expansion of the historic channel would be avoided to the extent practical to minimize the amount of material that is required to be transported out of the project area. Organic debris would be placed on higher ground adjacent to blockages to create topographic relief within the floodplain of Polk Swamp and promote the development of micro habitats and greater diversity within the restoration area. When feasible, large components of blockages consisting of trees and other organic material would be taken off site along with the inorganic material for upland use or disposal. In areas where significant impoundments exist, the blockages would be removed slowly to avoid large and sudden changes in water quality downstream of the work. Care would be taken to minimize the amount of debris that is allowed to leave the immediate area, and screens would be placed in the channel downstream of the work to capture and collect debris that is released into the channel.

Measure 2: initial application of herbicides
This measure includes an initial herbicide application of herbicide to approximately 290 acres that have been overtaken by cattails, alligator weed, and smart weed. Due to the size of the area and the difficulty of the terrain, application would be made by helicopter spraying. Through discussions with SCDNR Aquatic Invasive Species Staff, the Corps has determined that the preferred herbicide to be used for the initial spraying is Habitat™ (or a similar herbicide) mixed with a glyphosate (or a similar herbicide). The application rate would be 15-20 gallons/acre. Below is a brief description of the herbicides to be used:

> Habitat™ works by affecting enzymes only found in plants. It is absorbed through leaves, stems and roots and causes the plant to cease growing and exhaust its nutrient supply. Habitat™ is approved by the USEPA and has a history of effective herbicide use. This or a similar product would be applied in accordance with the agricultural pesticide standards. For product information please see: http://www.sepro.com/documents/Habitat_Label.pdf.
>
> Glyphosate is one of the most common, widely used products for weed control and is commonly used in household and commercial weed control products. It is the active ingredient in Round Up™, Ranger Pro™, and Strike Out™. Glyphosates are absorbed in the leaves, travel to the roots, and prevent plants from gathering nutrients. Glyphosates are broken down in the plants that absorb them and do not travel to be absorbed by other plants. Glyphosates have been long used for aquatic plant control. This or a similar product would be applied in accordance with agricultural pesticide standards. For product information please see: http://npic.orst.edu/factsheets/glyphotech.html.

Measure 3: targeted maintenance application of herbicides
After the initial application of herbicide, the project area would be spot-treated with herbicides to prevent the reintroduction of invasive species (from either germinated seeds or outside sources) for two years that would allow for the successful reestablishment of bottomland hardwood forests. Following that, if the conditions of the adaptive management plan are triggered, an additional two years of spot-treatment with herbicides would be required. The preferred herbicide to be used for the targeted herbicide application is Clearcast™ (or a similar herbicide) mixed with a glyphosate (or a similar herbicide). Application rate would be 15-20 gallons/acre with backpack spraying being the preferred method of application.

> Clearcast™ herbicide is an aqueous formulation that may be applied either directly to water for the control/suppression of certain submerged aquatic vegetation, broadcasted, or used for targeted application on floating and emergent vegetation. Like Habitat™, it attacks plant enzymes and inhibits nutrient uptake, growth, and subsequent survival. It is approved by the USEPA and has a history of use for aquatic plant control.

Measure 4: controlled burning
While the herbicide application would be fatal to *Typha sp.* and other invasive emergent aquatics, the cattails would still reside in the project area due to the fact that their root systems are well embedded and the plants would not be transported downstream, nor would they break down in any reasonable amount of time. The dead plant material must be removed, either by physical means or controlled burn. Conducting a controlled burn would be the most efficient means of removing the dead material and would have the benefit of releasing stored nutrients and carbon back into the system.

Measure 5: replanting and post planting
Replanting would be carried out to supplement natural regeneration. Specific species mix would include at a minimum bald cypress, willow oak, and water oak. Seedlings would be protected with biodegradable sleeves and monitored to ensure success. Diseased seedlings would be removed and replaced.

4.7.1. Acceptability

An ecosystem restoration plan should be acceptable to state and Federal resource agencies and laws, and local laws and ordinances. There is broad-based agency and stakeholder consensus and support for the Recommended Plan. It meets all of the project objectives and is acceptable to state and Federal resource agencies and laws, and local laws and ordinances. It would also realize the predicted habitat outputs by providing the complete mix of measures that ensures hydrologic, fish passage, wildlife, and vegetation objectives are addressed.

4.7.2. Efficiency

An ecosystem restoration plan must represent a cost effective means of addressing the restoration problems and opportunities. It has been determined that the Recommended Plan's restoration outputs cannot be produced more cost effectively by another agency or institution. The Recommended Plan provides substantial benefits at a moderate cost. These benefits cannot be realized more effectively by the non-Federal sponsor or other stakeholders because they do not have the resources to design and construct the primary elements of a project that restores bottomland hardwood forests and the natural hydrology to Polk Swamp on their own.

4.7.3. Effectiveness

An ecosystem restoration plan must make a significant contribution to addressing the specified restoration problems and opportunities. The Recommended Plan would restore the hydrology of Polk Swamp, thereby providing conditions that are conducive to reproduction of native aquatic species and the reestablishment of bottomland hardwood forest. The Recommended Plan would also remove invasive species from Polk Swamp, which would allow for the relatively rapid reestablishment of bottomland hardwood forest and associated wildlife. Lastly the Recommended Plan would ensure that the project area is not re-colonized by undesirable or invasive species by planting native hardwood species and applying herbicides to manage undesirable and/or invasive species.

4.7.4. Completeness

The Recommended Plan is expected to fully address all project objectives. Once the native species become established, there would be minimal continued O&M over the period of analysis. This project can be implemented without requiring other actions in the watershed in order to be successful.

4.7.5. Risk

Risk is the chance of an undesirable outcome and a measure of the probability and consequences of uncertain events. Consequences can be social, environmental, or economic. Risks can be encountered during all phases of project development and implementation. Risks or unseen circumstances encountered during planning and

design can affect project schedule, budget, and project viability. The following summarizes the major risks associated with the Polk Swamp Ecosystem Restoration Project.

In general, the project is relatively simple and does not apply any new, untested, or innovative techniques or technologies. There are no complex technical issues or access problems to resolve to complete the design and other than the channel clearing work, all the proposed work (such as applying herbicides and planting trees) is regularly performed by numerous contractors. Further, a very similar project (Pocotaligo Swamp, near Sumter, SC) has been successfully constructed by the Charleston District. Thus, there is little risk associated with the design and construction portions of the project.

During the implementation of ecosystem restoration projects, risks include the uncertainty of achieving the benefits from the action. For Polk Swamp, severe drought or flood related impacts present the greatest risk to the success of the project over time. Since the proposed blockage and invasive species removal are less susceptible to drought, this risk is concentrated on the survival of the trees that are planted. Since this is a small part of the effort and replanting would be relatively simple and inexpensive, the overall risk is small.

There is a risk that climate change could result in conditions that significantly differ from the historical conditions used to determine the Recommended Plan. However, the recommended plan would restore the natural unobstructed channel conditions, and the more natural hydrology would closely match areas immediately upstream and downstream of the project. Once constructed, the conditions created by the recommended plan would improve the system's ability to accommodate a wider range of climate variability. There is no expected change in land use of the watershed that would affect runoff into the swamp. Additionally, there is no expected wetlands fill that would affect the storage and attenuation of a flood hydrograph, and any changes in rainfall would affect both the no action and the proposed plan. No action would result in worsening conditions of longer inundation periods within the swamp, increased potential backwater flooding, increased degradation of the swamp, and roadway overtopping should climate change result in heavier rainfall because the obstructed stream cannot drain the floodwaters as efficiently as it can with the recommended plan.

Real estate risks associated with the project are minimal and are discussed at length in the real estate appendix (Appendix G).

CHAPTER 5 ENVIRONMENTAL IMPACTS

Environmental impacts for the Recommended Plan have been identified below. Restoration features that were not selected are not included in the analysis of impacts. Overall, the project is designed to have positive benefits on the environment.

5.1.Hydrology

The Recommended Plan would restore the main channel to a width of at least 21 feet through the entire project area. A maintained channel with reduced friction and the elimination of blockages would cause the flood hydrograph to rise and fall more quickly, mimic the natural unobstructed portion of the stream downstream of US Highway15 and restore natural conditions. Modeling of the stream was performed to predict the hydraulic changes that would result from the proposed action. Figure 5.1 illustrates the peak water surface elevations that are predicted to occur for a typical low flow flood under with and without project conditions. The low flow flood would be expected to occur regularly within the project area.

FEMA's definition of a "Regulatory Floodway" is the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water

surface elevation more than a designated height. Communities must regulate development in these floodways to ensure that there are no increases in upstream flood elevations. The proposed project is located in a FEMA floodway. However, the proposed project does not consist of "development" in a floodway. It attempts to restore the historical flow regime, thus does not increase upstream flood elevations.

Based on the model results, restoration of the main channel through the physical removal of blockages would result in inundations areas that are smaller but that closely resemble existing inundation areas. However, base flows would be constrained to the main channel frequently enough to allow bottomland hardwoods, cypress and tupelo to persist, once established and limit the re-establishment of emergent aquatic vegetation. Details related to the modeling effort are provided in Appendix C.

Figure 5.1: Inundation map for Low Flow Flood Condition - Existing versus proposed action and base flow for proposed action.

5.2. Land Use

Construction of the proposed project would not change the existing land use outside the project area. The change from cattail dominated marsh to cypress- tupelo swamp and bottomland hardwoods would allow historic land uses to occur within the project footprint including hunting, fishing, and trapping. The proposed project would have no impact to prime or unique farmland. Temporary and minor erosion would occur throughout a portion of the swamp from removal of blockages and operation of mechanical equipment. In order to minimize erosion, best management practices would be implemented for construction activities and the mechanical removal would be performed using floating mechanized equipment (likely an amphibious track-hoe) to clear blockages within the historic channel. Work would start at the downstream end of the project and move upstream. If additional blockages require removal after the initial pass through the project area, that work would be performed working back downstream. In areas where significant impoundments exist, the blockages would be removed slowly to avoid large and sudden changes in water quality downstream of the work. Care would be taken to minimize the amount of debris that is allowed to leave the immediate area, and screens would be placed in the channel downstream of the work to capture and collect debris that is released into the channel.

Erosion could temporarily increase in areas that have been cleared of invasive cattails. However, these areas would be replanted with native vegetation which would re-stabilize the area and prevent any further runoff and/or erosion.

5.3. Climate

No changes to the area's climate would occur as a result of the proposed project.

5.4. Water Resources and Aquatic Habitat

Temporary changes to water quality and surface waters related to turbidity and sedimentation are anticipated during construction. These impacts would include a cloudiness of water immediately downstream of construction leading to decreased visibility. These impacts would be localized, have minimal impact on the aquatic environment, and return to normal levels shortly after construction activities cease. The project area is a rural environment with little industrial or commercial areas from where high risk contaminants would have originated. As such, there is no reason to believe that unacceptable levels of contaminants within sediments or blockages would be present. The proposed project would benefit Polk Swamp by improving water quality (dissolved oxygen, temperature) and flows within the watershed. The project is consistent with applicable South Carolina water quality regulations and would not impair any such standard or fail to meet anti-degradation requirements for point or nonpoint sources. The constant inundation that currently exists in the Polk Swamp does not allow the historically-present tree species, listed in table 1, to survive; therefore, appropriate hydrology must be restored in order to promote restoration of the forest.

Construction of the proposed project would restore the project area to a more diverse habitat type. This would be accomplished by potentially increasing the density and species richness of the benthic community as well as the native fish assemblage. Removing the hydrologic impediments within Polk Swamp would allow for more effective migration into and out of the swamp from the Edisto River. It is expected that organisms currently established downstream (including more diverse assemblages of aquatic insects and other invertebrates) would re-colonize the project area following construction activities. Similarly, it is expected that a variety of freshwater fish species found downstream would likely increase in density and/or re-colonize the project area once construction is completed. An additional benefit of the project is that the restored connectivity within the swamp would allow native freshwater mussels, found downstream of the project area during initial study reconnaissance but not within the project footprint, to reestablish in the project area.

Red Breast Sunfish Habitat Suitability Index (HSI)

In order to better quantify and understand benefits to aquatic organisms, an HSI assessment on the benefits of the proposed project to the aquatic ecosystem was conducted using redbreast sunfish (Lepomis auritus) as a proxy for the aquatic community (Aho, et. al, 1986). Redbreasts are a centrachid (sunfish) found throughout eastern North America. Redbreasts are a stream dwelling fish preferring to inhabit waters with rather sluggish flow, including the blackwater stream systems of the southeastern coastal plain. They prefer areas with woody debris, stumps and other structures and tend to avoid areas that are stagnant or heavily vegetated. Their diet consists of insects, mollusks, and other fish. Spawning months for redbreast in South Carolina are May through July and they make nests in sand or gravel substrates. Redbreasts are an extremely popular game and food fish in the coastal plains of both South Carolina and Georgia.

US Fish and Wildlife Service developed an HSI for the redbreast to initially quantify changes in wetland habitats on the Savannah River Site near Aiken, South Carolina. The model was designed for use primarily in the southeastern coastal plain, where streams are low gradient (< 2 m/km) with few riffle/pool sequences and provides an index of the ability of an area to support a self-perpetuating population of red- breast sunfish throughout the year. The model is applicable to riverine, lacustrine, and palustrine systems. The palustrine variation of this model was chosen and applied in this study.

The redbreast HSI scores (Table 5.1) show that the project would improve habitat for aquatic fauna. In addition to improving conditions for redbreast, the project would also improve conditions for foraging and spawning for the other centrarchids that populate Polk Swamp. The model also shows that the benefits would come from improving habitat through improving hard structure and removing the vegetation choking the swamp and flood prone areas that are used by fish. While the HSI shows that the proposed project does not significantly improve water quality, restoring flow and removing oxygen consuming materials (dead plant matter) would enhance the aquatic environment. Full model results and formulas are given in Appendix H.

The HSI does not address the impacts that the blockages have with respect to limiting passage of fish through the project area. A recent South Carolina Department of Natural Resources fish survey of the Polk Swamp found only one living fish in the reach of Polk Swamp near the Town of Reevesville (upstream of the project area). This was attributed to the blockages within the project area reach. It is the opinion of SCDNR that the project area and reaches above the project area should quickly repopulate once the blockages are removed and passage is reestablished (personal comm.).

The project benefits shown in this HSI are incidental to the project. The overall purpose of this project is to restore the project area to a bottomland hardwood swamp. This is a relatively minor component of that ecosystem.

Table 5.1: Redbreast Sunfish HSI scoring.

Variable	Variable Description	Existing Condition	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
V1	% Hard Structure Cover During Average Spring Summer Water Levels	.4 (2%)	.5 (10%)	.5 (10%)	.5 (10%)	.5 (10%)	1 (25%)
V2	% Vegetative Cover during Average Spring Summer Water Levels	.5 (95%)	.7 (85%)	.7 (85%)	.7 (85%)	.8 (80%)	1 (50%)
V3	% of Vegetated Wetland with a Depth of ≥ 20 cm	.1 (10%)	.2 (20%)	.2 (20%)	.2 (20%)	.9 (75%)	.9 (75%)

	(Palustrine Habitats)						
V4	Maximum Water T at Preferred Spawning Depth (0.2-1.5 m) Sustained for at Least One Week during the Spawning Season	.4 (15-20)	.4 (15 20)	.4 (15 20)	.4 (15 20)	.4 (15 20)	.4 (15 20)
V5	% of Stream Area during Spawning Season that has a Current Velocity of $\leq$ 20 cm/s and is at least 20 cm in Depth	.2 (5%)	.8 (50%)	.8 (50%)	.8 (50%)	.8 (50%)	.8 (50%)
V6	% Area (during Spawning Season) at Preferred Spawning Depth (.02-1.5 m) Composed Primarily of Coarse Sand or Fine Gravel.	.2 (5%)	.9 (40%)	.9 (40%)	.9 (40%)	.9 (40%)	.9 (40%)
V7	Least Suitable pH during Spawning and Growing Season	1 (6.4)	1 (6.4)	1 (6.4)	1 (6.4)	1 (6.4)	1 (6.4)
V8	Minimum DO Range during Spawning Season	.4 (2.6)	.7 (4)	.7 (4)	.7 (4)	1 (5)	1(5)
V9	Maximum Monthly Average Turbidity during Spawning and Growing Season	1 (7.9)	1 (7.9)	1 (7.9)	1 (7.9)	1 (7.9)	1 (7.9)
V10	Maximum Weekly Water T (1-2 m Deep) During Growing Season	.8 (20-25)	.8 (20-25)	.8 (20-25)	.8 (20-25)	.8 (20-25)	.8 (20-25)
HSI Sum		5	7	7.7	7.7	8	8.6
Improvement Ratio		1	1.4	1.54	1.54	1.6	1.72

5.5. Wetlands, Stream Crossings and Floodplains

Construction of the proposed project would require work to take place in and around Polk Swamp. Work outside the main channel of Polk Swamp would be kept to a minimum. The blockage removal process would include both mechanical methods and hand clearing. Components of blockages consisting of inorganic material would be taken off site for upland use or placed on high ground. Organic debris would be placed adjacent to blockages on higher ground to construct topographic relief within the floodplain of Polk Swamp creating a variety of micro habitats within the restoration area. When feasible, large components of blockages consisting of organic material would be taken off site for upland use or disposal. The 404(b)(1), included as Appendix I, provides a detailed analysis of impacts to waters of the US and wetlands from construction of the proposed project. No significant negative impacts are expected from construction of the proposed project. Upon completion of the proposed project, the invasive cattails that now dominate the project area would be converted to cypress-tupelo swamp and bottomland hardwood forest and more natural flows would be restored in the swamp.

Temporary and minor sedimentation may occur during construction. However, significant movement of materials from the wetlands is not expected to occur. There would be a long term permanent conversion of the project area from invasive cattail dominated marsh to cypress- tupelo swamp and adjacent bottomland hardwood forest. The conversion of the swamp would be a direct result of the restoration of the natural hydro-period due to the removal of invasive species and obstructions within the channel. Plantings of cypress, tupelo and native bottomland hardwood tree species, along with the periodic herbicide application, would help ensure the area is not colonized by invasive or otherwise undesirable species.

The objectives of Executive Order 11988 have been considered in the formulation of plans for this project. The following determinations have been made in response to requirements of Executive Order 11988 which pertains to floodplain management. No practical non-floodplain alternative exists. The considered actions do not conflict with applicable state and local standards concerning floodplain protection. The considered action would not negatively affect the natural and beneficial values of the floodplain or encourage development within the floodplain. The considered action would restore natural floodplain storage.

The objectives of Executive Order 11990 have been considered in the formulation of plans for this project. The following determinations have been made in response to requirements of Executive Order 11990 which pertains to wetland management. No practical non-wetland alternative exists. The considered actions do not conflict with applicable state and local standards concerning wetland protection and permitting and are covered under USACE nationwide permit number 12. The proposed project would positively affect the natural and beneficial values of the impacted wetlands and protect native wetlands.

5.6. Terrestrial Resources and Wildlife

The proposed project would have both positive and temporary negative impacts on wildlife. The proposed project would have positive impacts on natural vegetative communities due to the removal of invasive cattails, reestablishment of native vegetation, and the restoration of natural hydrology to the swamp. The invasive cattails that now dominate the swamp provide habitat for wildlife. Restoration of Polk Swamp would provide a natural habitat for native wildlife species to move into, including game animals, fur bearers, and migratory birds. While there are numerous benefits of the project, there would also be a temporary adverse impact on some forms of fauna. Reptiles, amphibians, and other animals may be displaced to outlying areas during construction activities due to human presence and increased noise levels. However, these animals are expected to return after the construction activities are complete and thrive due to the increased availability of quality habitat.

5.7. Endangered Species

The project area is within the range of the species listed in Table 2.3. During extensive initial site reconnaissance (conducted in February and March of 2015), no threatened or endangered species were observed nor was suitable habitat for listed species observed within the footprint of the proposed project. Based on recommendations from the USFWS, the Corps conducted a survey to determine if wood storks are present within the project area. No wood storks or significant wood stork habitat were detected during the survey or during the initial site reconnaissance. The wood stork survey can be found in Appendix J. Based on the evidence available, the Corps has determined that these species and appropriate habitat for them are not present with the project area and, therefore, there would be no effect, positive or negative, to listed species. This determination has been coordinated with the USFWS and they concurred with this determination on October 15, 2015 (Appendix L).

5.8. Air Quality and Noise

The SCDHEC has air quality jurisdiction for the project area. The ambient air quality for Dorchester County has been determined to be in compliance with National Ambient Air Quality Standards and these counties are designated as attainment areas.

While the proposed project would contribute to local emissions, the impacts to air quality will be short-term and minor or even negligible in the immediate areas of project construction. Controlled burning would cause a temporary increase in particulate matter and carbon monoxide. Construction activities would cause temporary increases in exhaust and dust emissions from equipment operations. However, since both the controlled burn and operation of heavy equipment would be conducted in relatively small areas at a particular point in time, air quality impacts would be localized and temporary. Upon completion of work activities (including controlled burns) in any area, emissions would cease.

Implementation of the proposed project would cause a temporary increase in noise levels in the areas of project construction. However, since project construction would be conducted in relatively small areas at a particular point in time, increases in noise pollution would be minimal. Upon completion of work activities in any area, noise levels would return to pre-project levels. To further reduce noise pollution, construction would be limited to daylight hours in areas near dwellings.

5.9. Cultural Resources

There are no historic properties within or immediately adjacent to the proposed project. Additionally, the blockages that would be removed have occurred since Hurricane Hugo struck the area in 1989. Based on the information available, the USACE has determined that the undertaking would affect no historic properties. The Corps has coordinated with the South Carolina State Historic Preservation Office (SHPO) to confirm USACE's determinations regarding cultural resources. The SHPO concurred with the Corps determination in a letter dated September 28, 2015 (Appendix L).

5.10. Socioeconomics

According to Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, each federal agency must conduct its programs, policies, and activities that substantially affect human health or the environment, in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons (including populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination under, such programs, policies, and activities, because of their race, color, or national origin. Each Federal agency is required to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of Federal actions on minority and low-income populations.

The proposed project will not create a benefit for any group or individual, but rather provides region-wide benefits. There are no indications that the proposed aquatic ecosystem restoration project would be contrary to the goals of Executive Order 12898, nor would the project create disproportionately high or adverse human health or environmental impacts on minority or low-income populations of the surrounding community. Implementation of the proposed project would not cause significant adverse environmental impacts to any of the residents in Dorchester County, or surrounding counties regardless of race, national origin, or level of income. Therefore, the Corps has satisfied the requirements of Executive Order 12898. Similarly, the proposed project is consistent with Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks.

5.11. Hazardous, Toxic and Radioactive Waste

There are no known hazardous or toxic waste sites within the immediate vicinity of the project footprint. No hazardous, toxic or radioactive waste would be generated as a result of construction or maintenance of the proposed project. A Spill Prevention Plan would be drafted and submitted to the state as part of the Storm Water Pollution Prevention Plan prior to construction.

5.12. Recreation

Implementation of the proposed project would cause a temporary reduction of aesthetic appeal and a minor interference with recreational activities in the areas of project construction. However, since project construction would be conducted in relatively small areas at a particular point in time, recreational and aesthetic impacts would be localized. Upon completion of work activities in any area, aesthetic values and recreational opportunities would be greatly improved. The restoration of the area to a healthy cypress-tupelo swamp and associated bottomland hardwood forest would improve fishing, hunting, bird watching and other recreational activities within the swamp.

5.13. Cumulative Impacts

Cumulative impact is defined in 40 C.F.R. § 1508.7 as "...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." The following paragraphs summarize the cumulative impacts expected from the proposed project.

Before the arrival of European settlers in the area, Polk swamp was a forested wetland surrounded by upland forest. Over time the area was logged and converted into farm land. The swamp has been able to recover from past logging events and areas that drain into the swamp have returned to forest or remain as farmland and single family homes. Based on aerial photography and information from residents, there has been little change in the area over the past few decades except for a degradation of the swamp within the study area in the recent past. The environmental effects of the proposed project include restoring hydrology and alleviating persistent flooding conditions along the Polk Swamp channel, restoring the historic channel and lost bottomland hardwood forests, and enhancing local wildlife and recreational opportunities. No significant adverse environmental effects or mitigation are anticipated. Present and future development in and around the project area is controlled by management measures including control of floodplain development by zoning ordinances, subdivision regulations, and building codes. Future development in the area would be in compliance with the above listed management measures, minimizing impacts to the environment. In the foreseeable future no industrial or commercial development is anticipated in the area. The local sponsor is not aware of any plans to construct or develop significant developments in the area. The area surrounding the project is rural and low density. No high density developments are anticipated in the foreseeable future. It is anticipated that in the foreseeable future the area would continue to be dominated by farms and forested areas and that land use will remain largely unchanged. The positive cumulative impacts of the proposed project are many. The proposed project would restore the natural conditions of a tributary to Edisto River. The Edisto River is significant in that it is one of the largest free flowing blackwater rivers in North America (NRCS 2010). Additionally the proposed project is located near Four Hole Swamp which is home to the Francis Beidler Forest Audubon Sanctuary. The Sanctuary is home to virgin cypress-tupelo swamp. Restoring Polk Swamp would benefit both the Edisto River and Four Hole Swamp. Restoration would provide additional habitat for migratory birds, fish and wildlife, and likely improve water quality and connectivity in the Edisto River watershed. No negative cumulative impacts associated with the restoration of Polk Swamp have been identified.

The impacts of the proposed project, when considered along with past, present and future actions, are cumulatively insignificant. The overall lack of adverse impacts associated with the proposed project, as documented here, demonstrates both the benign nature and limited impacts of this project. No negative long-term impacts would occur from implementation of the selected alternative. However the proposed project would lead to positive impacts to the natural environment, water quality, and recreation. Any adverse impacts associated with the proposed project, when added to other past, present and reasonable foreseeable future actions are collectively insignificant.

5.14. Compliance with USACE Environmental Operating Principles

The United States Army Corps of Engineers Environmental Operating Principles were developed to ensure that Corps of Engineers missions include totally integrated sustainable environmental practices. The Principles provided corporate direction to ensure the workforce recognized the Corps of Engineers role in, and responsibility for, sustainable use, stewardship, and restoration of natural resources across the Nation and, through the international reach of its support missions.

Since the Environmental Operating Principles were introduced in 2002 they have instilled environmental stewardship across business practices from recycling and reduced energy use at Corps and customer facilities to a fuller consideration of the environmental impacts of Corps actions and meaningful collaboration within the larger environmental community.

The concepts embedded in the original Principles remain vital to the success of the Corps and its missions. However, as the Nation's resource challenges and priorities have evolved, the Corps has responded by close examination and refinement of work processes and operating practices. This self-examination includes how the Corps considers environmental issues in all aspects of the corporate enterprise. In particular, the strong emphasis on sustainability must be translated into everyday actions that have an effect on the environmental conditions of today, as well as the uncertainties and risks of the future. These challenges are complex, ranging from global trends such as increasing and competing demands for water and energy, climate and sea level change, and declining biodiversity; to localized manifestations of these issues in extreme weather events, the spread of invasive species, and demographic shifts. Accordingly, the Corps of Engineers is re-invigorating commitment to the Environmental Operating Principles in light of this changing context.

The re-energized Environmental Operating Principles are:

- Foster sustainability as a way of life throughout the organization.
- Proactively consider environmental consequences of all Corps activities and act accordingly.
- Create mutually supporting economic and environmentally sustainable solutions.
- Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the Corps, which may impact human and natural environments.
- Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs.
- Leverage scientific, economic and social knowledge to understand the environmental context and effects of Corps actions in a collaborative manner.
- Employ an open, transparent process that respects views of individuals and groups interested in Corps activities.

The Polk Swamp Section 206 Aquatic Ecosystem Restoration Project has incorporated the USACE Environmental Operating Principles into all aspects of the project since its inception. The USACE

Environmental Operating Principles will continue to be incorporated into all aspect of the project throughout the life of the project.

CHAPTER 6 IMPLEMENTATION RESPONSIBILITIES

6.1.Federal

Studies under Section 206 are subject to the cost sharing requirements of Section 105 of WRDA 1986, as amended. For projects implemented on non-Federal lands, costs are shared with the non-Federal sponsor. The Federal Government would provide 65 percent of the first costs of the recommended plan. The total first cost of the Recommended Plan is estimated to be $2,468,000. The Federal portion of this is estimated at $1,535,300. The Corps would also be responsible for project management and coordination with Federal and State agencies. The Charleston District would submit the Feasibility Report for approval, design, prepare plans and specifications, complete all National Environmental Policy Act (NEPA) requirements, execute a Project Partnership Agreement (PPA) with the sponsor, advertise and award construction contract(s), and perform construction contract supervision and administration.

6.2. Non-Federal

Dorchester County, SC is the non-Federal sponsor for this project, and is responsible for 35 percent of the project costs ($1,014,000). Up to 100 percent of the non-Federal share of project implementation costs can be provided as in-kind services. Operation and maintenance, repair, replacement and rehabilitation (OMRR&R) of the constructed project would be a 100% non-Federal responsibility. The future OMRR&R first cost is estimated at $1,653,000 over the 50-year evaluation period. This cost would include annual inspection, removal of blockages in the stream path and targeted application of herbicide to combat invasive species. The non-Federal sponsor would also be responsible for acquiring all lands, easements, rights-of-way, relocations, and disposal areas (LERRDs) needed for the project. Real Estate costs are estimated to be $487,000, which can be applied to the non-Federal cost share.

This following text describes the primary non-Federal Sponsor responsibilities in conjunction with the Federal Government to implement the recommended plan.

A model PPA has been reviewed by the non-Federal Sponsor and its legal representative. The non-Federal Sponsor is aware of its responsibilities. The PPA would be executed prior to implementation.

The Feasibility Study costs shall be included as part of the Federal Continuing Authorities Program total cost limit. The non-Federal Sponsor shall:

- Provide all lands, easements, rights-of-way, relocations, and disposal areas (LERRDs).
- The non-Federal sponsor shall not use any element included in this project for the purposes of mitigation banking or mitigation crediting, including Natural Resource Damage Assessment (NRDA) credits.
- Provide, during construction, any additional costs as necessary to make the total non-Federal contributions equal to 35 percent of the total project costs.
- Operate, maintain, repair, replace, and rehabilitate the completed project or functional portion of the completed project at no cost to the Federal Government, in accordance with the applicable Federal and

State laws and any specific directions prescribed by the Federal Government for so long as the project is authorized.

- Hold and save the Federal Government harmless from damages due to the construction and operation and maintenance of the project, except where such damages are due to the fault or negligence of the Federal Government or its contractors.

- Grant the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon land which the non-Federal Sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purposes of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

- Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as would properly reflect total project costs for a minimum of three years after completion of the project construction for which such books, records, documents, and other evidence are required.

- Prevent obstructions of, or encroachments on, the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) that might reduce the aquatic ecosystem restoration, hinder its operation and maintenance, or interfere with the proper function such as any new development on project lands or the addition of facilities that would degrade the benefits of the project.

- Not use Federal funds to meet the non-Federal Sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

6.3. Construction, Operation, and Maintenance

Implementation of the project may be driven by weather concerns. Ideally, the project schedule would follow the timeline below:

Begin project in fall when water levels are low; remove blockages and let drain over winter,
Conduct Habitat™ application at start of next growing season,
Conduct controlled burn late summer/early fall when conditions permit, and
Conduct follow up spraying and initiate replanting at start of next growing season.

If conditions permit, the replanting should take place in late winter/early spring after the controlled burn. This means that the trees would be in the ground within 18 months of project initiation. The risks to this schedule are that conditions may be too wet to allow for burning or replanting. If this is the case, then the project may be delayed until conditions are drier to allow for burning or replanting. Other than the delay in time, there is little risk until the project area is subject to burning. Once the blockages are removed or the Habitat™ is applied, the project area can remain dormant until conditions are favorable to burning or replanting, as long as the channel is kept free of blockages and subsequent flooding. Once the control burn is conducted, however, the project area needs to be replanted at the start of the next growing season, or else emergent herbaceous would become dominant. This may result in additional herbicide applications prior to replanting.

Maintenance of the project site should be performed to ensure the success of restored functions as demonstrated by various indicators that would be monitored. At this time, maintenance activities are expected to consist of inspections of the project area to ensure:

- The reach remains free from blockages and subsequent flooding,
- That emergent vegetation is free from the channel, and
- The survival of replanted vegetation.

Operation and Maintenance
Based on the implementation of the Recommended Plan and current policy and guidance, OMRR&R is the responsibility of the Sponsor. Maintenance responsibilities would address both the cleared channel and surrounding floodplain. With respect to the cleared channel, these responsibilities include maintaining the flow path open and free of blockages and the periodic application of herbicides to control nuisance aquatic vegetation. With respect to the adjacent floodplain, these responsibilities include monitoring the planted vegetation for survival, inspecting for and removing diseased vegetation, and the periodic application of herbicides to prevent nuisance emergent vegetation from overtaking the planted trees. Maintenance during the years immediately after construction and adaptive management would be the most critical (and aggressively pursued) to ensure long term restoration benefits. As the bottomland hardwood swamp develops and matures, the maintenance requirements need not be as aggressive. A detailed Operations and Maintenance Manual would be developed during the design and implementation phase of the project.

6.4. Monitoring

6.4.1. Post Project Monitoring

After construction, an operations, maintenance, repair, rehabilitation and replacement (OMRR&R) plan would be provided to the non-Federal Sponsor. The OMRR&R plan would outline procedures for documentation of restoration measures and the overall progress of the restoration areas.

Restoration success is dependent on a number of variables and often is subject to unforeseen or unpredictable obstacles. Therefore, the monitoring plan would prove critical in maintaining the relationship between the management plan and ecosystem response as it would allow for modifications and adjustments to the restoration as necessary and feasible until restored areas become self-sustaining. The USACE and non-Federal sponsor would monitor and evaluate the success of the constructed project with respect to the objectives listed above. With respect to keeping the reach free from blockages, inspections (by the Sponsor) of the project area would be conducted. The entire reach within the project area must be visually inspected annually; however, the inspection does not necessarily have to be continuous. Different reaches can be inspected at different times of the year, depending on Sponsor availability and site conditions.

With respect to the planted areas, during the inspections of the reach within the project area, the Sponsor would also visually inspect the planted sections for tree survival and growth. Photo-documentation of survivability, tree growth and bottomland hardwood swamp development would be collected and provided to the USACE. Areas threatened to be overwhelmed with herbaceous vegetation would be sprayed with herbicides to ensure tree survivability and growth. As the trees develop, this activity would decrease and eventually cease.

To quantitatively monitor the changes resulting from the project area, 3-5 vegetative plots would be established to measure mortality and growth of the planted trees. Measured parameters would include mortality, basil height, and tree diameter, as well as cataloging the emerging herbaceous layer that develops. This effort would continue for five years post construction. Dorchester County employs a team of beaver control experts that are responsible for managing beaver populations within the County. Construction of the proposed project would allow easy access to the entire project area for the beaver control experts. The county would actively manage the beaver population within the project area using existing staff.

6.4.2. Adaptive Management

Adaptive management may be described as management that recognizes uncertainty in its consequences and seeks to plan to minimize or address this uncertainty. Adaptive management is seen as a systematic approach for improving natural resource management, with an emphasis on learning about management outcomes and incorporating what is learned into ongoing management. Adaptive management can be viewed as a special case of structured decision making, which deals with an important subset of decision problems for which recurrent decisions are needed and uncertainty about management impacts is high.

There is some uncertainty, particularly with respect to the replanting, that a bottomland hardwood forest would be reestablished. Most of this uncertainty is due to environmental factors that are beyond the control of either the USACE or the Sponsor and would be more significant at the start of the project. This uncertainty, however, should be addressed wherever possible.

As the goal of this project is straightforward and simple (restore the natural condition of Polk Swamp) the criteria for success need not be complex. The adaptive management plan for the Recommended Plan is focused on ensuring that the trees that are planted are not outcompeted by invasive species, before they can become established. To quantitatively monitor this, 3 to 5 (1 acre) vegetative plots would be established throughout the project area and monitored for a 2 year period of time. These plots would be monitored for reestablishment of invasive species after the initial herbicide application and two years of spot treatment with herbicides is completed. If invasive species become established in greater than 25% of the area of any one of these plots an additional spot treatment of herbicides will occur throughout the project area. After two years of adaptive management the replanted trees should be large enough to out compete invasive species. As such, after two years of adaptive management is completed OMRR&R will begin as the sole responsibility of the non-Federal sponsor.

Disease: Cypress, for example, can be affected by various forms of a fungal disease known as needle blight. Trees impacted by needle blight have spotting on their foliage, bark and cones. During the annual inspections, the trees should also be inspected for disease. Suspicions of disease would be promptly reported to the South Carolina Forestry Commission (SCFC). If disease is confirmed by the SCFC, the Sponsor would respond with measures recommended by the SCFC, which may include pruning limbs or culling stricken trees.

Predatory Insects: Mites and cypress beetles feed on cypress needles and foliage. While the impact is small, cypress will discolor. Insecticide applications would remove infestations.

(Other planted species would also be monitored for disease or predatory impacts. If impacted, they would be treated with remedies recommend by the SCFC)

Drought: Drought conditions are beyond the control of either the Sponsor or the USACE. If extreme drought conditions are encountered, cypress needles will yellow until normal hydro-period conditions return.

Flooding: Excessive flooding conditions may also impact the project. The biggest risk is having too much water to allow for controlled burning or replanting. If it is too wet to burn or replant, the project may be delayed. As previously stated, this may delay the project until more favorable conditions are present; however, the construction schedule may be adjusted to accommodate water-related delays.

Fire: Fire is a natural activity that is part of a swamp's ecology. If fire occurs, the planted areas should be monitored to document mortality. Extreme mortality would be addressed in the OMRR&R.

Mortality: While some mortality is expected, the goal of this project is to have 75% of the planted trees survive for the life of the project. If mortality exceeds the expected 25%, the OMRR&R would include steps to replant to reach the 75% survivability target.

CHAPTER 7 COORDINATION AND REGULATORY COMPLIANCE

Executive Order 12372, Intergovernmental Review of Federal Programs, states that Federal agencies shall provide opportunities for consultation by elected officials of those State and local governments that would provide the non-Federal funds for or that would be directly affected by, proposed Federal financial assistance or direct Federal development. A public meeting was held on April 16, 2015, at the Kenneth F. Waggoner Services Center-County Council Chambers in St. George, South Carolina to inform and solicit input from the public. The proposed project is being coordinated with Federal, State, and local government agencies having jurisdictional responsibilities, or otherwise having an interest in the project. A list of all parties that received a notice via mail or e-mail of the issuance of this Draft EA and FONSI is attached in Appendix K. Correspondence received from other agencies and the public throughout the study can be found in Appendix L.

CHAPTER 8 COMPLIANCE WITH OTHER ENVIRONMENTAL LAWS

8.1. Clean Water Act

Material would be excavated to remove obstructions. The material in question is primarily woody in origin and evidence of the original bottomland hardwood swamp that once inhabited the project area. The woody material collected from blockages would be selectively placed with the project area (but not within the channel) to create micro topography and habitat refugee for a variety of species. It is anticipated that over time the organic material would break down. The removal of inorganic debris, with the exception of incidental removal, is not anticipated. Any significant quantities of organic debris would be removed from the project area and stored outside of waters of the US; however, at this time anticipated quantities of fill material are minimal.

The proposed project has been determined to be consistent with the terms and conditions of Nationwide Permit Number (NWP) 27. NWP 27 authorizes work in waters of the United States associated with the restoration, enhancement, and establishment of non-tidal wetlands and riparian areas, and the restoration and enhancement of non-tidal streams and open waters. The work to be conducted as part of the proposed project is within the types of activities authorized by NWP 27. Because the proposed project will result in a net increase in aquatic resource functions and services, compensatory mitigation is not required. This conclusion was coordinated with the Charleston District Regulatory Division. The South Carolina Department of Health and Environmental Control issued a 401 Water Quality Certification and a Coastal Zone Consistency Certification without conditions for Nationwide Permit 27 on April 23, 2012. Both the Coastal Zone Consistency and the 401 Water Quality Certification General Conditions are applicable and would be adhered to throughout the project.

8.2. Clean Air Act

The proposed project has been analyzed for conformity applicability pursuant to regulations implementing Section 176(c) of the Clean Air Act. The action will restore the area to its previous condition. Future activities conducted will be similar in scope and operation to activities currently being conducted at the existing land. There will be no change in the activities being conducted, other than the fact that the swamp will function

better. Because of this, it has been determined that the activities proposed under the proposed project are exempt by 40 C.F.R. Part 93, Subpart B, and Section 93.153.

8.3. Endangered Species Act

The requirements of Section 7 of the Endangered Species Act of 1973 have been fulfilled. Project documentation was provided to the USFWS for their review and comment. All comments received have been addressed and resolved to the satisfaction of the USFWS. The project is in full compliance with the Endangered Species Act. In its letter dated October 15, 2015, the USFWS concurred with the determination of the Charleston District USACE that the project will have no effect on listed species or critical habitat. (Appendix L).

8.4. Farmland Protection Policy Act

The Farmland Protection Policy Act is intended to minimize the impact Federal programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses. For purposes of this Act, "farmland" includes prime farmland, unique farmland, and land of statewide or local importance. There is no "farmland," as defined by this Act, that will be impacted by the Recommended Plan. No unnecessary and irreversible conversion of farmlands would occur as a result of construction of the proposed project.

8.5. Fish and Wildlife Coordination Act

The proposed project has been coordinated with the USFWS in order to fulfill the requirements of Section 2(a) of the Fish and Wildlife Coordination Act. All comments received have been addressed and resolved to the satisfaction of the USFWS (Appendix L).

8.6. Floodplain Management (EO 11988)

The objectives of Executive Order 11988 have been considered in the formulation of plans for this project. The following determinations have been made in response to requirements of Executive Order 11988 which pertains to floodplain management.

No practical non-floodplain alternative exists. The considered actions do not conflict with applicable state and local standards concerning floodplain protection. The considered action would not negatively affect the natural and beneficial values of the floodplain or encourage development within the floodplain. The considered action would restore natural floodplain storage.

8.7. Protection of Wetlands (EO 11990)

The objectives of Executive Order 11990 have been considered in the formulation of plans for this project. The following determinations have been made in response to requirements of Executive Order 11990 which pertains to wetland management.

No practical non-wetland alternative exists. The considered actions do not conflict with applicable state and local standards concerning wetland protection and permitting and are covered under USACE nationwide permit number 12. The proposed project would positively affect the natural and beneficial values of the impacted wetlands and protect native wetlands.

8.8. National Wild and Scenic Rivers

The National Wild and Scenic Rivers System was created by Congress in 1968 (Public Law 90-542; 16 U.S.C. 1271 et seq.) to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. A review of the Wild and Scenic River inventory list reveals that the proposed project would not affect a stream or portion of a stream that is included in the National Wild and Scenic Rivers System.

8.9. National Historic Preservation Act (NHPA)

The proposed project has been reviewed for historic properties (cultural resources listed on or eligible for listing on the National Register of Historic Places) pursuant to regulations implementing Section 106 of the National Historic Preservation Act (NHPA). In accordance with 36 C.F.R. § 800.4(d)(1), it was determined that the proposed undertaking would have no effect on historic properties. Documentation of this determination has been coordinated with the South Carolina State Historic Preservation Office and the SHPO concurred with this determination in a letter dated September 28, 2015 (Appendix L).

8.10. Coastal Zone Management Act

Dorchester County is one of the counties in South Carolina under the jurisdiction of the Federal Coastal Zone Management Act. A Coastal Zone Consistency Certification would be applied for and construction would not commence until the certification is issued establishing that the land and water uses are consistent with the State's Coastal Zone Management Program (SCCZMP). There are no technical concerns from construction of the proposed project that would impact the issuance of a Coastal Zone Consistency Certification.

CHAPTER 9 CONCLUSIONS AND RECOMMENDATIONS

9.1. Conclusions

This draft Integrated FR/EA documents the results of a study conducted under the authority of Section 206 of the Water Resources Development Act of 1996, as amended. The objectives of this study were to:

- Restore and enhance the aquatic environment by restoring natural hydrology and flows and connectivity;
- Restore and enhance the riparian corridor through the removal of invasive species; and
- Reforest the project area with keystone bottomland hardwood species thereby expanding existing riparian corridors, reducing fragmentation, and diversifying both habitat and wildlife.

This study has included an examination of potential and practicable alternatives for meeting the study objectives. The Recommended Plan is an incrementally justified and cost effective alternative that also meets the sponsor and public needs. The Recommended Plan would increase the habitat value of the project area over the life of the project by restoring approximately 290 acres of riparian bottomland hardwood with native vegetation and restore the historic hydrology of the area. Habitats not subject to direct management techniques would eventually become more valuable to wildlife species due to increased species and structural diversity (e.g., more food and cover). State and federal agencies across the country have made great efforts to protect and restore riparian and aquatic habitats. The Recommended Plan would play a role in accomplishing these goals and would provide an example and impetus for future restoration projects in South Carolina and across the nation. The Recommended Plan provides important fish and wildlife benefits at a reasonable construction and O&M cost. The Recommended Plan does not increase flood surface elevations. The Recommended Plan is

consistent with national policy, statutes, and administrative directives and has been reviewed in light of overall public interest, which includes the views of the non-Federal sponsor and interested agencies. After receiving the non-Federal sponsor's self-certification of financial capability on November 3, 2015, The District has concluded that Dorchester County is capable of meeting its financial obligations and that the total public interest would be served by implementation of the recommended plan. An EA was integrated into the FR/EA to assess the potential environmental impacts of implementing the recommended alternative.

9.2.Recommendations

I propose that the Recommended Plan (Alternative 5) described in this Integrated Feasibility Study and Environmental Assessment be approved for implementation under the authority of Section 206 of the Water Resources Development Act of 1996, as amended, as a Federal project, with such modifications as in the discretion of the Chief of Engineers may be advisable. The first cost of this project is estimated to be $2,468,000.

Prior to construction, and during the design and implementation phase, the non-Federal sponsor would: (1) provide all lands, easements, and rights of way necessary for project construction and operation and maintenance; (2) hold and save harmless the United States from damages due to the construction or operation and maintenance of the project; and (3) agree to meet the requirements for non-Federal responsibilities as outlined in this report and future legal documents. The non-Federal sponsor would also operate and maintain the project after construction for the life of the project (so long as the project remains authorized). Dorchester County, SC has demonstrated that they have the authority and the financial capability to provide all non-Federal requirements for the implementation, operation, and maintenance of the project. The recommendations contained herein reflect the information available at this time and current Department of the Army policies governing formulation of individual projects. They do not reflect the program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch.

Date July 1, 2016

MATTHEW W. LUZZATTO
Lieutenant Colonel, Engineer
Commander, U.S. Army Engineer District,
Charleston

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