U.S. Army Corps of Engineers

Charleston District

Charleston Harbor Deepening Project (Post 45)

Charleston Harbor, SC

Appendix P:

Mitigation Planning and

Monitoring and Adaptive Management Plan

April 29, 2015

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1.0 Framework

In accordance with the mitigation framework established by Section 906 of the Water Resources Development Act (WRDA) of 1986 (33 USC 2283), as amended by Section 2036 of WRDA 2007 and Section 1040 of the Water Resources Reform and Development Act (WRRDA) of 2014, the Council on Environmental Quality (CEQ)'s National Environmental Policy Act (NEPA) regulations (40 CFR Sections 1502.14(f), 1502.16(h), and 1508.20), and Section C-3 of Engineer Regulation (ER) 1105-2-100, the Corps will ensure that project-caused adverse impacts to ecological resources are avoided or minimized to the extent practicable, and that remaining, unavoidable impacts are compensated to the extent justified. For adverse impacts to wetlands which cannot be avoided or minimized, options include compensatory mitigation in the form of restoration, establishment, enhancement, and/or preservation. Any proposed mitigation should be practicable and ensure that the project will not have more than negligible adverse impacts on ecological resources.

Mitigation planning is an integral part of the overall planning process. The Charleston District began the mitigation evaluation early in feasibility study process. In order to evaluate appropriate mitigation options, an estimate was made of the type, location, and level of potential adverse ecological impacts. Practicable avoidance and minimization measures were considered, followed by an assessment of potential compensatory mitigation measures and a rough order of magnitude cost for those measures. This process included consultation with an Interagency Coordination Team (ICT) made up of Federal and State resource agencies. The plan identified below will continue to be refined throughout the planning process by utilizing the expertise of the ICT for the project.

The following sections describe the variety of avoidance and minimization measures for various ecological resources and measures to mitigate for those impacts that are projected to be significant prior to the implementation of any compensatory mitigation. Significant impacts that will require compensatory mitigation are hardbottom habitat and palustrine freshwater forested and herbaceous wetlands. The majority of ecological impacts are described within the Final IFR/EIS. This appendix also further addresses water quality impacts (to dissolved oxygen) and salinity intrusion (other than wetland impacts) not determined to be significant.

1.1 Minimization and Avoidance Measures

The first step in mitigation planning involves efforts to avoid and/or minimize impacts. The initial array of alternatives was coordinated with the resource agencies through a number of ICT meetings. These meetings centered on the primary concerns of the project (cultural resources, dissolved oxygen (DO), salinity increase, wetlands, fish habitat, endangered species, and hardbottom habitat) as identified during NEPA scoping. The following section outlines measures the USACE has taken to avoid and minimize project related effects.

1. Cultural Resource Impact Avoidance

Cultural Resource investigations involving side scan sonar, sub-bottom profiling, and magnetometer surveys identified three potential anomalies. Subsequent diver investigations of these anomalies revealed three targets. Two of these anomalies consisted of modern debris and did not represent significant historic or cultural items; however, an anomaly adjacent to Bennis Reach will require an archaeologist on board to monitor for cultural resources when dredging occurs in that area. If any additional resources are discovered during construction, the dredge will be shut down and coordination will be conducted to comply with the National Historic Preservation Act.

2. No anchorage allowed within hardbottom habitat during construction

As a means to avoid or minimize effects of anchorage during dredging on hardbottom habitat, the design specifications will be written to require the contractor to avoid anchoring of equipment within adjacent hardbottom habitat. The approximate locations of these resources will be shown in the contract drawings. If the contractor is required to anchor outside the channel to utilize a cutterhead dredge, anchor placement shall be placed to avoid affecting any of the identified hardbottom habitat or any of the created hardbottom habitat reefs.

3. Hardbottom Habitat Impact Minimization

To avoid direct impacts to hardbottom habitat in the entrance channel, an avoidance measure was coordinated with the ICT. This method involves maintaining the existing channel side slopes and extending them downward, rather than the more typical approach of maintaining the existing bottom width and extending the side slopes outward. The measure would avoid all direct impacts to hardbottom habitat along the margins of the entrance channel. This measure has the additional benefit of reducing the quantity of dredged material. The only impact to the Navigation Channel would be the movement of the toe of the ledge inward by roughly 20 feet on either side. The overall channel would be 944’ rather than 1000’ (Figure 1), with no loss of width in the main shipping channel.

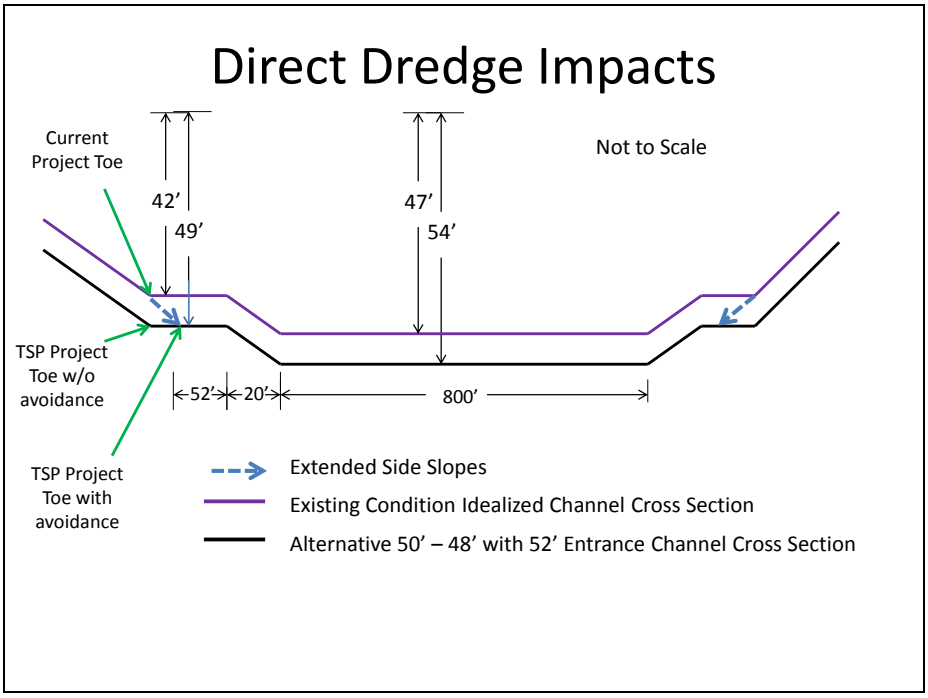


Figure 1. Proposed Side Slope Extension to Avoid Hardbottom Areas

4. Biological Impacts from Rock Blasting

Geotechnical investigations involving rock strength analysis indicates the rock that requires removal to obtain the project depth can be removed with either a cutterhead dredge or a rock bucket clamshell dredge and will not require blasting. As a result of this analysis the District intends to avoid blasting as an option for rock removal, therefore eliminating any potential effects resulting from noise impacts to marine mammals and fish that blasting may cause.

5. PED phase channel widening reductions

During the Preconstruction Engineering and Design (PED) phase, the District will use ship simulation results to optimize the widening and turning basin expansion measures to the size necessary to safely maneuver vessels. For purposes of the impact assessment in the feasibility phase, these measures have been assumed to be at maximum size. The optimization of those measures could reduce environmental impacts to DO, fish habitat, salinity intrusion, wetlands, and shallow subtidal habitat, as well as the projected increase in channel shoaling. Meaningful reductions in significant impacts and/or compensatory mitigation requirements will be disclosed during this phase.

6. Use of existing upland disposal sites

Environmental impacts associated with any expansion of the footprint of upland confined disposal facilities (CDFs) in Charleston Harbor for the Post 45 project are avoided by the use of existing, previously-used disposal sites. New CDFs would necessitate direct impacts to and loss of estuarine wetlands. New CDFs would, however, increase the dredged material disposal capacity in the harbor and in the long-term would ease the coordination and scheduling necessary for the use of existing CDFs.

7. Alternative disposal sites and beneficial use of dredged material

The proposed project contemplates the use of materials from the navigation channels for various beneficial uses. These include the placement of materials for offshore hardbottom reefs, as well as within the Lower Harbor at Fort Sumter, Crab Bank and Shutes Folly Island. These materials would otherwise go into the ODMDS, decreasing the expected life of the disposal site and/or requiring either expansion of the site or consideration of a new site.

8. Use of advanced maintenance to reduce dredging frequency

The continued use of advanced maintenance for portions of the navigation channel which experience more rapid shoaling serves to reduce the frequency of future maintenance dredging requirements after deepening. This, in turn, reduces the frequency of the temporary adverse impacts associated with maintenance dredging, such as increased turbidity, removal of sediment and benthos, and fish displacement.

2.0 Brackish and Freshwater Wetlands:

2.1 Guidance and Framework

Section 2036(a) of WRDA 2007 required, among other things, that mitigation plans comply with the applicable mitigation standards and policies of the regulatory programs administered by the Secretary of the Army. On April 10, 2008, USACE and the USEPA published regulations (33 CFR Parts 332, and amending 33 CFR Part 325 and 40 CFR Part 230) entitled, "Compensatory Mitigation for Losses of Aquatic Resources," ("Mitigation Rule"). The primary goal of these regulations is to improve the quality and success of compensatory mitigation plans that are designed and implemented to offset impacts to aquatic resources authorized by Department of the Army regulatory permits. Subsequent guidance issued by USACE (CECW-PC Memorandum, Implementation Guidance for Section 2036 (a) of the Water Resources Development Act of2007 (WRDA 07) - Mitigation for Fish and Wildlife and Wetlands Losses, 31 August 2009) concluded that civil works guidance on mitigation planning is consistent with the applicable standards and policies of the Corps Regulatory Program for wetlands mitigation.

Under civil works guidance and the Mitigation Rule, District Engineers are charged with determining on a case-by-case basis what is environmentally preferable. The Mitigation Rule emphasizes the strategic selection of compensatory mitigation sites on a watershed basis and establishes equivalent standards for all three types of compensatory mitigation: mitigation banks, in-lieu fee programs, and permittee-responsible mitigation plans. The Mitigation Rule's preference hierarchy for types of wetland mitigation was applied to this project, and is as follows:

1. Mitigation bank credits
2. In-Lieu fee program credits
3. Permittee-responsible mitigation (PRM) under a watershed approach
4. On-site and/or in-kind permittee-responsible mitigation
5. Off-site and/or out-of-kind permittee-responsible mitigation

Where mitigation bank or in-lieu fee program credits within the watershed are either unavailable or would be substantially exhausted, or where PRM involves an outstanding resource, the preference hierarchy may be overridden in favor of PRM. The degree of risk is also a factor to be considered in applying the preference hierarchy. Using these types of mitigation, there are four basic methods for providing compensatory mitigation: restoration, enhancement, establishment, and preservation. Under civil works guidance and the Mitigation Rule, restoration should be the first method considered. However, preservation may be considered if a) the aquatic resources provide important physical, chemical, or biological functions for the watershed; b) the resources to be preserved contribute significantly to the ecological sustainability of the watershed; c) preservation is appropriate and practicable; d) the resources are under threat of destruction or adverse modification; and, e) the preserved site will be permanently protected. Other factors to be considered in evaluating preservation is environmentally preferable include a site's location in or near an urban area, the inclusion of riparian areas and upland buffers that help protect or sustain the aquatic resources, and whether the preservation will remove or reduce stressors on the watershed in the long term.

Consistent with the directives under the USACE SMART Planning approach, this study considered the impacts resulting from the proposed project's maximum dimensions. As discussed above, during the PED phase of the project ship simulation will be used to potentially reduce impacts by minimizing/eliminating wideners. Therefore, all mitigation alternatives are evaluated from the perspective of maximum impacts, with the intent that additional avoidance and minimization will be done during PED.

2.2 Wetland Impact Summary

Indirect impacts are expected to occur through a shift from fresh/brackish marsh to brackish/salt marsh as a function of salinity changes altering the naturally occurring vegetative composition, soils, and habitat functioning of the system. The majority of these effects will occur within tidal freshwater systems, as these systems are not typically adapted to high salinity concentrations at increased frequencies or durations. Plants that cannot tolerate higher salinities will be replaced by those that can. Details on the determination/quantification of wetland impacts can be found in Appendix L. Table 1 presents the results of the wetland impact analysis as determined in Appendix L.

Table 1. Indirect wetland impacts for the proposed project.

Average Wetland Impacts (resulting from 4 different sea level rise scenarios)	
Wetland Impacts	**52/48**
Ashley River forested wetlands	4.36 acres
Ashley River marsh wetlands	13.16 acres
Cooper River forested wetlands	126.37 acres
Cooper River marsh wetlands	179.83 acres
Total	**323.72 acres**

2.3 Mitigation Options for Indirect Wetland Impacts

Prior to using the Uniform Mitigation Assessment Method (UMAM) for analysis of functional gains to compensate for known functional losses, the Charleston District explored a variety of wetland mitigation options including various restoration and preservation options, consistent with the 2008 Mitigation Rule discussed in Section 2.1. The wetlands that could be affected as a result of the proposed project are mainly freshwater forested and emergent wetlands that are tidally-influenced along the shoreline. While the purchase of the appropriate number and type of mitigation credits from an approved mitigation bank or in-lieu fee program is preferred, a review of the Corps Regulatory In-Lieu Fee and Bank Information Tracking System (RIBITS) and internal discussions revealed that the type and amount of credits necessary to compensate for the projected impacts were not available. Similarly, there is a lack of suitable in-kind wetland restoration opportunities within the targeted watershed, which limits the potential to apply in-kind PRM. Two mitigation banks are located in the area: Congaree-Carton and Pigeon Pond. Pigeon Pond drains to the Wassamassaw Swamp and ultimately the Ashley River and therefore is less appropriate for an indirect impact in which the majority of the impacts are in the Cooper River wetlands.

Within the greater Charleston area, a large amount of the natural wetland system has been converted into residential, urban, and industrial development, most prior to enactment of the Clean Water Act. While there are some opportunities for wetland restoration, most of them relate to restoring tidal flow and reintroducing salt water to what have become freshwater wetlands. While there is functional wetland/watershed value in this, it does not provide in-kind mitigation for the project impacts which change freshwater to brackish or brackish to saline wetlands as a result of salinity intrusion. It is deemed not practicable in terms of cost or logistics to purchase developed land with the intention of restoring it

back to wetlands or to create wetlands, and the likely requirement for condemnation means that such lands are not readily available. Restoration and preservation options considered are described below:

2.3.1 Restoration Options

2.3.1.1 NOAA Identified Restoration Opportunities

A recent NOAA study of potential tidal creek/wetland restoration sites were used to identify potential mitigation sites for this project (NOAA, Habitat Conservation Division, Charleston, SC, unpublished data). USACE evaluated 98 NOAA identified sites for opportunities for freshwater wetland mitigation. After examining the data, three sites were identified in the Ashley River watershed and two sites in the Back River (Cooper River) that could be explored as potential restoration sites. The other sites were not commensurate with the impacts of the project. Essentially, the majority of the NOAA identified restoration projects involve creating salt marsh in place of impounded freshwater/brackish ponds and marshes. USACE recognizes the merit in these projects; however, since the indirect impacts of the proposed project are a result of creating more salt marsh it is not appropriate to mitigate for the impacts by essentially causing the same type of change. The sites that were identified as options are Ashley River 1, Ashley River 2, Ashley River 3, Back River 1 and Back River 2 (Table 2, Figures 2 and 3). Real estate information was documented for each privately owned parcel (Table 2). The Back River sites are located on Joint Base Charleston property.

The Back River sites were originally pursued and coordinated with NMFS staff. USACE met with Joint Base Charleston personnel to discuss options for restoration of the two Back River sites. At the time of the meeting, Joint Base Charleston staff was not interested in pursuing restoration of those sites, because they are periodically managed for waterfowl habitat and hunting is allowed in certain areas of the Base property.

For the Ashley River sites, in addition to negotiations with the land owners (of which more than one would be required), further work would be needed to determine the number of acres of wetlands that could be restored as well as assessing restoration methods that could be successfully employed. At the present time, the extensive amount of time and expense to assess the feasibility and cost for use of these sites preclude consideration of these sites and this option from further analysis.

Table 2. Ashley River and Back River potential wetland mitigation sites and real estate information

SITE	ACREAGE	Price per Acre ($)
Ashley River Site #1	56.58	390,425
	9.6	336,000
	8.8	308,000
Ashley River Site #2*	97.6	10,000
Ashley River Site #3	530.24	3,963,590
Back River #1	US Gov't Land	
Back River #2	US Gov't Land	

Figure 2. Back River Restoration Sites

Figure 3. Ashley River Restoration Sites

2.3.1.2 Tuxbury Horse Trail Restoration

The Tuxbury Horse Trail is located on US Forest Service (USFS) lands of the Francis Marion Forest. This site has numerous isolated wetlands that have been severely altered by previous land management practices prior to becoming part of the Francis Marion National Forest. Much of the Tuxbury Trail runs along a former tram bed that was used to transport lumber in the early to mid 1900's. This tram bed is impacting numerous isolated wetlands in the Wando Area, including potential Frosted Flatwoods Salamander and Carolina Gopher Frog breeding wetlands. This tram is impacting the hydrology of numerous isolated wetlands due to the fact that it is ditched on both sides and was intentionally built up to traverse through wetlands. There are no culverts or bridges on this horse trail/tram. As such, this artificial land feature serves as a barrier to sheet flow and is impacting the hydrology of adjacent wetlands. Restorative wetland activities could be implemented in these areas, which could also improve habitat conditions for the Frosted Flatwoods salamander and other isolated wetland dependent organisms.

This option would not include any land purchase. Necessary work to pursue this option includes delineating existing wetlands and developing a restoration plan that would comply with the 2008 Mitigation Rule. Preliminary UMAM results for this alternative were not conducive to continued consideration of this option as compensatory mitigation for projected wetland functional losses resulting from the proposed project because the functional lift was not equivalent to the functional loss and the option would only restore hydrologic connectivity to existing wetlands.

2.3.2 Wetland Creation

Wetland creation was considered as a form of compensatory mitigation for the proposed project. For wetland creation, uplands are typically excavated to the elevation of adjacent wetland areas in order to establish a similar hydroperiod and then are planted with hydrophytic vegetation. As previously indicated, the creation opportunities needed to offset project effects are of insufficient quantity within the greater urbanized Charleston area and are either too expensive or technically risky in terms of achieving desired gains to balance functional losses within the project area. Due to these reasons there are no effective options to consider wetlands creation for this project that will compensate for the functional wetland losses.

2.3.3 Preservation Options

2.3.3.1 US Forest Service Land Acquisition

The USFS provided USACE with a list of potential mitigation sites that could be purchased and conveyed to the USFS for long term stewardship. All properties are strategically located within the Francis Marion NF proclamation boundary and within the Cooper River Basin (HUC 03050201) (Figure 4). Many properties have been identified by The Nature Conservancy (TNC) and targeted for preservation due to their natural characteristics and vulnerability to development. One property in particular has been identified by TNC as the single most important acquisition for the Francis Marion National Forest, and by the USFWS as the number 1 priority parcel for purchase east of the Mississippi. Through purchase by the USACE or SCSPA any of the considered parcels may be set aside as conservation, purposed, and then conveyed to USFS ownership. The advantage of this approach is that the acquisition of any of these parcels for preservation would benefit the watershed by increasing the amount of contiguous preserved areas. The properties are surrounded on multiple sides by conservation lands, including both privately protected properties and federally managed lands. Many of the properties have consistently been managed for timber production, recreation, and historic ricefield impoundments. Conversion to residential development, specifically small lot residential development, and incompatible forestry practices, remain key threats as these properties are highly desirable due to their recreational amenities and close proximity to the Town of Mt. Pleasant and City of Charleston (TNC, Sarah Hartman, Real Estate Abstract and Resolution, Francis Marion, 2012).

Many of the available parcels have complex mosaics of upland and wetland communities, with extensive northeast-southwest trending ecotones. Wetlands include both tidal and non-tidal palustrine (freshwater) systems. Some of the parcels comprise current and former wetlands that were converted to inland ricefields at the time of European settlement, but which have since been left to natural reforestation. These areas are now populated by common forested wetland trees such as pond cypress, red maple, laurel oak, and sweetgum. The riparian areas and adjacent uplands are primarily pinelands or savannah. Many of these uplands were historical longleaf areas that have been converted to loblolly pine plantation, or southern maritime forest. The parcels lie in proximity to one of the largest remaining expanses of longleaf pine forest, a known reservoir for rare, threatened and endangered species. The surrounding Francis Marion National Forest was recently identified as a Significant Geographic Area for the maintenance and restoration of longleaf pine. The parcels are also proximal to the extensive

marshes and estuaries of the Cape Romain National Wildlife Refuge, a Class I Wilderness area. The Refuge is recognized as a United Nations Educational, Scientific and Cultural Organization (UNESCO) Biosphere Reserve, and a Ramsar wetland of international significance. Ramsar wetlands are established through an intergovernmental treaty that strives to maintain the ecological character of important wetland areas in their territories. These designations are bestowed only on the most significant natural habitats of the world. The Nature Conservancy (2010) has developed habitat models for foraging habitat of the red-cockaded woodpecker (federally endangered), pond-breeding amphibians (including the federally threatened flatwoods salamander), and juvenile rearing habitat for swallowtail kites (federal candidate species), all located within some of these parcels. See the Real Estate Appendix for more details on the parcel locations.

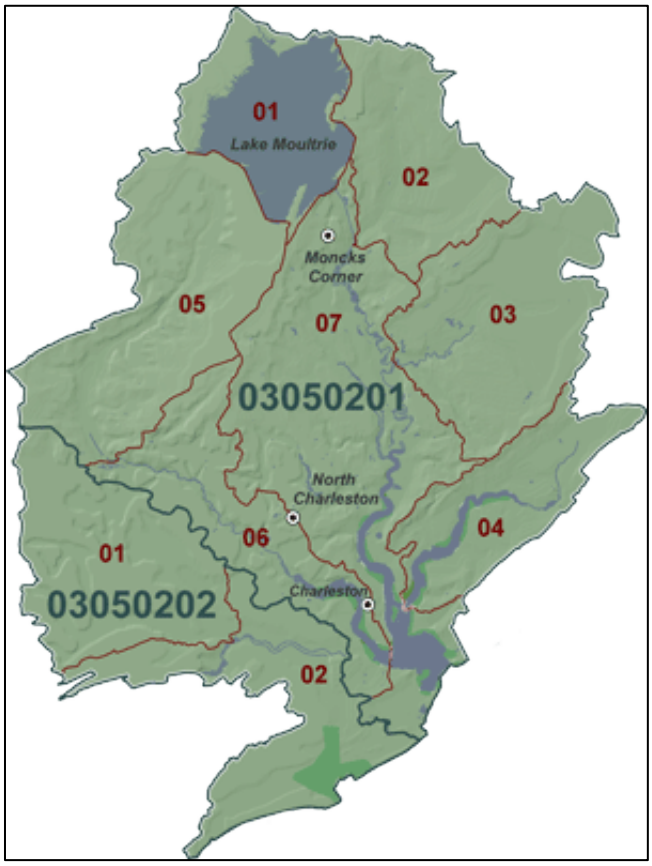


Figure 4. General location of preservation parcels for the conveyance to USFS within HUC 03050201 – Cooper River Basin

2.3.3.2 Cainhoy Plantation Protection

This property is in the heart of the Cooper/Wando watershed, and is a component of a controversial development project (Figure 5). The northern half (above Clements Ferry Road) contains approximately 2,500 acres of healthy, mature longleaf pine with extensive, intact freshwater wetland systems interspersed with uplands and is the most ecologically significant portion of the property. Some of the longleaf specimens in this area of the property are well over 100 years old. The forest has been expertly managed since at least the 1930's, with regular prescribed burning and removal of invasive species.

Additionally, this portion of the property has functioned as a continuation of the Francis Marion National Forest, which is directly across Cainhoy Road, providing essentially a contiguous habitat from the National Forest to the Cooper River. The property contains potential habitat for at least four federally endangered or threatened species – Red cockaded woodpecker, American chaffseed, Southern spicebush, and the flatwoods salamander. Suburban and urban levels of development on the northern portion of Cainhoy Plantation have been proposed and could present a significant obstacle to both the Forest Service's management practices in the Francis Marion (controlled burning). Early coordination indicates that this property would be expensive relative to other options. More importantly, the preservation would only involve conservation easements and development would still occur on portions of the property and potentially surrounding the preserved wetlands, thereby reducing the functionality of the site from its existing condition. USACE determined that this type of preservation would not provide the long term protection and functional lift using the mitigation assessment tool (UMAM).

Figure 5. Cainhoy Location Map

2.3.3.3 West Branch Cooper River Easement Purchase

The Lord Berkeley Conservation Trust identified a combination of potential property easements along the West Branch of the Cooper River that if acquired, would potentially meet the project's mitigation needs. According to the National Wetlands Inventory (NWI) data and spatial analysis using Geographic Information Systems (GIS), the West Branch Tracts contain approximately 846 acres of wetlands

associated with the Cooper River. These wetlands consist of historic ricefields in varying stages of succession, non-riverine swamp forests, coastal plain small stream swamp forests, and cypress ponds.

While these properties are in the Cooper River watershed and present an excellent opportunity to protect wetlands adjacent to upland that is highly desirable for development or already developed, a conservation easement doesn't afford the same level of protection as land acquisition. The inability to purchase adjacent upland buffers to these wetland easements also limits the functional value and gains associated with this option. However, these tracts would allow for the preservation of tidal freshwater wetlands directly in the watershed of the impacted wetlands.

2.4 Selected Alternative for Mitigation

Based upon civil works mitigation requirements and the 2008 Mitigation Rule, USACE selected preservation of land and conveyance to the USFS as the environmentally-preferred mitigation alternative. Sufficient mitigation bank or in-lieu fee program credits are not available. For PRM, although restoration is generally preferred over preservation for wetland mitigation, opportunities for in-kind restoration are limited and insufficient. Owing to the type of aquatic resource to be restored and the nature of the restoration, the risk and the long-term cost of monitoring are greater. Acquisition of real estate for restoration could cause further difficulties, especially on developed, private lands. Many of the restoration options that were considered would not provide for appropriate in-kind mitigation and would therefore require multiple land purchases. Also, as noted above, the nature of the proposed project's impacts, which represent a vegetation change that would occur in a naturally functioning wetland system as a result of salinity intrusion, do not squarely fit with the Charleston District's regulatory guidelines for compensatory mitigation plans. Table 3 provides wetland mitigation measure outputs in acres and estimated costs.

Preservation of land and conveyance to the USFS meets all of the criteria of Section 332.3(h)(1)(i-v) of the Mitigation Rule, as outlined above. It offers strategic value within the watershed and provides important physical, chemical and biological functions to the Cooper River Basin. It is consistent with the Charleston Harbor Special Area Management Plan (SCDHEC 2000), which emphasized ecosystem-level planning and prioritized non-tidal freshwater wetlands (the Plan states that, "although tidal wetlands have been relatively well protected, significant losses have occurred in freshwater non-tidal areas"). The preservation of this land will make a significant contribution to the sustainability of the watershed based on the assessment above. Among other things, they will help ensure that the functions of bottomland hardwood and emergent wetlands on these properties are protected in perpetuity, and will also enhance lands already within the Francis Marion National Forest by functioning as a buffer to future development. Permittee-responsible mitigation (PRM) in the form of preservation in this case is a low risk, practicable option. Continued population growth, industrial/commercial development, and changes in land use in the Charleston metropolitan area put these resources at risk of destruction and adverse modification. This mitigation proposal would permanently protect these at-risk resources. In addition, the inclusion of riparian areas and adjacent uplands will help protect or sustain the aquatic resources, and removing these lands from the pool of potential development will reduce stressors on the watershed in the long term.

Table 3. Wetlands Mitigation Measures and Costs

Alternative Preservation / Restoration Measures	Plan Outputs Acres	Plan Costs	$ Costs / Acre	Additional Cost for Restoration
Ashley River Site #1				
	56.58	$390,425	$6,900	unknown
	9.60	$336,000	$35,000	unknown
	8.80	$308,000	$35,000	unknown
*Ashley River Site #2	97.60	$10,000	$102	unknown
Ashley River Site #3	530.24	$3,963,590	$7,475	unknown
USFS Tracts	**Various**		**$4,500**	**N/A**
Cainhoy Plantation	2,500.00	Unknown	unknown	N/A
West Branch Cooper River Easement	846.00	$5,835,000	$6,897	N/A

Anomaly – not confident in these numbers

The Charleston District has also determined that preservation of land within the proclamation boundary of the Francis Marion National Forest best meets the compensatory mitigation requirements based on the cost effectiveness and incremental cost analysis (see Figure 7).

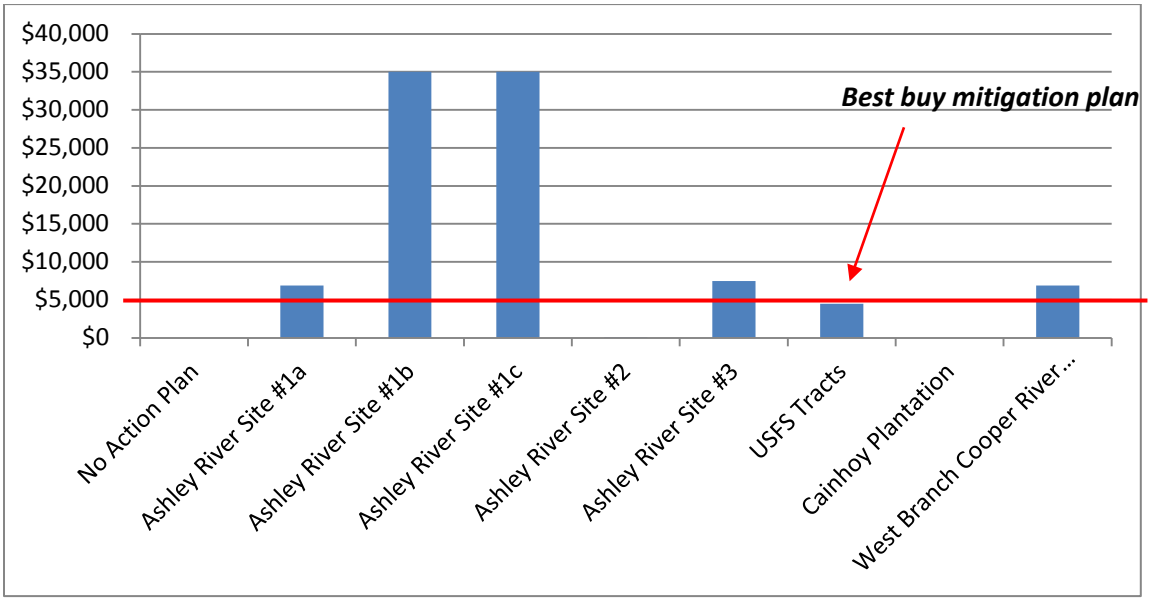


Figure 7. Cost per unit acre for mitigation alternatives

While disclosing a mitigation preservation parcel at this time in the feasibility phase is not common practice due to real estate uncertainties, on-going reviews, funding uncertainties, etc, USACE has

committed to providing details on the preferred parcel (at the request of the SCSPA) to better inform the public and resource agencies of the value of the preserving the identified parcel.

USACE intends to implement this plan by working with the non-federal sponsor (SCSPA), the USFS, and the Open Space Institute Land Trust, Inc. The preferred property has been selected to maintain and improve the quality and quantity of aquatic resources within the watershed in consideration of trends in habitat loss and conversion as wells as the impacts of ongoing development. Private in-holdings in and abutting the Francis Marion National Forest were deemed as the most appropriate mitigation option due to 1) their high ecological value, 2) aquatic resources that are at risk of development, and 3) their priority for inclusion in the National Forest. The lands recommended as options for preservation are shown in the real estate appendix. Of these, the Fairlawn Tract (B-2B) is the preferred site (Figure 8), but is subject to change depending on numerous uncertainties with real estate transactions.

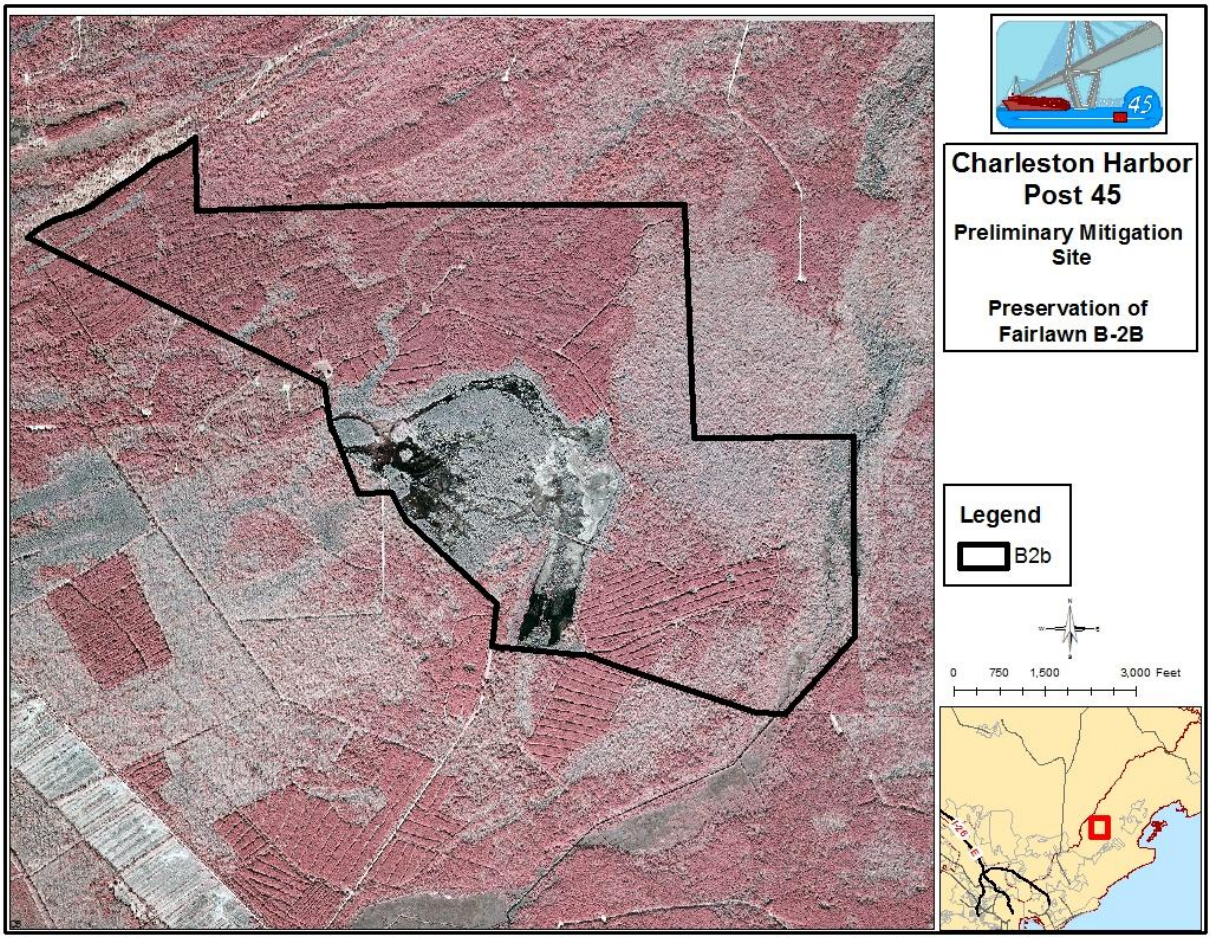


Figure 8. Location of preferred mitigation parcel, Fairlawn B2-B

USACE used the watershed approach to provide mitigation for unavoidable project impacts. The example parcel (B-2B) is located within the same 8-digit HUC as the impacted wetlands (HUC 03050201) (Figure 9). This HUC consists of 8 different 11-digit HUCS, and the proposed mitigation site is located in 03050201-080 (Wando River) (Figure 10). Additional parcels that could be preserved are located within

03050201-040 (Figure 11). The following description of the Wando River watershed is provided within http://www.scdhec.gov/
homeandenvironment/docs/03050201-04.pdf:

> The watershed "*is located in Berkeley and Charleston Counties and consists primarily of the Wando River and its tributaries. The watershed occupies 72,370 acres of the Coastal Zone region of South Carolina. Land use/land cover in the watershed includes: 33.1% forested land, 22.6% forested wetland, 17.0% nonforested wetland, 16.8% urban land, 7.7% water, 2.4% agricultural land, and 0.4% barren land. The Wando River headwaters flow through I'on Swamp (Mayrants Reserve) and accepts drainage from Alston Creek (SFH), Darrell Creek (SFH), Deep Creek, Toomer Creek (SFH), and Wagner Creek (SFH) before receiving Guerin Creek (SFH) drainage (Lachicotte Creek, Old House Creek, Fogarty Creek) near Cat Island. I'on Swamp and Guerin Creek drainages flow through the Francis Marion National Forest. Johnfield Creek enters the river downstream followed by Horlbeck Creek (SFH) (Boone Hall Creek-SFH), Foster Creek (SFH), Beresford Creek (Martin Creek, Sanders Creek, Hopewell Creek), Ralston Creek (SFH), Rathall Creek (SFH), Bermuda Creek, Hobcaw Creek (SFH), and Molasses Creek (SFH). The Wando River then drains into the Cooper River, which flows into the Charleston Harbor. The Wando River is classified SFH from its headwaters to a point 2.5 miles north of its confluence with the Cooper River, and is classified SA downstream of this point to its confluence with the Cooper River. Beresford Creek drains into both the Wando River and Clouter Creek and is classified SFH from its confluence with the Wando River to a point 4 miles away from the confluence, and classified SA from that point to the confluence with Clouter Creek. There are a total of 46.3 stream miles, 38.7 acres of lake waters, and 5,408.6 acres of estuarine areas in this watershed*"

"Surface Water Quality

Station #	***Type***	***Class***	***Description***
RT-08076	*RT-08*	*SFH*	*750 YARDS UPSTREAM DEEP CREEK OFF OF WANDO RIVER*
RT-06012	*RT-06*	*SFH*	*TOOMER CREEK, 2.5MI E OF SC 41 BRIDGE OVER WANDO RIVER*
MD-115	*P/INT*	*SFH*	*WANDO RIVER AT S.C. 41*
RT-07056	*RT-07*	*SFH*	*JOHNFIELD CREEK, 0.25MI FROM MOUTH*
RT-052100	*RT-05*	*SFH*	*BOONE HALL CREEK, 1.5MI WNW OF US 17/SC 41 INTERSECTION*
RO-056092	*RO-05*	*SFH*	*BERESFORD CREEK, 5.3 MI NNE OF WANDO & COOPER RIVER CONFLUENCE*
MD-264	*INT*	*SFH*	*WANDO RIVER AT I-526MARK CLARK EXPRESSWAY*
MD-198	*P/W*	*SFH*	*WANDO RIVER BETWEEN RATHALL & HOBCAW CREEKS*

Deep Creek (RT-08076) - *Aquatic life and recreational uses are fully supported. Although dissolved oxygen excursions occurred, they were typical of values seen in such systems and were considered natural, not standard violations.*

Toomer Creek (RT-06012) - *Aquatic life uses are not supported due to dissolved oxygen excursions. Recreational uses are fully supported.*

Wando River - *There are three monitoring stations along the Wando River and recreational uses are fully supported at all sites. Aquatic life uses are fully supported at the upstream site* ***(MD-115)****. There is a significant decreasing trend in pH. Although dissolved oxygen excursions occurred, they were typical of values seen in such systems and were considered natural, not standard violations. Significant decreasing trends in turbidity, total phosphorus concentration, and total nitrogen concentration suggest improving conditions for these parameters. At the midstream site* ***(MD-264)****, aquatic life uses are fully supported; however, there is a significant increasing trend in five-day biochemical oxygen demand. At the downstream site* ***(MD-198)****, aquatic life uses are fully supported. In addition, significant decreasing trends in five-day biochemical oxygen demand, turbidity, total phosphorus concentration, total nitrogen concentration, and fecal coliform bacteria concentration suggest improving conditions for these parameters.*

Johnfield Creek (RT-07056) - *Aquatic life and recreational uses are fully supported. Although dissolved oxygen excursions occurred, they were typical of values seen in such systems and were considered natural, not standard violations.*

Boone Hall Creek (RT-052100) - *Aquatic life uses are fully supported. Although dissolved oxygen excursions occurred, they were typical of values seen in such systems and were considered natural, not standard violations. Recreational uses are partially supported due to fecal coliform bacteria excursions.*

Beresford Creek (RO-056092) – *Aquatic life uses are partially supported due to dissolved oxygen excursions. Recreational uses are fully supported."*

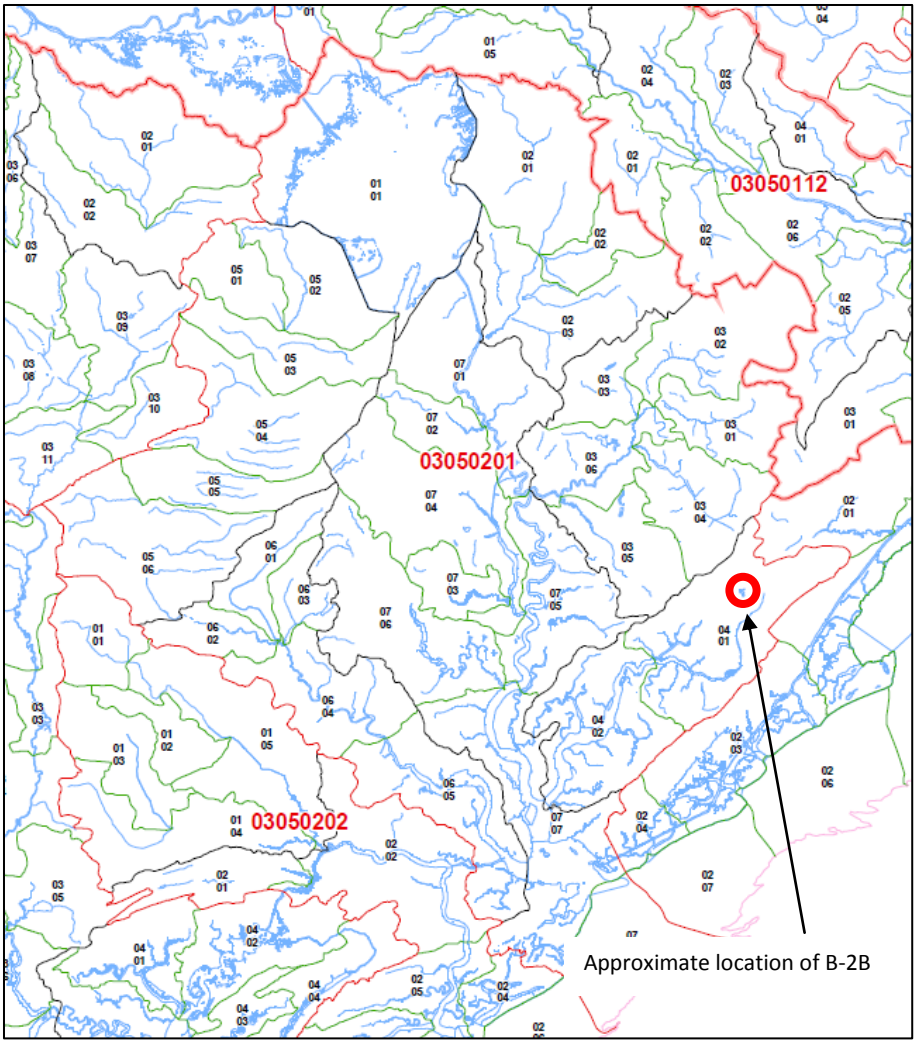


Figure 9. Location of B-2B within the 03050201 HUC

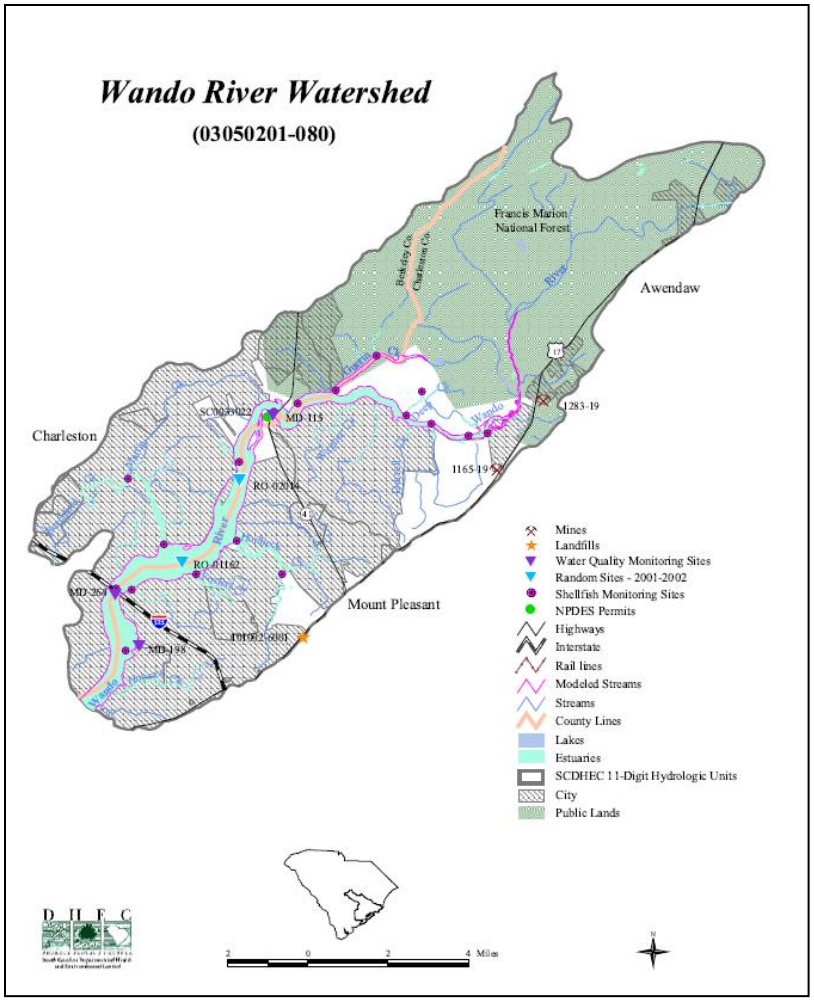


Figure 10. 11-digit HUC where preferred preservation parcel (Fairlawn B2-B) used for the UMAM analysis is located.

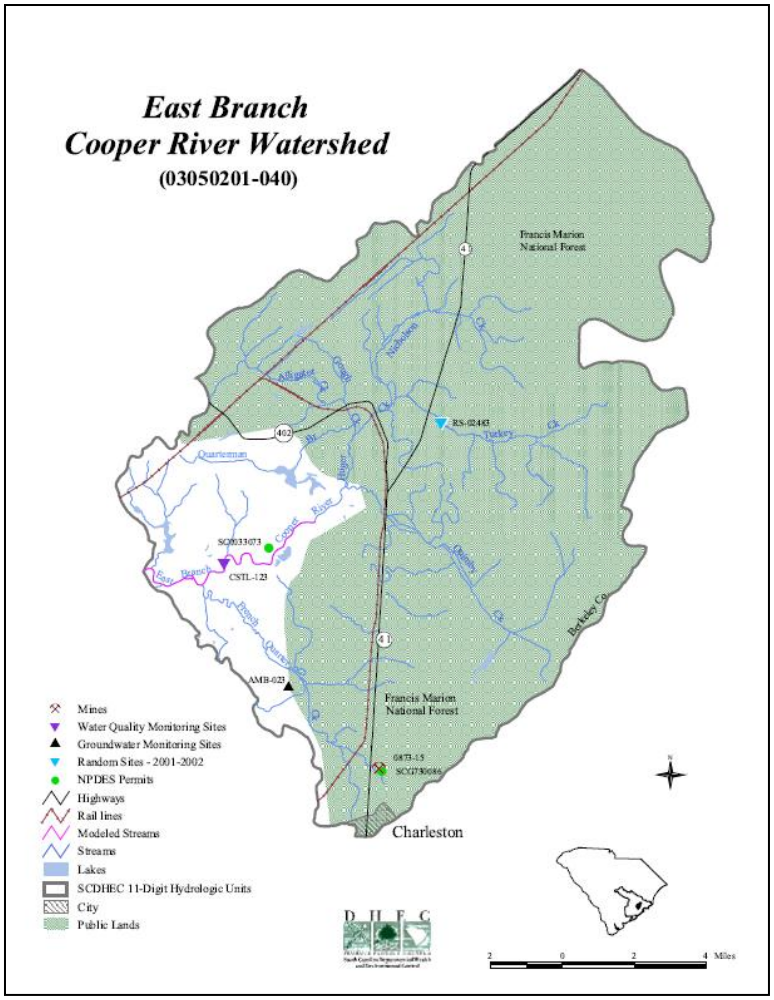


Figure 11. 11-digit HUC where additional properties could be purchased for wetland preservation and conveyed to USFS

As stated in the Final IFR/EIS, preservation of the USFS tracts, specifically B-2B, meets all of the criteria of Section 332.3(h)(1)(i-v) of the Mitigation Rule (more details provided below). It offers strategic value within the watershed and provides important physical, chemical and biological functions to the Cooper River Basin. It is consistent with the Charleston Harbor Special Area Management Plan (SCDHEC 2000), which emphasized ecosystem-level planning and prioritized non-tidal freshwater wetlands (the Plan states that, "although tidal wetlands have been relatively well protected, significant losses have occurred in freshwater non-tidal areas"). The USFS tracts will make a significant contribution to the sustainability of the watershed based on the assessment above. Among other things, they will help ensure that the functions of bottomland hardwood and emergent wetlands on these properties are protected in perpetuity, and will also enhance lands already within the Francis Marion National Forest by functioning as a buffer to future development. Permittee-responsible mitigation (PRM) in the form of preservation in this case is a low risk, practicable option. Continued population growth, industrial/commercial development, and changes in land use in the Charleston metropolitan area put these resources at risk of destruction and adverse modification. This mitigation proposal would permanently protect these at-risk resources by appropriate fee or conservation restrictions, and transfer to the Forest Service. The inclusion of riparian areas and adjacent uplands will help protect or sustain the aquatic resources, and removing these lands from the pool of potential development will reduce stressors on the watershed in the long term. Finally, considering that the proposed project does not directly result in the destruction in wetland habitat, preservation is an appropriate form of mitigation.

USACE focused on finding mitigation parcels in the watershed that:

- Included freshwater wetlands that can be preserved and conveyed to the USFS to provide physical, chemical, and biological functions and contribute to the ecological sustainability of the watershed
- include wetlands that do not necessarily need enhancement to provide the functional lift as determined by using the UMAM tool agreed to by the resource agencies
- are under substantial and imminent threat of destruction or irreversible modifications that would impair their conservation value
- provide connectivity with other protected parcels to form landscape scale preservation
- are within the proclamation boundary of the USFS Francis Marion National Forest
- provide habitat for T&E species
- are a focus of regional land conservation efforts
- will benefit the public if preserved
- can be easily conveyed to the USFS for management under their Forest Plan
- would be permanently protected
- reduce risk of development and adverse impacts to aquatic resources

The proposed mitigation sites and specifically B-2B meet these criteria. USACE has evaluated the proposed project mitigation with respect to the Mitigation Rule- entitled "Compensatory Mitigation for Losses of Aquatic Resources", 33 CFR Part 332 (and also 40 CFR Part 230) (jointly established by the USEPA and USACE and published in the Federal Register on April 10, 2008) (referred to herein as the Mitigation Rule). The USACE-Charleston District Regulatory guidance to assist permits applicants in complying with the Mitigation Rule (http://www.sac.usace.army.mil/Portals/43/docs/regulatory/Permittee_Responsible_Mitigation_Plan_Template.pdf; and http://www.sac.usace.army.mil/Portals/43/docs/regulatory/Requirements_for_a_Mitigation_Plan.pdf) applies to Clean Water Act Section 404 permit applications, not Corps Civil Works projects such as this study. Nevertheless, the Corps has attempted in good faith to consider and follow the Mitigation Rule guidance to the extent practicable in order to provide sufficient information in a manner suitable for 401 Water Quality Certification and to provide the necessary information to expedite the permit process should the SCSPA pursue construction upon completion of this study pursuant to Section 1014 of WRRDA of 2014. As shown in the following sections, the Corps has determined that the proposed project mitigation is consistent with the requirements and intent of the Mitigation Rule, 33 CFR Part 332.

2.5 Consistency with the Mitigation Rule

2.5.1 Goals and Objectives

33 CFR 332.4 (c) (2) states, "*A description of the resource type(s) and amount(s) that will be provided, the method of compensation (i.e., restoration, establishment, enhancement, and/or preservation), and the manner in which the resource functions of the compensatory mitigation project will address the needs of the watershed, ecoregion, physiographic province, or other geographic area of interest*."

The goal of the mitigation plan is to compensate for the relatively minor change of wetland function as a result of the indirect impact of the proposed project on freshwater wetlands in the Cooper and Ashley Rivers. A detailed analysis of the alternatives considered in the development of the wetlands mitigation plan is provided above. Since there is no net loss of wetland acreage associated with the impacts of the proposed project, preservation of lands and conveyance to the Forest Service is deemed an appropriate mitigation strategy. 33 CFR 332.3 (h) (1) (i-v) states, "*Preservation may be used to provide compensatory mitigation for activities authorized by DA [permits] when all the following criteria are met: (i) The resources to be preserved provide important physical, chemical or biological functions for the watershed; (ii) The resources to be preserved contribute significantly to the ecological sustainability of the watershed. In determining the contribution of those resources to the ecological sustainability of the watershed, the district engineer must use appropriate quantitative assessment tools, where available; (iii) Preservation is determined by the district engineer to be appropriate and practicable; (iv) The resources are under threat of destruction or adverse modifications; and (v) The preserved site will be permanently protected through an appropriate real estate or other legal instrument (e.g., easement, title transfer to state resource agency or land trust).*"

USACE has concluded that:

(i) the preserved lands provide important physical, chemical and biological functions for the Francis Marion National Forest, the Cooper River watershed, and the Charleston Harbor watershed;

(ii) the preserved lands will contribute to the sustainability of the watershed by ensuring the functions of bottomland hardwood wetlands on these properties are sustained in perpetuity, and the Francis Marion National Forest will be protected with a significant area of land that will function as a buffer in perpetuity;

(iii) for the reasons identified in (i) and (ii), the District Engineer has determined that preservation of any of the available parcels is appropriate and practicable so long as they meet the functional lift provided through the use of the UMAM tool;

(iv) USACE and other entities anticipate that the Charleston Harbor, and areas surrounding the Francis Marion National Forest, will continue to experience population growth, industrial/commercial development, and changes in land use. Preservation of any of these parcels ensures aquatic resources on the associated properties will be protected in perpetuity. The preserved land will provide additional buffer so that any future development in the vicinity will not result in a secondary and/or indirect impact to existing Forest Service lands; and

(v) preservation of any of the parcels will include a restrictive covenant and the recording of a fee conveyance of the property to the USFS.

Given that the impact will not result in a loss of wetland acreage, and only a relatively minor change in function/values, preservation is appropriate for use as mitigation. Additional reasoning as to why preservation only is an appropriate mitigation plan for the wetland impacts resulting from the proposed project are provided below:

- The proposed project does not directly impact any wetlands,
- The proposed project does not result in a net loss of wetland acreage
- Most of the existing wetland functions will still exist with only minor changes due to conversion of wetland vegetation
- The mitigation site is located in a highly desirable area to be developed
- The mitigation site will include upland buffers and will be buffered from development pressure by the Francis Marion National Forest
- The mitigation site will reduce stressors on the watershed by minimizing area to be developed
- The mitigation site will provide connectivity between existing protected lands
- The mitigation site will provide public access to Mayrants Reserve.
- As evidenced in the mitigation assessment described in Section 3.5 below and in the Final IFR/EIS, the functional lift needed to offset project induced indirect impacts is attained by preservation and conveyance to the USFS.

The plan will preserve hardwood swales, evergreen bays, and isolated wetlands. It addresses the overall ecological needs of the Cooper River Watershed and coastal South Carolina by preserving valuable tidal and non-tidal palustrine habitat as noted above.

While the proposed mitigation plan for wetland impacts consists of preservation only (based on purchase and conveyance to the USFS), under the ownership and management of the USFS, the preserved lands could undergo various enhancement and restoration efforts in accordance with the Forest Service's Plan. The latest version of the Forest Service's Forest Plan was completed in 1996 and can be found at: https://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5430357.pdf. The document characterizes the lands within the Forest and how the USFS intends to manage newly acquired lands. The plan is currently being updated and revised to consist of four chapters: 1. Introduction, 2. Vision and Strategy, 3. Design Criteria, and 4. Monitoring and Adaptive Management. The new USFS Plan has not been released yet, but proposed management strategies can be found at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3805368.pdf. The USFS would not be required to complete any restoration/enhancement as part of this mitigation plan. The new Forest Plan will emphasize the following broad concepts throughout the plan which will result in opportunities for enhancement/restoration where possible:

1. Maintain, improve or restore the unique landscapes and features on the Francis Marion;
2. Improve the quality of life and health for forest visitors and the surrounding communities;
3. Respond to challenges;
4. Share operational and planning resources among partners. Keep ongoing collaborative efforts vibrant while continuing to develop new ones;
5. Develop a monitoring strategy that provides information for rapid responses to changing conditions; and
6. Manage resources by integration and coordination.

Proposed management strategies for wet pine savannas and flatwoods that could be implemented on the parcel include the following:

"1. Reducing loblolly pine densities to a range of 10 to 40 ft2 basal area in favor of longleaf pine, pond pine or pondcypress savannas and flatwoods on mesic and wet sites;

2. Maintaining and restoring historic fire regimes to include frequent, one-to-three year fire return intervals for restoration burns including growing season burns at least every third burn;

3. Preventing and controlling the introduction and spread of NNIS by collaborating with partners on education, native understory restoration, timely treatment and control, equipment cleaning and early detection and rapid response;

4. Collaborating with others on practices which restore and maintain native forb communities and pollinator habitats;

5. Encouraging practices which minimize the displacement of soil, rutting and associated alteration of hydrology; and

6. Restoring native landscapes, to include high quality ecosystems and habitats for at-risk species. "

Proposed management strategies for forested swamps and floodplain forests that could be implemented on the parcel include the following:

"1. Maintain and restore forested swamps and floodplain forests using characteristic, infrequent natural fire regimes (2-218 years). Fire regimes may be variable depending on landscape position;

2. Promote characteristic hardwood composition and structural diversity through forest and vegetation management activities;

3. Control and prevent the spread of non-native invasive species (NNIS) conditions (feral hogs, fire ants, non-native invasive plants) as needed to achieve desired."

Proposed management strategies for systems similar to Mayrants Reserve that could be implemented on the parcel include the following:

"1. Manage recreational fishing ponds for public use;

2. Provide good water quality and habitat for associated riparian and aquatic dependent species;

3. Control aquatic nuisance species; and

4. Improve water quality by liming, adding habitat structures to ponds and stocking desired fish species."

It should be restated that the USFS would not be held responsible for the timing or implementation of any of these management practices and they are only presented here as examples of the types of practices that the USFS is proposing in the forthcoming Forest Plan. It is reasonable to anticipate that many of these actions would be implemented over time.

Collectively, the information provided here justifies the use of preservation and conveyance to the USFS as the preferred mitigation alternative for the indirect impacts that result in a conversion of freshwater wetland vegetation to salt-tolerant vegetation. USACE used a watershed approach when identifying and establishing the preservation parcels as mitigation for the 323.72 acres of freshwater wetland conversion to more salt tolerant species. Using a watershed approach, these areas of preservation have been identified as high priority mitigation (33 CFR 332.3(h)(2)). As such, the USACE has determined that acquisition of these lands is the environmentally preferable mitigation alternative and that the plan achieves the mitigation goal. Given the impact to tidal freshwater marsh would result in a vegetative conversion with minor impacts to fish and wildlife habitat, the proposed mitigation is satisfactory and also compliant with EPA Region 4's Mitigation Policy.

2.5.2 Site Selection

33 CFR 332.4 (c) (3) states, "*A description of the factors considered during the site selection process. This should include consideration of watershed needs, on-site alternatives where applicable, and the practicability of accomplishing ecologically self-sustaining aquatic resource restoration, establishment, enhancement, and/or preservation at the compensatory mitigation project site."* Details in 33 CFR 332.3 (d).

Mitigation regulations require a discussion of the criteria used to determine the suitability of the mitigation site. The following discussion summarizes the criteria and analysis that was performed to document the suitability of the selected parcel as mitigation for the projected impacts. Parcel B-2B is at risk for development. Residential development is incompatible with fire-based management practices because of human health and safety concerns. Residential areas make management of the abutting National Forest lands significantly more difficult, particularly with respect to controlled burning used for forest management by the USFS. Residential development also leads to degraded water quality. Thus, preservation of B-2B is critical to maintain the integrity of the National Forest and receiving waters of the watershed. Preservation of wetlands and upland buffers adjacent to the existing Francis Marion National Forest is a sustainable mitigation approach that would expand the Forest Service property; protect wetlands and upland buffers, expand/protect wildlife corridors; reduce the likelihood of future indirect impacts associated with stormwater runoff and septic systems; and decrease the risk of wildfire that comes with development and human encroachment.

B-2B is located in the Mid-Atlantic Coastal Plain ecoregion (as defined by USEPA). This ecoregion,

> "*consists of mostly flat plains, but it is a heterogeneous region containing barrier islands, coastal lagoons, marshes, and swampy lowlands along the Gulf and Atlantic coasts. In Florida, an area of discontinuous highlands contains numerous lakes. This ecoregion is lower in elevation with less relief and wetter soils than the Southeastern Plains (65). It is warmer, more heterogeneous, and has a longer growing season and coarser textured soils than the Middle Atlantic Coastal Plain (63). Once covered by a variety of forest communities that included trees of longleaf pine, slash pine, pond pine, beech, sweetgum, southern magnolia, white oak, and laurel oak, land cover in the region is now mostly slash and loblolly pine with oak-gum-cypress forest in some low lying areas, citrus groves in Florida, pasture for beef cattle, and urban*."

B-2B contains approximately 726 acres of wetlands (Figure 12). In order to approximate the number of acres of wetlands, GIS analysts used the sources listed below to prepare a wetland delineation of the three river basins within the project impact area, including the Wando River watershed where the mitigation wetlands are located in:

- True-color aerial photography - National Agriculture Imagery Program (NAIP) 2011
- Color Infra-red (CIR) aerial photography - National Geospatial Center of Excellence (NCGC) 2009
- EFDC model output data (salinity isopleths)

- LiDAR (light detection and ranging) topographic/elevation data - 1 foot contours from 5-10 foot DEM grids
- ERDC marsh vegetation study
- SC OCRM (Ocean and Coastal Resource Management) wetland study
- National Wetlands Inventory (NWI) maps
- Land (wetland) cover types from two SCDNR files: i.e.,
- SCDNR Alternative Energy Geodatabase Land Use/Cover (the file including polygons named "Palustrine Forested Wetland")
- SCDNR Landuse/Cover Wetlands (the file including polygons named simply "forested wetland")

The method of delineation for the mitigation area is consistent with the methods used to determine impacts to both forested and emergent wetlands.

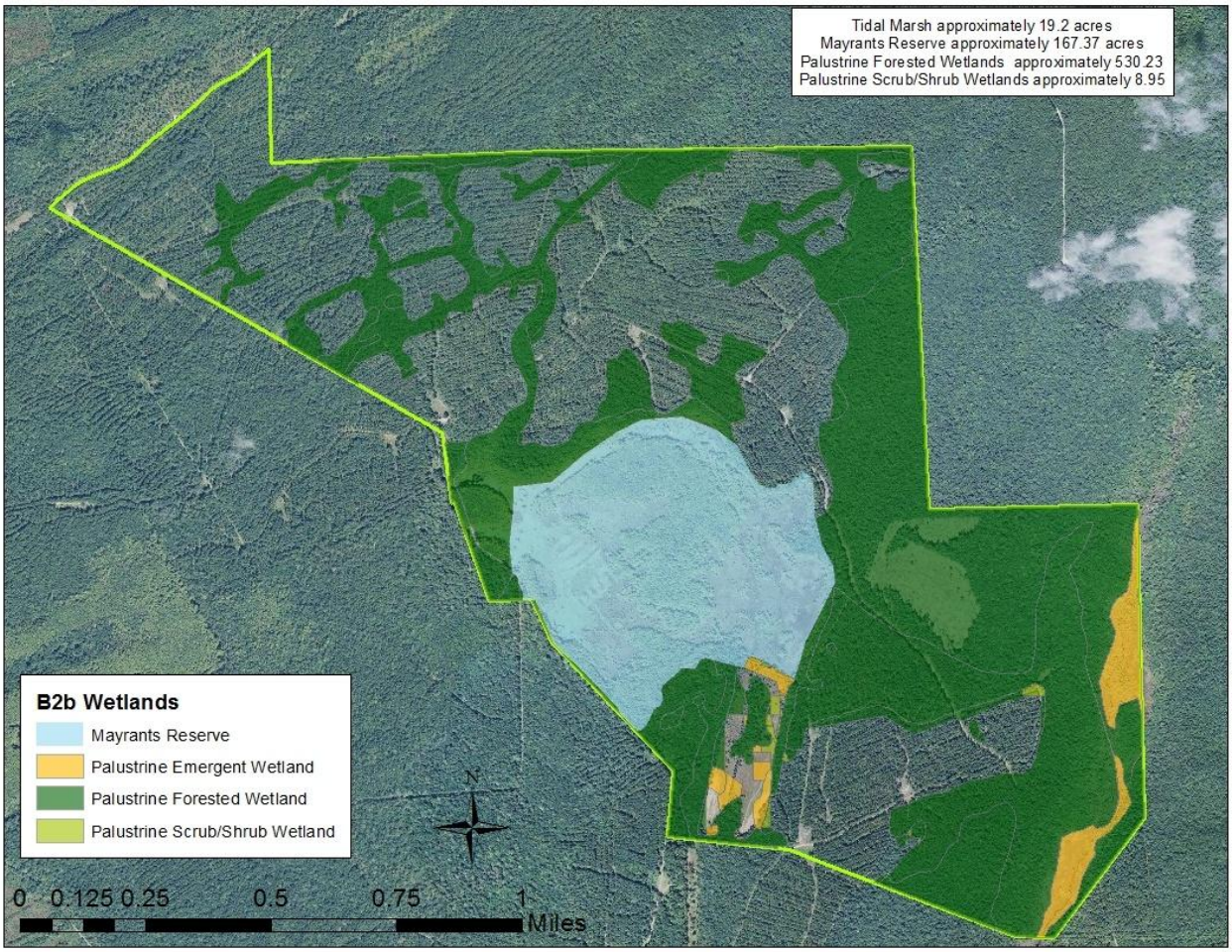


Figure 12. B-2B Wetland approximation

Within the Wando River basin, the OCRM wetland study provided the highest resolution and most accurate data from which to build on. In addition to the OCRM data, SCDNR and NWI data layers were

utilized. Unfortunately, the SCDNR and NWI data sometimes had overlapping cover types that conflicted in designation or areas with no coverage type indicated whatsoever. This necessitated the comparison of LIDAR topographic data and landscape position to other reliable wetland polygons to determine the typical elevation of the boundary between wetland and upland. The landward extent (from each river channel's centerline) of wetlands associated with the river (as defined below) was then determined. The five-foot elevation contour (specifically NAVD88 datum GEOID09) provided a reasonable uphill limit (i.e., boundary) for wetlands in the watershed. Per convention (observed in SCDNR data sets), open water areas (sloughs, creeks, canals, etc.) that were not part of the main river channel were not classified as wetland areas. The B-2B wetlands fall within a portion of the watershed where LIDAR data was not available In order to determine if the wetlands were "connected to the river" similar to the impacted wetlands in the wetland impact analysis, a digital elevation model data was used from the SCDNR GIS data clearinghouse. Using this data, the forested wetlands were edited by using the GIS "intersect" tool to delineate areas that were less than 5 feet and over 5 feet. The use of CIR aerial photography, ditches, drainages, provided an additional method for verifying the inclusion or exclusion of habitats as wetlands "connected" to the river. This method results in a wetland layer that has similar data to those generated for the project impacts. These data were reconciled into a unified wetland delineation providing the optimum combination of comprehensive coverage and best available accuracy for estimating existing wetland type and acreage and subsequently, an approximation of wetlands within the mitigation parcel.

Many of the forested wetland areas include both tidal and non-tidal systems but were both determined to be connected to the river. Similar to the impacted wetlands in the Cooper and Ashley Rivers, these wetlands are defined as palustrine wetlands using the Cowardin (1979) system of wetland classification; however, it should be noted that some of these wetlands receive the majority of their water from precipitation, not riverine flooding. This method of wetland approximation provides a more accurate estimate of wetlands (than just land cover alone) in the potential mitigation parcel because it factors in a variety of data sources.

Table 4. Acreage and type of wetlands on Fairlawn B-2B used in UMAM calculations

Wetland Type	Acreage determined from wetland approximation method
Tidal marsh	19.2
Mayrants Reserve (palustrine wetlands)	167.37
Freshwater Forested Wetlands	530.23
Palustrine scrub/shrub	8.95

The preservation areas include the hardwood swamp wetland types similar to those that could be impacted as a result of the proposed project. They also include bay swamps, which contain evergreen species such as wax myrtle. The parcel can be characterized by wetlands and uplands. The wetlands are classified as bottomland hardwood forest, dominated by old-growth oaks, cypress, sycamore and sweetgum. The sites are both temporarily and seasonally flooded and/or forested wetlands. While some of the wetlands on the parcel are considered non-tidal, they are still palustrine wetlands. The impacted wetlands are mostly tidal. However, it should be noted that similar spatial wetland delineation that was performed in the impacted area of the proposed project was used in the Wando watershed and the wetlands of B-2B were delineated using that same methodology. Therefore, while the mitigation wetlands are not entirely in-kind due to their different primary hydrology, they are both palustrine forested and were delineated using the similar methodology. The overall site topography is a relict dune and swale pattern that runs northeast to southwest, with wetlands in the swales, as well as low topography wetlands hydraulically connected to the Wando.

The preservation of this parcel will benefit the aquatic resources of the tributary streams and the main branch of the Wando and Cooper Rivers. It will also benefit threatened and endangered species such as the frosted flatwoods salamander, gopher frog, red cockaded woodpeckers, American chaffseed, ciliate leaf tickseed, pondberry, and Canby's dropwort. The site may also contain Bachman's warbler and swallowtail kite rearing habitat. The USFS will incorporate these lands into their most up to date Forest Plan which includes provisions for burning and enhancement of bottomland hardwoods and upland pine forest. Given this plan, loblolly areas could be managed to reestablish longleaf pine habitat, a known reservoir for threatened and endangered species. The surrounding National Forest was recently identified as a Significant Geographic Area for maintenance and restoration of longleaf pine in the 2009 Range-Wide Conservation Plan for Longleaf Pine (www.americaslongleaf.org). The tract also aids in providing connectivity and wildlife corridors between the nearby marshes and estuaries of the Cape Romain National Wildlife Refuge.

B-2B is a private parcel adjacent to National Forest lands and is currently managed for silviculture. While it is located within the proclamation boundary of the National Forest, it is still vulnerable to development. Under the preservation and conveyance mitigation plan, B-2B's future management will be compatible with the habitat management plans of the Francis Marion Forest Plan. B-2B is part of Fairlawn Plantation, which has been designated as an Important Bird Area by the Audubon Society. Avian species will benefit from the prescribed fire regimen once under the Forest Plan and management by the USFS. If development encroached on this area, human safety and health concerns may override the bird habitat management goals that prescribed fires can bring. Mayrants Reserve, a historic ricefield impoundment, is managed for fishing, waterfowl and bird habitat.

2.5.3 Site Protection

33 CFR 332.7(a)(1), *Site Protection, states: "The aquatic habitats, riparian areas, buffers, and uplands that comprise the overall compensatory mitigation project must be provided long-term protection through real estate instruments or other available mechanisms, as appropriate. Long-term protection may be provided through real estate instruments such as conservation easements held by entities such as federal, tribal, state, or local resource agencies, non-profit conservation organizations, or private land*

managers; the transfer of title to such entities; or by restrictive covenants. For government property, long-term protection may be provided through federal facility management plans or integrated natural resources management plans." To mitigate for the vegetative conversion of 323.72 acres of freshwater wetland, the Corps proposes that the SCSPA acquires land identified by the USFS as high priority acquisition parcels. Once acquired, the land would be provided to the USFS to manage as additions to the Francis Marion National Forest and the lands would be subject to the same protections and use requirements as defined in the "*Conservation Land Use Agreement Between the U.S. Army Corps of Engineers, Charleston District and the U.S. Department of Agriculture, U.S. Forest Service, Francis Marion and Sumter National Forests*," dated July 10, 2013 (CLUA) (Attachment 3 to this Appendix).

2.5.4 Baseline Conditions

Baseline conditions/existing conditions of the impacted wetlands are described in Appendix L of the Final IFR/EIS. Existing conditions of the proposed mitigation site can be found above in Section 3.2. Additional baseline conditions details are provided below.

Fairlawn Plantation, including parcel B-2B, is strategically located within the Francis Marion National Forest proclamation boundary and contains the headwaters of the Wando River which drains into the Cooper River watershed. Fairlawn has been identified by TNC as the single most important acquisition for the Francis Marion National Forest. Fairlawn Plantation is surrounded on multiple sides by conservation land, including both privately protected properties and federally managed lands. The property has consistently been managed for timber production, recreation, and historic ricefield impoundments. However, conversion to residential development, specifically small lot residential development that is incompatible forestry practices, remain key threats to Fairlawn Plantation. Fairlawn Plantation is highly desirable property due to its recreational amenities and close proximity to the Town of Mt. Pleasant and City of Charleston (TNC, Sarah Hartman, Real Estate Abstract and Resolution, Francis Marion, 2012).

The Fairlawn tracts have very complex mosaics of upland and wetland communities, with extensive northeast-southwest trending ecotones. Wetlands include both tidal and non-tidal palustrine (freshwater) systems. Wetland acreages and type are shown in Table 4, above. The property comprises current and former wetlands that were converted to inland ricefields at the time of European settlement, but which have since been left to natural reforestation. These areas are now populated by common forested wetland trees such as pond cypress, red maple, laurel oak, and sweetgum. The riparian areas and adjacent uplands are primarily pinelands or savannah. Many of these uplands were historical longleaf areas that have been converted to loblolly pine plantation, or southern maritime forest. The property lies in proximity to one of the largest remaining expanses of longleaf pine forest, a known reservoir for rare, threatened and endangered species. The surrounding Francis Marion National Forest was recently identified as a Significant Geographic Area for the maintenance and restoration of longleaf pine. The property is also proximal to the extensive marshes and estuaries of the Cape Romain National Wildlife Refuge, a Class I Wilderness area. The Refuge is recognized as a United Nations Educational, Scientific and Cultural Organization (UNESCO) Biosphere Reserve, and a Ramsar wetland of international significance. Ramsar wetlands are established through an intergovernmental treaty that strives to maintain the ecological character of important wetland areas in their territories. These

designations are bestowed only on the most significant natural habitats of the world. The Nature Conservancy (2010) developed habitat models for foraging habitat of the red-cockaded woodpecker (federally endangered), pond-breeding amphibians (including the federally threatened flatwoods salamander), and juvenile rearing habitat for swallowtail kites (federal candidate species). All of these habitat types fall within the boundary of B-2B.

The site has little to no topographic gradient (Figure 13). Soil types on B-2B reflect drainage patterns, and their permeability, grain size, and other properties. The wetland soils on B-2B have been mapped by the NRCS (Figure 14, Table 5). Primary soil types consist of Yonges loamy fine sand, water, Santee loam, Wadmalaw fine loamy sand. All of them are hydric soils. Figure 12 (above) shows an aerial of the project site. The landscape is mostly forested and contains intact habitats. Mayrants Reserve is a ponded area.

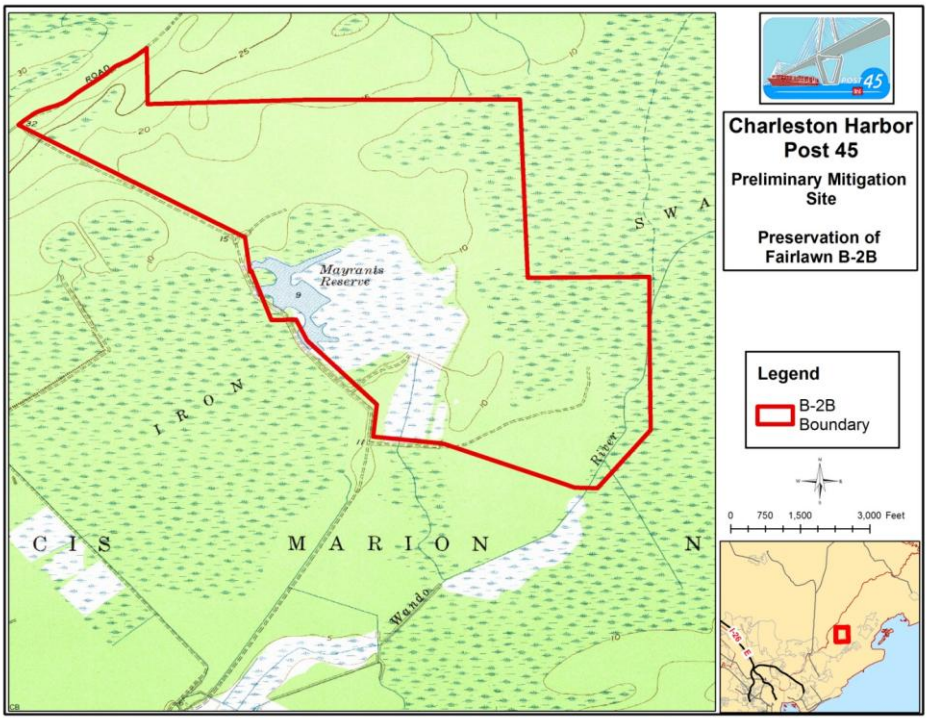


Figure 13. ESRI seamless topographic data for B-2B

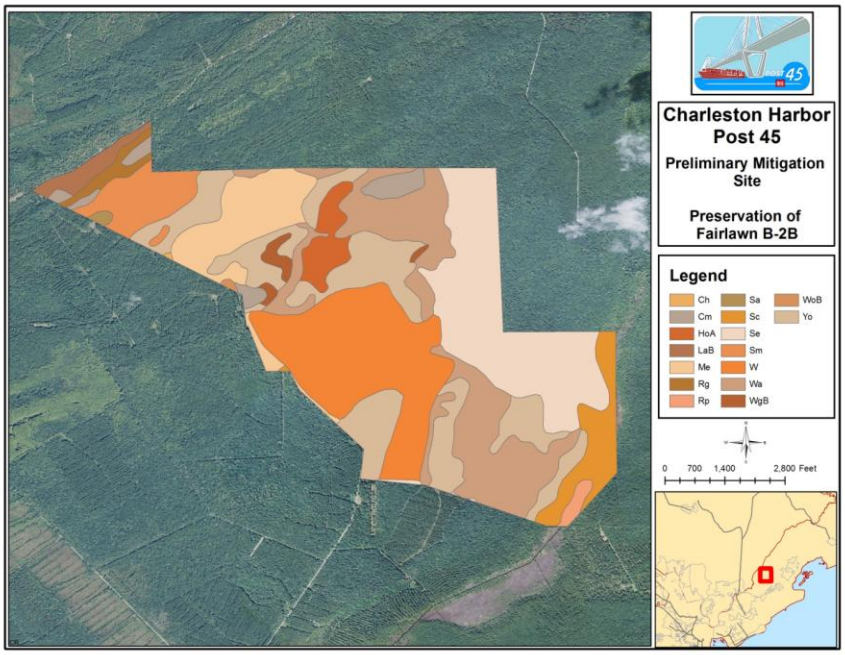


Figure 14. National Resource Conservation Service Soils Data for B-2B

Table 5. Soil types at B-2B

Map Unit Symbol	Map Unit Name
Ch	Charleston loamy fine sand
Cm	Chipley Loamy fine sand
HoA	Hockley loamy fine sand, 0-2 percent slopes
LaB	Lakeland sand, 0-6 percent slopes
Me	Megget clay loam
Rg	Rutlege loamy fine sand
Rp	Rutlege-Pamlico complex
Sa	St. Johns fine sand
Sc	Santee clay loam
Se	Santee loam
Sm	Seewee complex
W	Water
Wa	Wadmalaw fine sandy loam
WgB	Wagram loamy fine sand, 0-6 percent slopes
WoB	Wicksburg loamy fine sand, 0-6 percent slopes
Yo	Yonges loamy fine sand

The mitigation site lies within the South Carolina Coastal Plain, which forms an embayment south of the Cape Fear Arch. The stratigraphy of the South Carolina Coastal Plain consists of partially consolidated, unconformity bound, southeast dipping estuarine-marine shelf Tertiary deposits, which are overlain by unconsolidated Quaternary barrier and nearshore deposits. Figure 15 shows a map of the SCDNR identified geologic data for the B-2B. Nearly all of the surficial deposits in the Charleston area are Quaternary in age, and they uncomformably overlie the Tertiary strata. These sediments were deposited during sea level fluctuations caused by multiple interglacial cycles throughout the Pleistocene. More details related to the geology of the area can be found within Appendix B of the Final IFR/EIS.

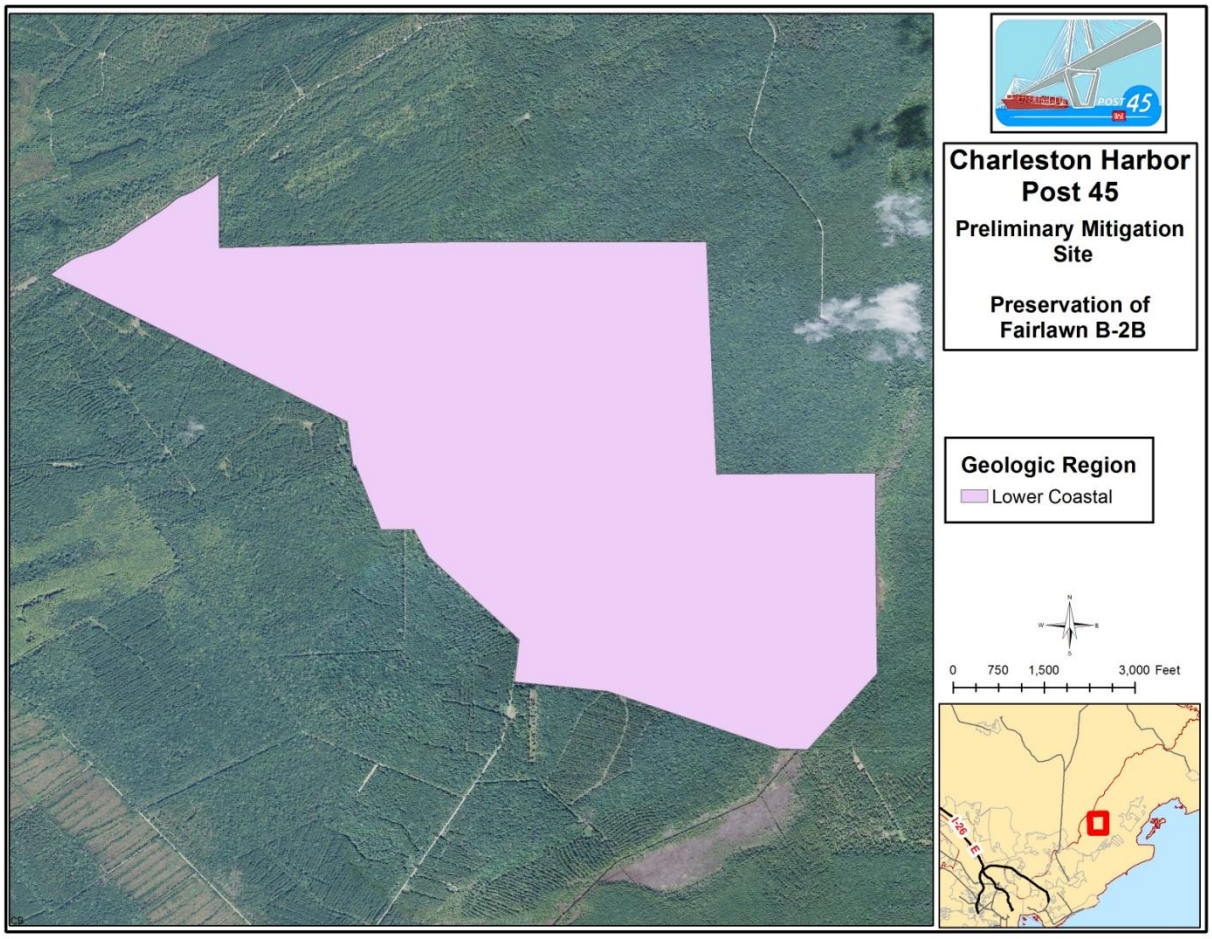


Figure 15. SCDNR Geologic Map Data for B-2B

Figure 16 shows an inventory of threatened and endangered species as indicated by the SC Heritage Trust and last updated in 2006. The site indicates that colonial waterbirds, red cockaded woodpeckers, black bears, cooper's hawk, black swamp snake, barn owl, swainson's warbler, black-throated green warbler, flatwoods salamander, swallow-tailed kite, Mississippi kite, and wood stork were all sited in and around the area in the past.

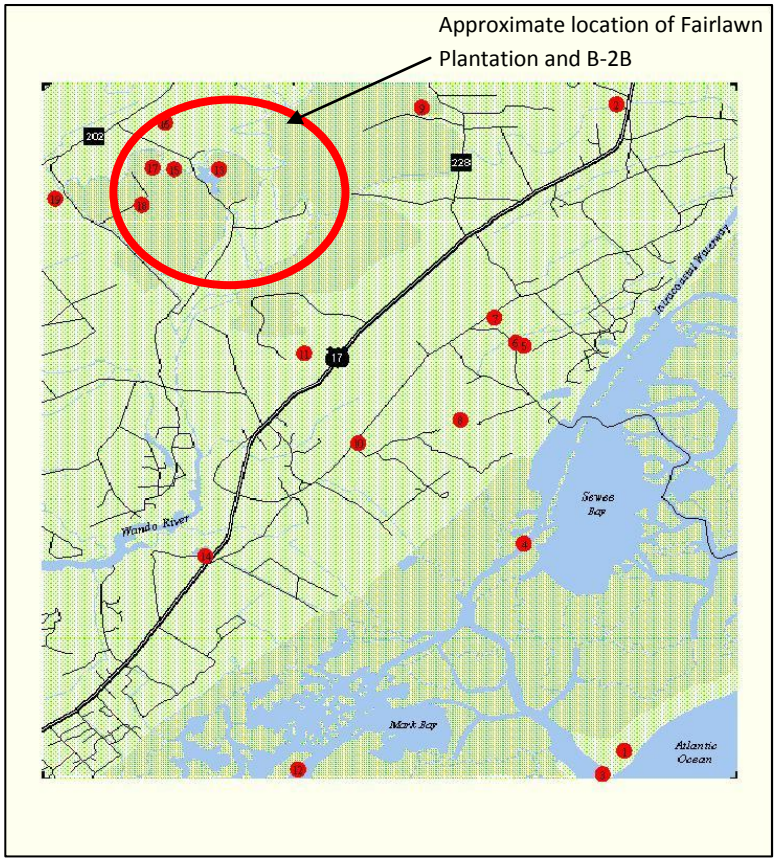


Figure 16. SCDNR Heritage Trust identified threatened and endangered species locations

Map Legend (Green=species found in around Fairlawn)

Marker	Genus species
1	COLONIAL WATERBIRD
2	*TRIPHORA TRIANTHOPHORA*
3	*AMARANTHUS PUMILUS*
4	COLONIAL WATERBIRD
5	*HALIAEETUS*
6	*HALIAEETUS*
7	*HALIAEETUS*
8	*CANNA FLACCIDA*
9	COLONIAL WATERBIRD
10	*PTEROGLOSSASPIS*
11	*TRIPHORA TRIANTHOPHORA*
12	COLONIAL WATERBIRD
13	COLONIAL WATERBIRD
14	COLONIAL WATERBIRD
15	*CONDYLURA CRISTATA*
15	*URSUS AMERICANUS*
15	*ACCIPITER COOPERII*
15	*MELANERPES*
15	*SEMINATRIX PYGAEA*
15	*TYTO ALBA*
15	*LIMNOTHLYPIS SWAINSONII*
15	*DENDROICA VIRENS*
15	*AMBYSTOMA CINGULATUM*
15	*ELANOIDES FORFICATUS*
15	*ICTINIA MISSISSIPPIENSIS*
16	*AIMOPHILA AESTIVALIS*
16	*PICOIDES BOREALIS*
17	COLONIAL WATERBIRD
18	*MYCTERIA AMERICANA*
19	*EUPATORIUM ANOMALUM*

Figure 17 documents visually identified flow blockages within and around the B-2B parcel. The sites were identified by USFS personnel and retired USFS hydrologist William Hansen by using remote hydrologic modification coverage using LIDAR and infrared photos. These are approximate points where Mr. Hansen identified locations that water needs to pass, and may be contained or diverted by apparent structures. Some of the data had these breached for flow passage of their streams. All roads, former dikes, etc were considered hydrologic modifications, and as such, some of the blockages may be bridges where there is no or limited hydrologic modification. None of these sites have been field verified.

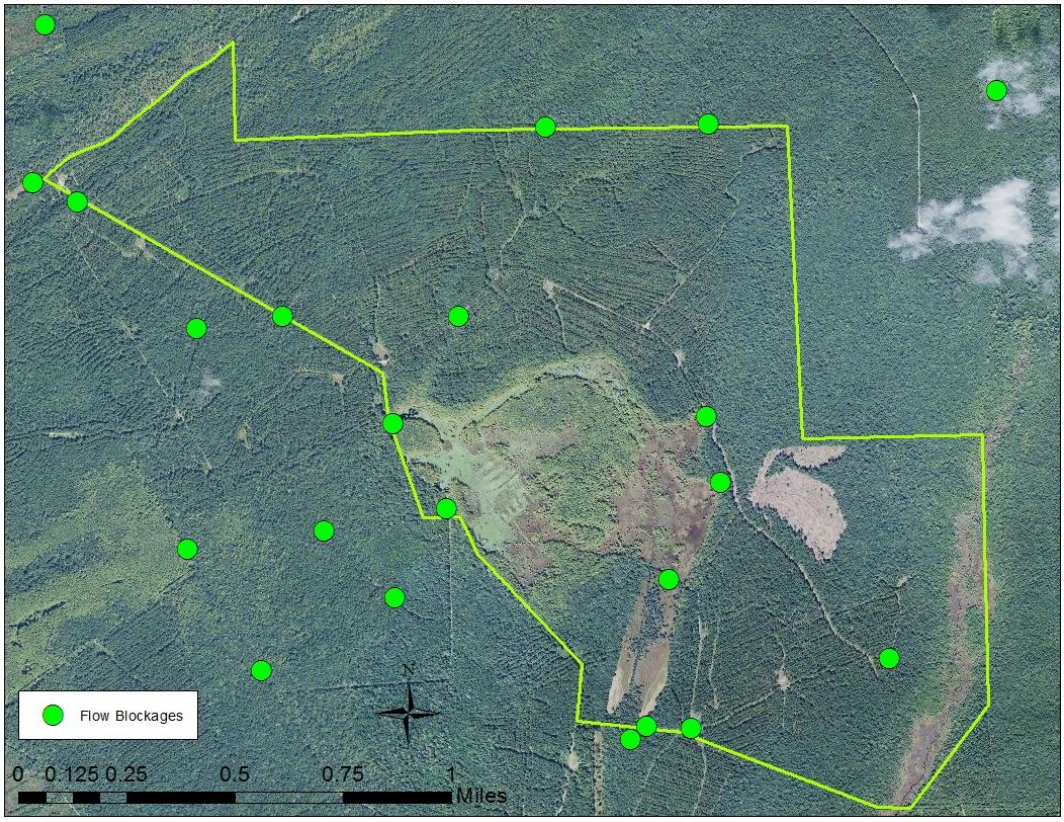
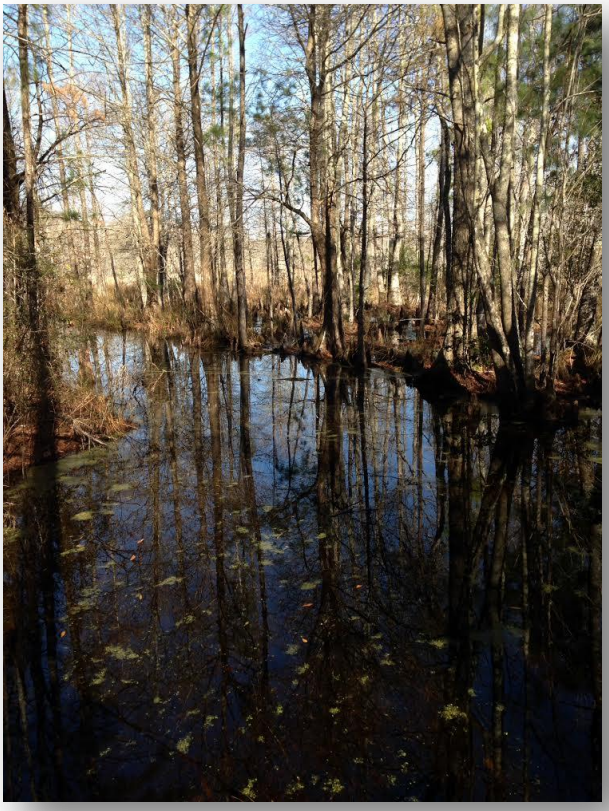


Figure 17. USFS identified potential flow blockages

The below photographs show the wetlands on the proposed mitigation parcel B-2B taken on April 30, 2014.



2.5.5 Determination of Credits

33 CFR 332.4 (c) (6) states, "*A description of the number of credits to be provided, including a brief explanation of the rationale for this determination. (See § 332.3(f).) (i) For permittee-responsible mitigation, this should include an explanation of how the compensatory mitigation project will provide the required compensation for unavoidable impacts to aquatic resources resulting from the permitted activity.*"

The challenge with determining appropriate mitigation for wetland impacts resulting from the Post 45 project is that the predicted salinity intrusion impacts to naturally functioning wetlands are not within the scope of what would typically be addressed in the 404 process (filling, clearing, draining or converting from one wetland form [forested] to another [emergent]). While not a loss of waters of the United States, the impacts here are a result of causing a shift from one dominant type of wetland

vegetation to another (freshwater tidal to brackish, brackish to salt) and cannot be adequately captured by either the Charleston District Regulatory Division's Guidelines for Preparing a Compensatory Mitigation Plan or any current mitigation standard operating procedure (SOP) within the South Atlantic Division of the Corps. Because of this, it was necessary to apply an alternative method to accurately determine the number of acres of potential impact. Additionally, a model/tool had to be used that could appropriately document and account for the anticipated impacts of the projects USACE coordinated various methods through the ICT. Many methods/models were evaluated, including, Habitat Suitability Indices (HSI), Modified Regulatory Standard Operating Procedure (SOP), Habitat Equivalency Analysis (HEA), Hydrogeomorphic Method (HGM), Wetlands Valuation Assessment (WVA), and Uniform Mitigation and Assessment Method (UMAM). A description of each method and a brief synopsis of its use for the indirect wetland impacts associated with the project were provided to the ICT. Ultimately, the USACE recommended the use of UMAM as the tool of choice because it is the most appropriate available model for this application. . After selecting UMAM (description provided in Section 2.5.5.1 below), a two-day UMAM training and field work exercise with ICT participation was conducted for the impacted wetlands in the Cooper River. Results of the UMAM field work were disseminated by USACE staff and circulated to the ICT for comments and concerns with the UMAM assessment. No comments were received that would have changed any of the UMAM assessment scoring.

The UMAM is appropriate for use for determining compensatory mitigation related to indirect wetland impacts resulting from this project. The UMAM was recently used by the Jacksonville District for calculating wetland mitigation needs resulting from similar wetland impacts for Jacksonville Harbor. Nothing in the methodology limits it to application only in Florida; in fact, it can be used for mitigation calculations on more than just wetlands. The UMAM training manual states that, "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….." Because of this, it was determined to be suitable for use by the Charleston District for Post 45. Based on a recommendation from the USACE Ecosystem Planning Center of Expertise, UMAM was approved for single-use by the USACE Model Certification Team on 21 May 2014.

2.5.5.1 UMAM Description

The Uniform Mitigation Assessment Method (UMAM) rule was developed in response to a State of Florida mandate [subsection 373.414(18) F.S.] which required the establishment of a uniform mitigation assessment method to determine the amount of mitigation needed to offset adverse impacts to wetlands and other surface waters. The UMAM provides a standardized procedure for assessing the ecological functions provided by wetlands/surface waters, the amount that those functions are reduced by a proposed impact, and the amount of mitigation necessary to offset that loss. This standardized methodology also is used to determine the degree of improvement in ecological value of proposed mitigation bank activities.

UMAM assesses the function of an area based on three categories, scored on a scale from 0 to 10: 1. Location and landscape support, 2. Water environment, and 3. Community structure. Location and landscape support assesses ecological functional value based on the assessment area's position within the landscape and relationship with surrounding areas. The second category, water environment

assesses hydrologic alterations which improve or impact ecological functions. Finally, community structure is the evaluation of the conditions which support functions that provide optimal benefits to fish and wildlife.

Scores for the three categories are assigned for the existing/without-project condition and the with-project condition. The scores are summed and normalized (divide by 30) for each condition (without and with project). The difference between the without-project condition and with-project condition is calculated and referred to as the Delta.

The Functional Loss for the impact site is calculated by multiplying the Impact Site Delta by the acres of impact. The Relative Functional Gain is the per acre quality gain for the mitigation site and is calculated using the Mitigation Site Delta, a time lag factor, a risk factor, and a preservation adjustment factor, if applicable.

Time lag is the period of time between when the functions are lost at the impact site and when those functions are gained at the mitigation site. The time lag factor ranges from 1 (mitigation fully offsets impacts prior to or at time of impact) to 3.91 (time lag of >55 years). Application of the time-lag factor is similar to calculating net average annual outputs of the mitigation site. Delay in achieving function at the mitigation site produces lower mitigation output over the period of analysis. UMAM accounts for this by reducing the Relative Functional Gain at the mitigation site, which results in more area required to offset project impacts/Impact Site Functional Loss.

The risk factor is related to the degree of uncertainty that the mitigation site will achieve the anticipated functional gain. The risk factor is scored from 1 (no risk/de minimus risk) to 3 (high risk).

The preservation adjustment factor reduces the mitigation site Relative Functional Gain when using preservation to mitigate for project impacts. The preservation adjustment factor ranges from 0 (no preservation value) to 1.0 (optimal preservation value) and considers factors such as management activities that promote natural ecological conditions, preservation of ecological and hydrologic relationships, scarcity of habitat type and use by listed species, and extent and likelihood of adverse impacts if area is not preserved.

The Mitigation Site Relative Functional Gain is calculated by multiplying Mitigation Site Delta by the preservation adjustment factor and dividing by the product of the time lag factor and the risk factor.

The area of mitigation required is calculated by dividing the Impact Site Functional Loss by the Mitigation Site Relative Functional Gain.

2.5.5.2 Functional Analysis Using UMAM

The UMAM scoring for the Post 45 project was based on site assessments, vegetation data collected, and hydrodynamic modeling results. On 17 April 2014, USACE conducted a site assessment and performed UMAM scoring with staff from EPA, USFWS, NMFS, SCDNR, and SCDHEC-OCRM (Collectively called the Interagency Coordination Team (ICT). The ICT participated in the detailed collaborative UMAM scoring only for the Cooper River. After the field work, USACE staff compiled comments and recommended scores for the UMAM sheets and sent them to the ICT team for review. Comments from the review were incorporated into the UMAM scoring sheets. There were no adverse comments

received about the scores/assumptions used in the UMAM sheets. The UMAM scoring for the Ashley River was based upon field work conducted on 10 October 2013, modeled data, and assumptions on vegetation changes based on expected outcomes on the Cooper River. The Ashley River sheets were not submitted to the ICT for early review, although the deltas between the baseline and with project scoring were the same for each wetland system within the different rivers. Table 2 summarizes the assessment scoring used for each affected wetland type within the two river systems that are predicted to experience salinity affects to freshwater systems. As shown, the total wetland functional loss is – 73.46 units. For details on the UMAM scoring and to see the sheets used to develop these scores please see the UMAM sheets in Attachment 1.

Table 6. UMAM functional loss results for the Post 45 Project

Wetland UMAM Results					
Wetland Type	**UMAM score for baseline condition**	**UMAM score for with project condition**	**Delta**	**Affected acreage**	**Calculated UMAM functional loss**
Cooper River - Forested	0.8	0.53	-0.27	126.37	-33.70
Cooper River - Marsh	0.8	0.6	-0.2	179.83	-35.97
Ashley River - Forested	0.77	0.5	-0.27	4.36	-1.16
Ashley River - Marsh	0.77	0.57	-0.2	13.16	-2.63
TOTAL					**-73.46**

2.5.5.3 UMAM Analysis for Preservation Mitigation

The UMAM functional loss analysis presented above identified a total functional loss of 73.46 units. This loss must be offset by the Relative Functional Gain (RFG) of a mitigation alternative. RFG is the per acre quality gain for the mitigation site and is calculated using the Mitigation Site Delta, a time lag factor, a risk factor, and a preservation adjustment factor, if applicable (these variables are discussed above in the description of the UMAM tool). The mitigation site RFG is calculated by multiplying the mitigation site delta by the preservation adjustment factor and dividing by the product of the time lag factor and the risk factor. The area of mitigation required is calculated by dividing the Impact Site Functional Loss by the Mitigation Site Relative Functional Gain (Numbers in table adjusted for rounding).

USACE implemented a collaborative effort with various resource agencies in order to determine UMAM scores for the preservation parcel. USACE hosted a 2 day meeting 28-29 January 2015 (pictures below) in order to facilitate resource agencies' opinions on the scoring. At the agencies' request, the parcel was divided into various "assessment areas" for the scoring. UMAM defines an "assessment area" as all or part of a wetland or surface water impact site, or a mitigation site that is sufficiently homogeneous in character, impact, or mitigation benefits to be assessed as a single unit."

A summary of the UMAM scoring for the proposed mitigation site is provided in Table 7. The functional lift resulting from preserving the site is primarily due to the prevention of development from occurring within the property boundary. If development were to occur, many wetland functions would be reduced including water storage, nutrient retention, water purification, flood protection, groundwater recharge, subsurface storage, to name a few. Development in the upland areas would fragment habitat in the area. Disturbances could cause exotic species to colonize the area. Wildlife access would decline due to the fragementation. Regardless of the likelihood of development, economic activity would continue to occur on the property, including timber harvesting and mining of resources. Even though direct development would not be anticipated, houses/docks/piers will fragment the marshes and increase stormwater runoff into the marsh and receiving waters of the Wando River. Development would also degrade water quality due to an increase of nutrients, bacteria, and hydrocarbon pollutants from changing land use patterns. Development would also inhibit the ability of the USFS to actively and efficiently perform prescribed burning operations.

USACE evaluated the preservation adjustment factor using the 5 criteria in the UMAM guidance: 1. Extent to which management activities promote natural conditions, 2. Ecological and hydrological relationship between wetlands and uplands, 3. Scarcity, 4. Proximity to other preserved areas, and 5. Extent and likelihood of impacts if not preserved. The time lag factor was determined using an assumption of 5 years before development pressure would start if the land was not preserved. Please see the UMAM sheets provided as an attachment to this document for more details.

Table 7. UMAM analysis for Preservation of Fairlawn B3-B and Conveyance to USFS.

UMAM Results for Fairlawn B2-B Assessment Areas								
Wetland Type	**UMAM score for baseline condition**	**UMAM score for with project condition**	**Delta**	**Preservation Adjustment Factor1**	**Adjusted Mitigation Delta**	**Time Lag Factor**	**Risk Factor**	**Relative Functional Gain**
Site 1 – Forested Wetlands	0.6	0.867	0.267	0.5	0.133	1.14	1	0.117
Site 2 – Mayrants Reserve	0.567	0.833	0.267	0.5	0.133	1.14	1	0.117
Site 3 – Forested Wetlands	0.6	0.867	0.267	0.5	0.133	1.14	1	0.117
Site 4 – Tidal Marsh	.767	.9	.133	0.9	.12	1.14	1	.105

**Numbers in this column represent the numbers from the UMAM sheets in Attachment 1.*

Using these assumptions for the parcel B-2B, 665.56 acres of the example wetlands would need to be preserved to offset the functional loss from the impacted wetland areas (Table 8).

In summary, the Charleston District is assuming that 665.56 acres of wetlands will be needed to offset the functional loss due to indirect impacts to wetlands in the Cooper and Ashley Rivers as a result of the proposed project.

Table 8. Compensatory mitigation acreage calculations

	Functional Loss (FL)	/	Relative Functional Gain (RFG)	=	Acres of Mitigation Needed
Cooper Marsh	-35.96600	/	0.105	=	-342.53
Cooper Forested	-33.69867	/	0.117	=	-288.02
Ashley Marsh	-2.63200	/	0.105	=	-25.07
Ashley Forested	-1.16267	/	0.117	=	-9.94
				Sum	**-665.560114**

2.5.6 Mitigation Work Plan

33 CFR 332.4 (c) (7) states, "*Detailed written specifications and work descriptions for the compensatory mitigation project, including, but not limited to, the geographic boundaries of the project; construction methods, timing, and sequence; source(s) of water, including connections to existing waters and uplands; methods for establishing the desired plant community; plans to control invasive plant species; the proposed grading plan, including elevations and slopes of the substrate; soil management; and erosion*

control measures. For stream compensatory mitigation projects, the mitigation work plan may also include other relevant information, such as planform geometry, channel form (e.g., typical channel cross-sections), watershed size, design discharge, and riparian area plantings." To mitigate for the vegetative conversion of 323.72 acres of tidal freshwater wetland, USACE proposes that the SCSPA acquires parcels of land identified by the USFS as priority parcels, specifically B-2B. Once acquired, the land would be conveyed to the USFS to manage as additions to the Francis Marion National Forest, and the lands would be subject to the same protections and use requirements as defined in Francis Marion Forest Plan. Thus, USACE has concluded that no mitigation work plan is necessary for the preserved land. The land will be managed as wetlands in perpetuity through the CLUA and the Forest Plan for the Francis Marion National Forest.

2.5.7 Maintenance Plan

33 CFR 332.4 (c) (7) states, "*A description and schedule of maintenance requirements to ensure the continued viability of the resource once initial construction is completed.*" To mitigate for the vegetative conversion of 323.72 acres of tidal freshwater wetland, USACE proposes that the SCSPA acquires parcels of land identified by the USFS as priority parcels, specifically B-2B. Once acquired, the land would be provided to the USFS to manage as additions to the Francis Marion National Forest, and the lands would be subject to the same protections and use requirements as defined in Francis Marion Forest Plan. Thus, USACE has concluded that no maintenance plan is necessary for the preserved land. The land will be managed as wetlands in perpetuity through the CLUA and the Forest Plan for the Francis Marion National Forest.

The preamble to the conveyance deed will state the project name and identify that lands being conveyed are for purposes of compensatory mitigation for environmental impacts caused as a result of said project. It is the expectation of the Forest Service that the lands being conveyed will be perpetually managed for National Forest purposes. In the unlikely event that any of the lands must be alienated from federal ownership, appropriate restrictive deed covenants will be put in place to ensure the lands are held as compensatory mitigation lands in perpetuity to meet the project mitigation requirements, or alternative compensatory mitigation will be provided consistent with Executive Orders 11988 and 11990.

2.5.8 Performance Standards

33 CFR 332.5(a) *Ecological Performance Standards,* states: *"The approved mitigation plan must contain performance standards that will be used to assess whether the project is achieving its objectives. Performance standards should relate to the objectives of the compensatory mitigation project, so that the project can be objectively evaluated to determine if it is developing into the desired resource type, providing the expected functions, and attaining any other applicable metrics (e.g., acres)."* The conversion of 323.72 acres of tidal, freshwater marsh to brackish marsh would be mitigated through the preservation of bottomland hardwood wetland, emergent vegetation, and uplands adjacent to the Francis Marion National Forest. Since there is no enhancement or restoration needed to meet the functional lift needed for this project, there is no need to establish ecological performance standards for the preservation mitigation sites.

2.5.9 Monitoring Requirements

33 CFR 332.6(a)(1), *Monitoring,* states: *"Monitoring the compensatory mitigation project site is necessary to determine if the project is meeting its performance standards, and to determine if measures are necessary to ensure that the compensatory mitigation project is accomplishing its objectives. The submission of monitoring reports to assess the development and condition of the compensatory mitigation project is required, but the content and level of detail for those monitoring reports must be commensurate with the scale and scope of the compensatory mitigation project, as well as the compensatory mitigation project type. The mitigation plan must address the monitoring requirements for the compensatory mitigation project, including the parameters to be monitored, the length of the monitoring period, the party responsible for conducting the monitoring, the frequency for submitting monitoring reports to the district engineer, and the party responsible for submitting those monitoring reports to the district engineer."* The conversion of 323.72 acres of tidal, freshwater marsh to brackish marsh will be mitigated through the preservation of parcels consisting of existing bottomland hardwood wetland, emergent vegetation, and uplands adjacent to the Francis Marion National Forest. It would be transferred to the US Forest Service and would be protected by their long term management program. As such, there would be no need to establish monitoring protocols for the mitigation preservation sites. However, in an effort to document the success of the mitigation, the USACE will convene field visits with the ICT to verify that the functions are still being met. These visits will occur 1, 3 and 5 years after construction is complete.

2.5.10 Long Term Management Plan

33 CFR 332.7(d)(1), *Long-term management* states: *"The permit conditions or instrument must identify the party responsible for ownership and all long-term management of the compensatory mitigation project. The permit conditions or instrument may contain provisions allowing the permittee or sponsor to transfer the long-term management responsibilities of the compensatory mitigation project site to a land stewardship entity, such as a public agency, non-governmental organization, or private land manager, after review and approval by the district engineer. The land stewardship entity need not be identified in the original permit or instrument, as long as the future transfer of long-term management responsibility is approved by the district engineer."* To mitigate for the vegetative conversion of 323.72 acres of tidal freshwater wetland, the Corps proposes to acquire land identified by the USFS as priority parcels. With concurrence from the USFS, the preservation sites will be subject to and governed by the "*Conservation Land Use Agreement Between the U.S. Army Corps of Engineers, Charleston District and the U.S. Department of Agriculture, U.S. Forest Service, Francis Marion and Sumter National Forests*," dated July 10, 2013 (CLUA) (Attachment to this Appendix). The terms of the CLUA, including Articles IV(f) , V, and VI, implement and/or closely track the language of 33 C.F.R. § 332.7(a), ensuring that the preservation sites will be properly set aside and managed by the USFS. As described above, the land will be conveyed to the USFS and managed by the USFS per the terms of the CLUA, as well as the soon to be revised Forest Plan. The USFS has also indicated that a special management plan will likely be developed for the land after it is acquired; however the development and implementation of an additional management plan is not required to ensure long term protection under the CLUA.

2.5.11 Adaptive Management

33 CFR 332.7(c)(2-3) *Adaptive Management,* states: *"If monitoring or other information indicates that the compensatory mitigation project is not progressing towards meeting its performance standards as anticipated, the responsible party must notify the district engineer as soon as possible. The district engineer will evaluate and pursue measures to address deficiencies in the compensatory mitigation project. The district engineer will consider whether the compensatory mitigation project is comparable to the original objectives of the compensatory mitigation project. (3) The district engineer, in consultation with the responsible party (and other federal, tribal, state, and local agencies, as appropriate), will determine the appropriate measures. The measures may include site modifications, design changes, revisions to maintenance requirements, and revised monitoring requirements. The measures must be designed to ensure that the modified compensatory mitigation project provides aquatic resource functions comparable to those described in the mitigation plan objectives."* The conversion of 323.72 acres of tidal, freshwater marsh to brackish marsh will be mitigated through the preservation of parcels consisting of bottomland hardwood wetlands, emergent vegetation, and uplands adjacent to the Francis Marion National Forest. As such, there would be no concern with performance standards and/or deficiencies on the actual preservation mitigation sites.

2.5.12 Financial Assurances

33 CFR 332.3(n) *Financial Assurances* states*:* "*The district engineer shall require sufficient financial assurances to ensure a high level of confidence that the compensatory mitigation project will be successfully completed, in accordance with applicable performance standards. In cases where an alternate mechanism is available to ensure a high level of confidence that the compensatory mitigation will be provided and maintained (e.g., a formal, documented commitment from a government agency or public authority) the district engineer may determine that financial assurances are not necessary for that compensatory mitigation project."* The need for Financial Assurances, as defined in the 2008 Final Mitigation Rule, and its application toward civil works projects like Charleston Harbor Post 45, has not been justified. Regulation 33 CFR 332.3 (n)(1) of the 2008 Final Mitigation Rule states, *"In cases where an alternate mechanism is available to ensure a high level of confidence that the compensatory mitigation will be provided and maintained (e.g., a formal, documented commitment from a government agency or public authority) the district engineer may determine that financial assurances are not necessary for that compensatory mitigation project."* As this subsection recognizes, financial assurances are not required when a government agency would construct the project. The Charleston Harbor Post 45 project is a civil works project that will receive funding from the Federal government. A future Record of Decision (ROD) will constitute a formal, binding commitment to implement the project mitigation, subject to Congressional appropriation of funds for the project. Mitigation features are required to be implemented before or concurrent with construction, so the project could not proceed if there were not sufficient funds to implement mitigation. After construction, mitigation operation and maintenance would be the Corps' highest budget priority. The South Carolina State Ports Authority would be committed to providing a cost-share for the project. There is little risk that mitigation features will not be implemented as planned and be maintained for the life of the project.

3.0 Hardbottom Habitat

Hardbottom refers to a classification of coral communities that occur in temperate, subtropical, and tropical regions that lack the diversity, density, and reef development of other types of coral communities (SAFMC 1998). For the purposes of this investigation, hardbottom habitat is defined as exposed areas of rock or consolidated sediments, distinguished from surrounding unconsolidated sediments, which may or may not be characterized by a thin veneer of live or dead biota, generally located in the ocean rather than in the estuarine system. These hardbottom reefs are an important component of South Carolina's offshore resources, which provide habitat and foraging grounds for a diverse array of invertebrate and fish species (Wenner et al. 1983; Sedberry and Van Dolah 1984). These communities support habitat-structuring sessile epifauna such as sponges, corals, bryozoans, and ascidians (Burgess et al. 2011). A detailed description of the impacts to hardbottom habitat is provided in Appendix I of the Final IFR/EIS. For the determination of required mitigation, Habitat Equivalency Analysis (HEA) was utilized. This process is also thoroughly discussed in the hardbottom appendix (Appendix I of the Final IFR/EIS).

3.1 Mitigation Options for Direct Impacts to Hardbottom Habitat

USACE evaluated a variety of alternatives to mitigate for anticipated impacts resulting from implementation of the alternatives considered. Table 8 shows the anticipated amount of necessary mitigation resulting from these impacts.

Table 8. Mitigation required for various alternatives.

Alternative's Authorized Depth for which mitigation was calculated	Alternative's Actual Depth (ft) for which mitigation was calculated	Mitigation Requirement from Direct Impacts (acres)	Mitigation Requirement from Indirect Impacts (acres)	**Total Mitigation Requirement (acres)**
50	54	29.2	0.4	**29.6**
50	52	29.2	0.4	**29.6**
52	56	29.3	0.4	**29.7**
54	58	29.4	0.4	**29.8**

3.1.1 Hardbottom Reef at ODMDS

One option to mitigate impacts to hardbottom habitat is to create/construct an offshore artificial reef. USACE may build a bathymetric anomaly using dredged rock from the entrance channel to provide fish habitat and substrate for sessile and mobile invertebrates while preserving ODMDS capacity and serving as a containment berm for the disposal of soft/fine material. This beneficial use/mitigation project will consist of a berm created with material from the entrance channel. The project would involve the use of limestone material dredged from the entrance channel to construct an "U" shaped berm (i.e., artificial reef) along the south and west perimeter of the Ocean Dredged Material Disposal Area (ODMDS) (Figure 18). This area represents approximately 71 acres of the ODMDS. The dimensions would be roughly 15,000 ft x 16,000 ft x 15,000 x 100 ft wide x 10 ft high. The ideal reef design to mitigate for hardbottom impacts, while also minimizing sediment transport would be a two tiered berm running along the perimeter of the ODMDS and created with limestone rock dredged from the entrance channel. The outer portion of the reef would be a low profile berm which then transitions to a higher berm at the inner portion (Figure 19). This design is idealized, and will be limited by the best available technology to complete. The reef would serve multiple purposes, including hardbottom habitat, fish habitat, and sediment containment.

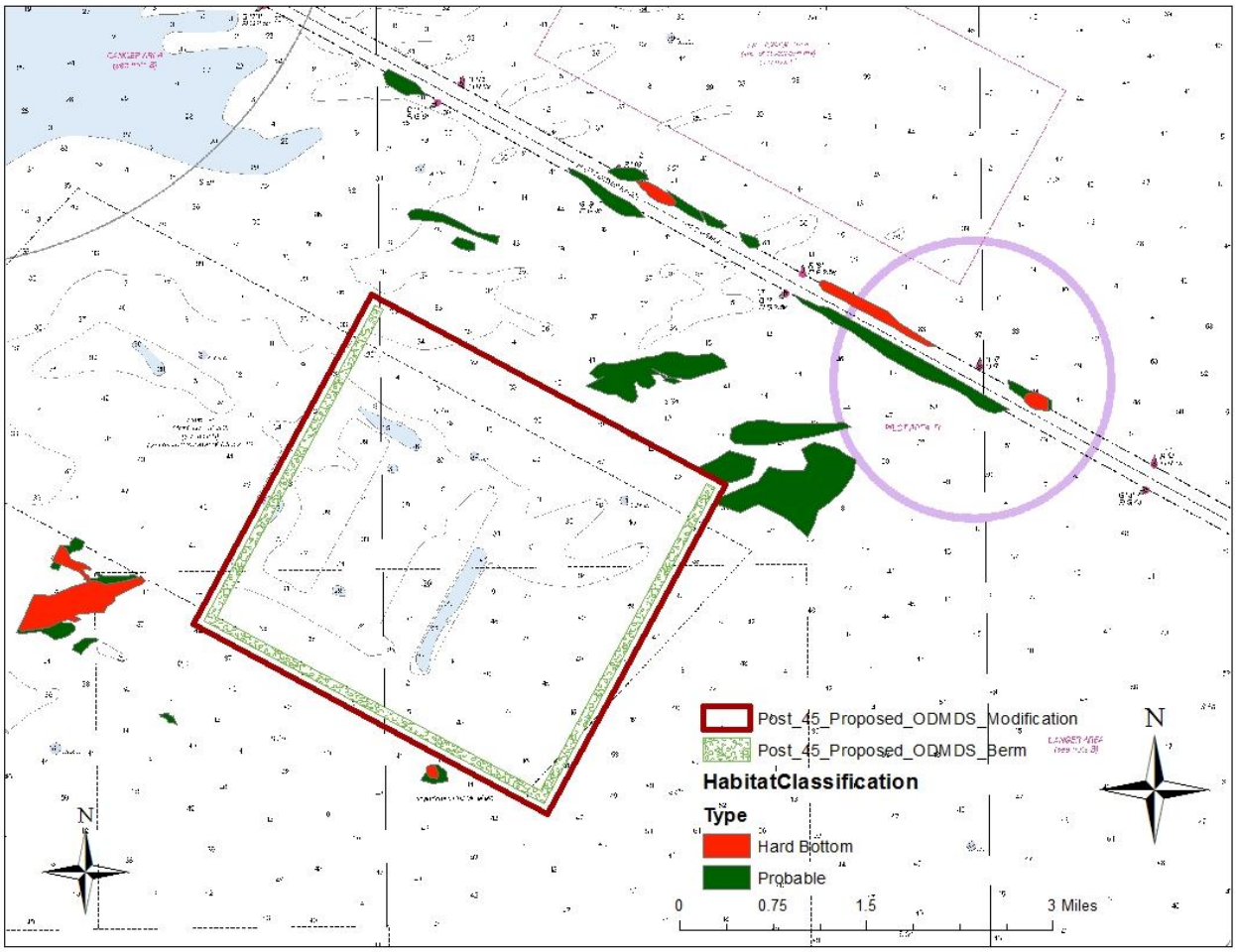


Figure 18. Proposed ODMDS and location of hardbottom habitat and the habitat berm

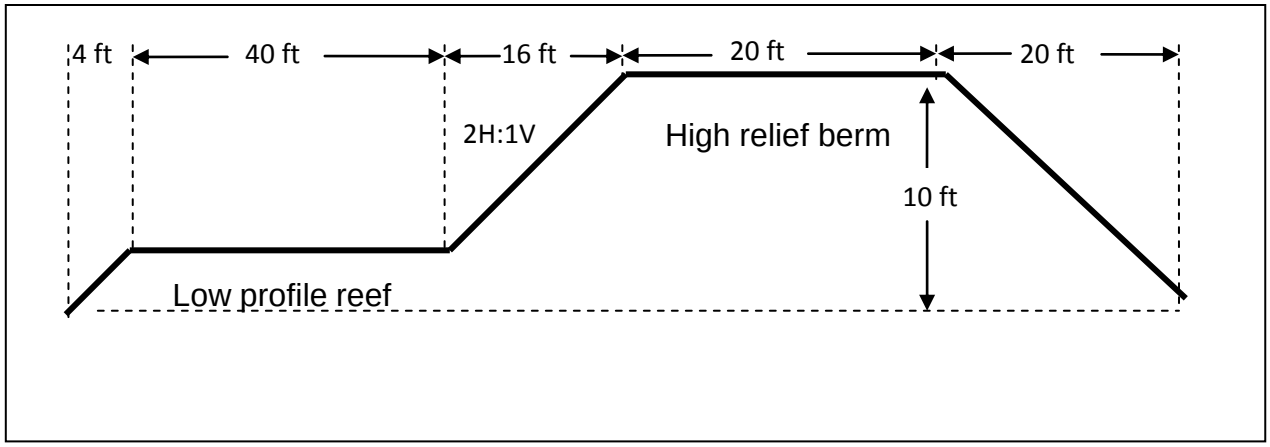


Figure 9. Preliminary idealized hardbottom reef design

3.1.2 Depositing limestone rock along outside edge of channel

This alternative would involve similar dredging methods to the first alternative. However, since there would be no additional goal of containing sediment in the ODMDS, the material could be deposited in the most effective form to allow for functional recovery of the habitat. This would allow for shorter scow travel distances as well as fewer scows needed to obtain the desired amount of mitigation, while also minimizing risk of accidental discharge in undisturbed areas from longer transits. The objective of the mitigation is to create a marine "patch reef-like" feature in mound formations that will replace the functions of the hardbottom dredged from the entrance channel. This alternative would also reduce the capacity demands on the ODMDS and minimize the required footprint. The designated mitigation area would be surveyed and reviewed prior to construction and must not contain existing hardbottom habitat or support other traditional uses of the marine environment such as trawling or sand mining areas. The material would be placed or discharged, likely by scow or barge to reach the designed configuration. An excavator or clamshell dredge would permit the largest diameter material to comprise the reef; however, a cutterhead suction dredge could also be used. More details on this process can be found in Appendix I.

3.1.3 Barging material from upland sources

Following similar methodology to SCDNR's artificial reef program, the creation of artificial reefs using modular materials or construction site debris instead of dredged rock is another alternative. This alternative is identical to the Reef Creation alternative discussed above, but for the use of modular reef materials. This alternative utilizes modular reef components that are created onshore and moved to the reef placement site. Modular reef habitat construction as a compensatory restoration alternative would consist of using established technology to construct and place cement reef-replication modules in a manner to provide a range of desirable ecological services. For example, a modular reef can be designed to maximize vertical profile, surface area for settling organisms, crevices for shelter, foraging habitat for pelagic organisms, or some combination of services such as these. Prefabricated reef modules have been used in the United States to restore coral reefs impacted by vessel groundings and deployment of telecommunication cables. The creation of an artificial reef that mimics low relief hard-bottom coral reef

can be designed for both aesthetics and habitat function. The project to construct and place cement reef-replication modules in a shallow or deep hard-bottom environment could be located in one or more favorable settings north or south of the project footprint.

Costs for this alternative are relatively higher due to (1) on-shore labor to create the modules, (2) land-based, as well as sea-based, transportation costs, and (3) the use of commercial diver labor necessary to place the modules on the seafloor. However, the benefits include ease of construction, their secure placement on the seafloor, and immediate functional habitat gain. SCDNR artificial reef program manager, Bob Martore, indicated that SCDNR pays $15,750 per 100ft x 30 ft barge load. This equates to $228,260/acre of artificial reef habitat.

3.1.4 Barging Cooling Tower debris offshore

This alternative consists of utilizing construction debris from the cooling towers, associated with Santee Cooper's Pinopolis Generating Station. The towers consist of approximately 12,000 tons of clean concrete. The material would be barged offshore and deposited at selected SCDNR locations closest to Charleston Harbor. This alternative would result in the creation of roughly 2.75 acres of hardbottom habitat. The cost of this is estimated to be $1,016,553.

3.2 Selected Alternative

The proposed mitigation involves use of dredged material (limestone rock) transported to a designated area to construct a marine patch reef feature. This method is the most cost effective alternative to mitigate for hardbottom habitat, and it also reduces the overall construction cost of the project due to shortened transport distances compared to depositing material at the ODMDS. Originally, the ODMDS berm was going to be the preferred hardbottom mitigation alternative; however, after further consideration it was determined that the success of the reef would be greater with this alternative. The ODMDS berm will still be created and have hardbottom function, but the below discussed measure will be used as mitigation for the project impacts. Each placement will be surrounded by a halo of native sand or native material. The ring of native sand along with the hard substrate feature provides landscape and edge diversity, and foraging area. Reef morphology and material influences the relative value of refuge and forage functions, and reef utilization by benthic, epibenthic, and nektonic organisms. Reef patchiness will increase the edge to interior ratio, and may enhance use by organisms that favor edge regions (ecotones), or decrease use by species requiring more interior habitat. The hard substrate and rugosity will provide attachment substrate for epifauna. In summary, the proposed Charleston Post 45 hardbottom mitigation patch reef is designed to replace the existing hardbottom that will be dredged as well as provide physical features/vertical structure to provide habitat diversity. Physical features which are believed to be important include material used, shape and landscape, substrate, relationship to currents, and size. Vertical relief, primarily the rugosity of the reef, is highly desirable for creating substrate for invertebrates and habitat for fish. The harbottoms being impacted by the entrance channel dredging are not high relief reefs to begin with. This mitigation project will create a more rugose reef and thereby higher quality habitat.

As discussed previously, the designated mitigation area adjacent to the Charleston entrance channel, between the Charleston ODMDS and the channel. Water depths in the mitigation area are between 35 and 50 feet. The new reef feature will consist of individual low relief mounds separated by existing bottom native sands/sediment. The reef feature is designed to provide bathymetric anomalies, hard bottom surfaces material, habitat diversity, and stability. The reef to be constructed will not impair navigation clearances. For descriptive purposes, Figure 20 shows bathymetry from the Shark River Reef offshore New Jersey. The Shark River Reef site contains almost 4 million cubic yards of dredged rock material. Ninety-six percent of the reef material on Shark River Reef is rock.

Logistics of dredging and placement will be subject to many interdependent variables, such as dredge availability, placement site depth, travel distance, and attendant environmental conditions at the site. Specifics such as dredging location and depth, quantity, quality of material are generally project determined.

A simple patch reef design and a simple operational plan compatible with dredge plant and transportation capabilities are required. Accordingly, a grid placement plan will be used. The grid will consist of 300-foot by 300-foot cells. The cells will be two (2) across by eight (8) long. This would create approximately 33 acres of patch reef habitat (project footprint). The patch reef area would be 600 feet by 2,400 feet long. At a minimum one scow load of material dredged from rock areas would be discharged near the center of each cell. Accordingly, the 16 cells would require 32 - 4,000 to 6,000 cy scow loads, or approximately 128,000 to 192,000 cy. Filling the scows to maximum capacity with each load is not a likely occurrence. The desired peak vertical relief is 3.5 – 4.5 feet and the desired aerial coverage within each cell is 75% coverage. However, placing the load directly on top of each other will be a challenge. Placing more than two loads in each cell can be done in order to make a higher mound or to cover more area. Additional loads could be placed on specific cells if the single load did not achieve desired areal coverage. This will be monitored during construction and if necessary, will be adapted.

It is anticipated that the material will be dredged mechanically by a rock bucket clamshell dredge or excavator dredge, in which case the rock may be removed in softball to larger basketball size pieces. The scows would be 4,000 to 6,000 cyd vessels. Dredged materials for the patch reef will be new work (not previously dredged) rock to the extent practicable, although some overlying and intermixed sediments will be dredged along with the rock. The scow will transport the dredged material to the placement location. A placement grid will be developed to provide the patch reef design. Grids will be divided into sequentially numbered cells. Each cell would be a placement target. One or more scow placements would occur in a manner that will produce discrete mounds. The heights of the mounds will depend on the characteristics of the dredged material (coarser materials do not spread out much on the bottom).

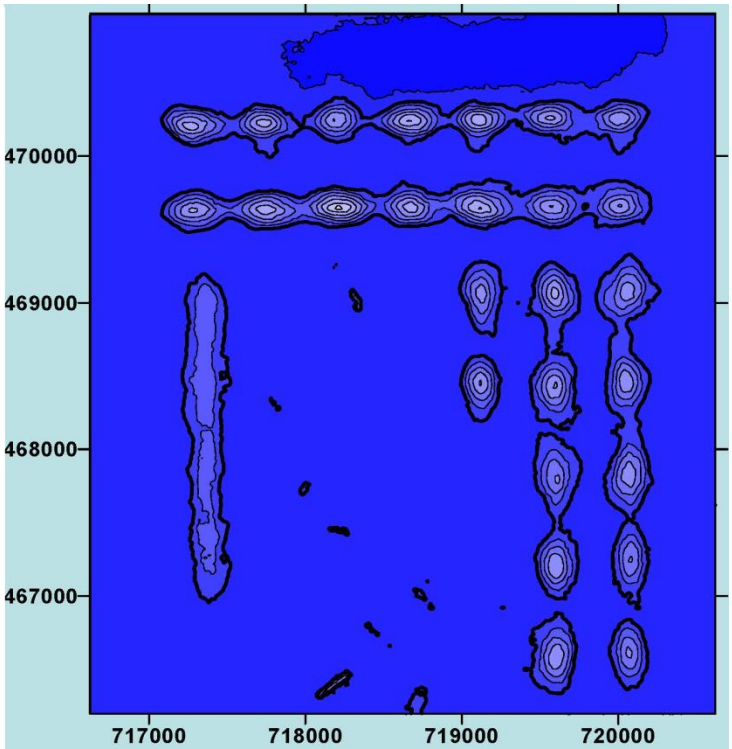


Figure 20. Bathymetry of Shark River Reef mounds, Constructed of rock dredged material.

The proposed location for the Charleston Post 45 hardbottom mitigation area is in an area between the entrance channel (from where the substrate rock will be dredged) and the Charleston ODMDS (Figure 21). This location will provide the mitigation area similar ocean environmental conditions as the hardbottoms impacted. Similar to the affected habitat, water depths are between about 35 and 50 feet. The proposed placement area avoids being too near the entrance channel and avoids the Charleston ODMDS. Return of material to the entrance channel or otherwise impacting navigation would not be acceptable. Locating the mitigation area within the ODMDS would not be acceptable as future use of the Charleston ODMDS is required and future disposal of dredged material over the mitigation area could void or reduce the benefits of the patch reef rock placement. Additional bottom surveys and coordination with local fishing interest will be required to site the mitigation project within the area indicated.

3.3 Summary of Reef Creation

The compensatory mitigation requirements are for 29.8 acres of reef. This will be accomplished by creating the aforementioned 33 acre reef. As discussed in the Final IFR/EIS and in Appendix I, USACE will construct another similar 33 acre reef as a contingency plan in case the mitigation monitoring success criteria are not met and more mitigation is deemed necessary, since the entrance channel rock will only be dredged for the initial construction. In addition to these two reefs (one required mitigation, one contingency), USACE will construct six other 33 acre reefs with limestone rock from the entrance channel. These reefs are a least cost disposal option and add quality habitat to the nearshore

Charleston region. These reefs will place the rock up to -25 feet MLLW in order to maximize the amount of material placed at each site.

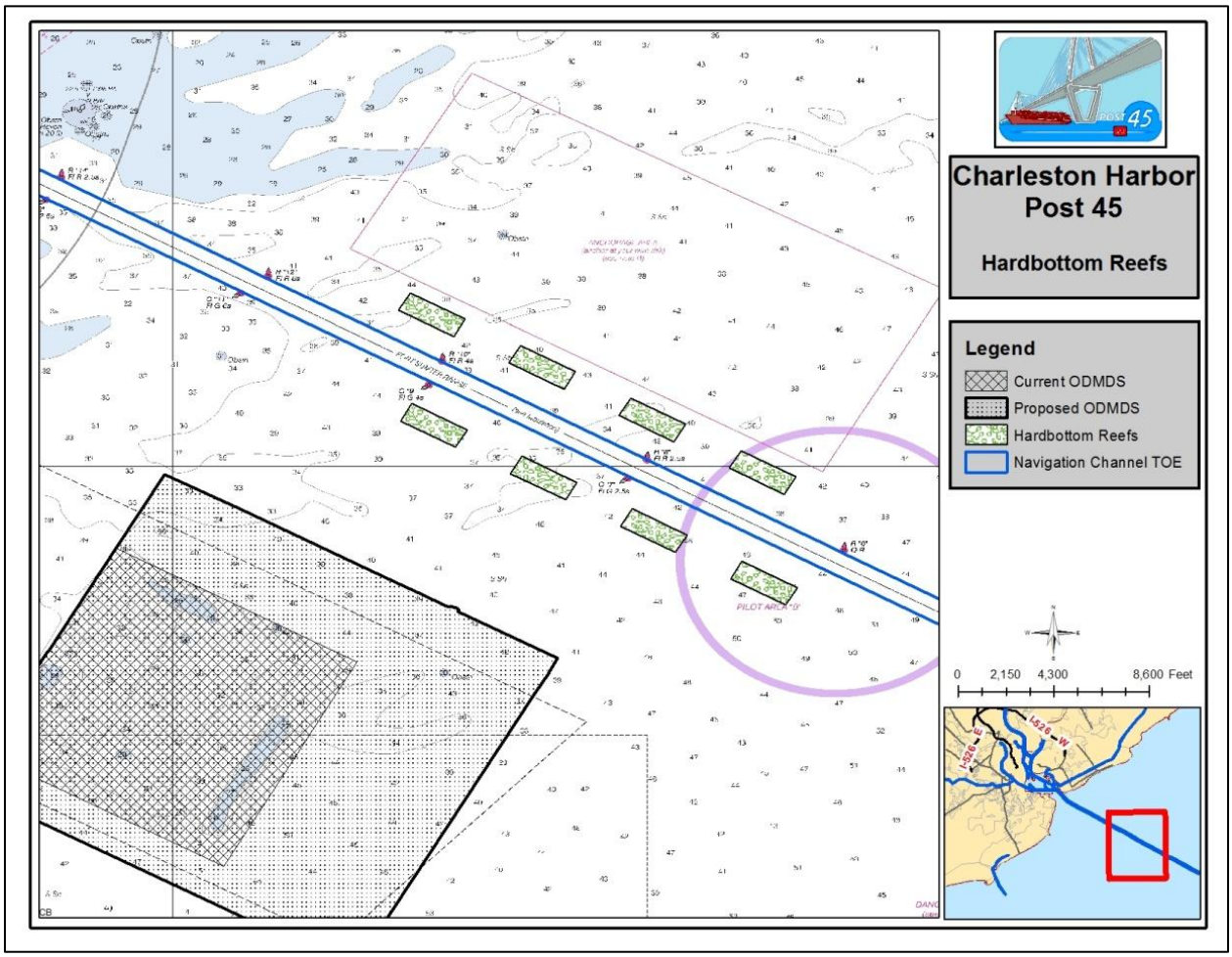


Figure 21. Conceptual locations of hardbottom habitat reefs

4.0 Dissolved Oxygen and the Charleston Harbor Total Maximum Daily Load (TMDL)

Enlargement of federal navigation channels can result in lower dissolved oxygen (DO) concentrations due to changes in water dynamics. Dissolved oxygen concerns relating to harbor deepening can be divided into three issues: (1) as the channel depth increases, the ability of oxygen to reach the river bottom decreases, causing lower average concentrations of dissolved oxygen at the bottom, (2) as the channel prism enlarges, additional saltwater is moved to the upper portions of the harbor and into the estuary, decreasing the ability of those waters to accept oxygen from the air, and (3) as the channel prism enlarges, the average velocity decreases, reducing the mixing of oxygen throughout the water column. If dissolved oxygen concentrations decrease to unacceptable levels, it could have deleterious effects on fish and other aquatic organisms. Lower dissolved oxygen concentrations also reduce the ability of the estuary to handle the point- and non-point source loads of pollutants entering the estuary.

Predicted DO impacts were modeled using the Environmental Fluid Dynamics Code (EFDC) hydrodynamic and water quality model. While the project would cause minor (average of 0.03 mg/L) reductions in DO, the project must comply with the existing Total Maximum Daily Load (TMDL) established for the system. This TMDL allocates the amount of oxygen demanding substances that an industry can discharge into the waterbody. In accordance with the SC Pollution Control Act, Post 45 must comply with the TMDL even though the project is not a point source discharge. In doing so, the cumulative effect of the dischargers and the project must not exceed at any point in the waterbody a reduction greater than 0.149 mg/L.

The 2013 dissolved oxygen (DO) total maximum daily load (TMDL) revises and combines the existing 2002 Cooper River-Wando River-Charleston Harbor TMDL ("Cooper TMDL") and the 2003 Ashley River TMDL ("Ashley TMDL"). The revised TMDL is for Charleston Harbor, Cooper, Ashley and Wando Rivers DO TMDL ("Charleston Harbor TMDL"). The basis for this revision is a new 3-Dimensional Environmental Fluid Dynamics Code model (EFDC) model covering the entire system completed in 2008, a revised DO standard as amended in the South Carolina Pollution Control Act in 2010 (adopted in South Carolina Regulation 61-68), and subsequent reallocation of the TMDLs led by the Berkeley-Charleston-Dorchester Council of Governments (BCDCOG, see http://www.bcdcog.com/).

USACE performed an evaluation of the cumulative impacts of the proposed project and the NPDES dischargers on DO throughout the project area. Recent model runs of the EFDC model for the proposed action (Post-45) indicate the maximum depth alternative of 52 feet in Wando and Lower Cooper River and 48 feet in the Cooper River above the new Navy Base terminal would not have significant effect on the TMDL WLA. The DO impacts from point-source discharges estimated by the TMDL (Cantrell 2013) are not used for this cumulative impacts analysis. The TMDL is conservative because it was calculated based on the assumption that all of the discharges are constantly and simultaneously discharging at the maximum permitted load. This assumption does not recognize the time-varying nature of the individual point-source discharge loading rates, which is particularly important for a system with multiple point-source dischargers. In general, point-source discharges tend to have a wide range of discharge rates that occur over time. The probability of all dischargers being at the maximum load at the same point in time is extremely small, and it is even less likely that these discharges would be sustained at that constant maximum permitted load over the entire TMDL analysis time period (March through October). Although DHEC used the conservative assumption of constant discharges for the purposes of establishing the Waste Load Allocation for the TMDL, this analysis for the Post 45 project uses improved methods (coordinated with SCDHEC and USEPA) that provide a more accurate approach to characterize the point-source discharges. Specifically, in order to incorporate the time-varying nature of the point-source discharges, this analysis uses time-varying discharge loading rates input to the TMDL model that are based on measured daily discharge data collected by the existing dischargers.

The methodology used for this analysis includes several steps. First, the available daily discharge monitoring data for the past 10 years was solicited from each of the major dischargers. This data was then analyzed to develop a statistical characterization of the discharge flows and pollutant concentrations that affect DO (specifically, biochemical oxygen demand (BOD) and ammonia nitrogen). This data was then used to randomly generate a long-term 50-year record of discharge flows and

pollutant loads into the harbor. This long-term record was created so that a wide range of possible combinations of discharge loading rates into the harbor could be evaluated.

For each discharge, the loading rate time series was then multiplied by a scaling factor so that the 99th percentile of the monthly-averaged ultimate oxygen demand (UOD) was equal to the monthly permit limit allocated in the TMDL. The resulting time series of loading rates incorporates daily variations consistent with the measured data while representing the maximum loading rate given by the TMDL wasteload allocation. The synthesized time-varying daily loading rates were then input to the same EFDC model used for the 2013 TMDL study in order to model the effects of the point-source discharge loading rates on DO concentrations in the estuary.

After modeling the DO impacts resulting from the time-varying discharges, the impacts were combined with the impacts resulting from the Post 45 project in order to estimate the cumulative effects on DO. Post 45 impacts were based the 52'/48' Alternative, which represents the maximum deepening and widening alternative under consideration for the EIS. The results indicate that the cumulative dissolved oxygen DO impacts resulting from both the point-source pollution discharges into the estuary and the proposed Post 45 Project navigation channel expansion will not cause cumulative DO impacts greater than the 0.1 mg/L allowed by DHEC's anti-degradation rule (Figures 22-24). Although the greatest cumulative impacts are estimated to be 0.14 mg/L, this is less than the 0.1499 mg/L allowed in practice. As a result, mitigation for DO impacts should not be required to offset project impacts in order to comply with the anti-degradation rule. As shown in Figures 22-24, the impacts are less than 0.1 mg/L in most portions of the harbor, which is less than the standard detection limit of most equipment used to measure DO. This means that it is not likely that the reduction in DO could be quantified in-situ.

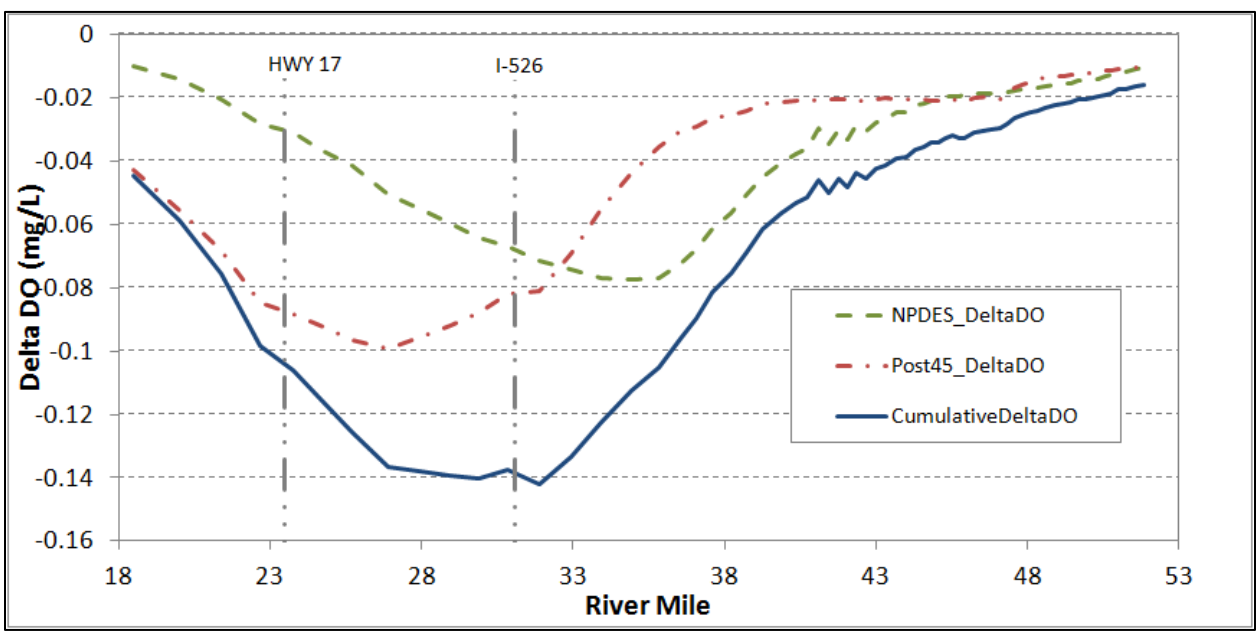


Figure 22. Longitudinal plot of 90th percentile delta DO along the Cooper River

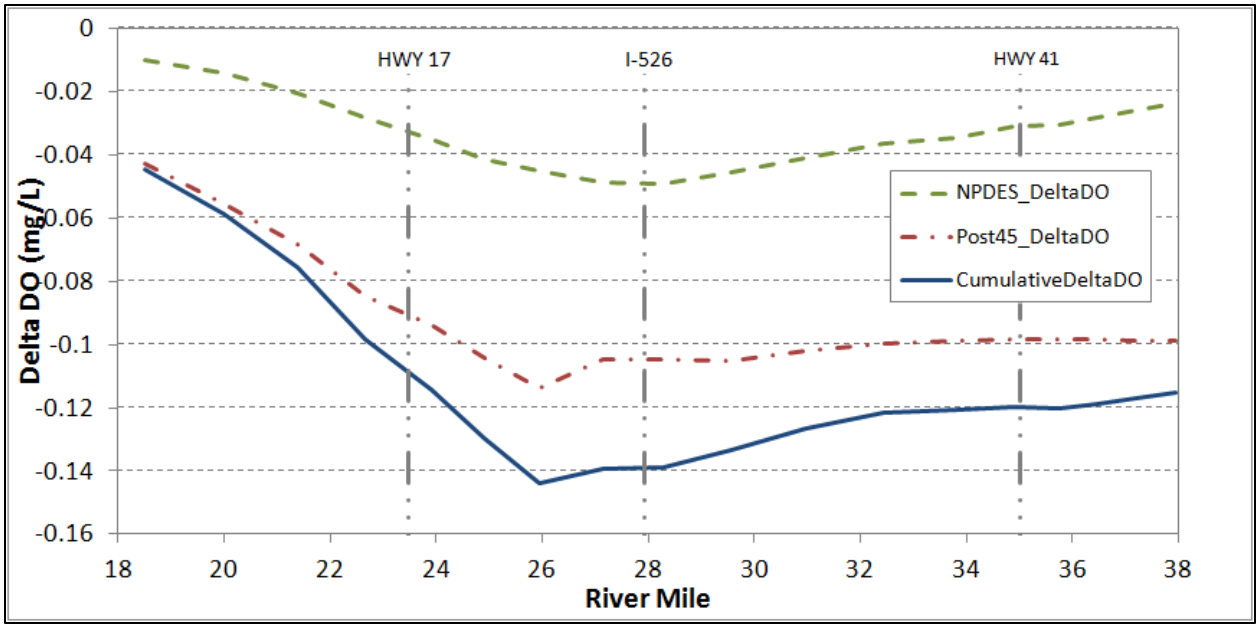


Figure 23. Longitudinal plot of 90th percentile delta DO along the Wando River

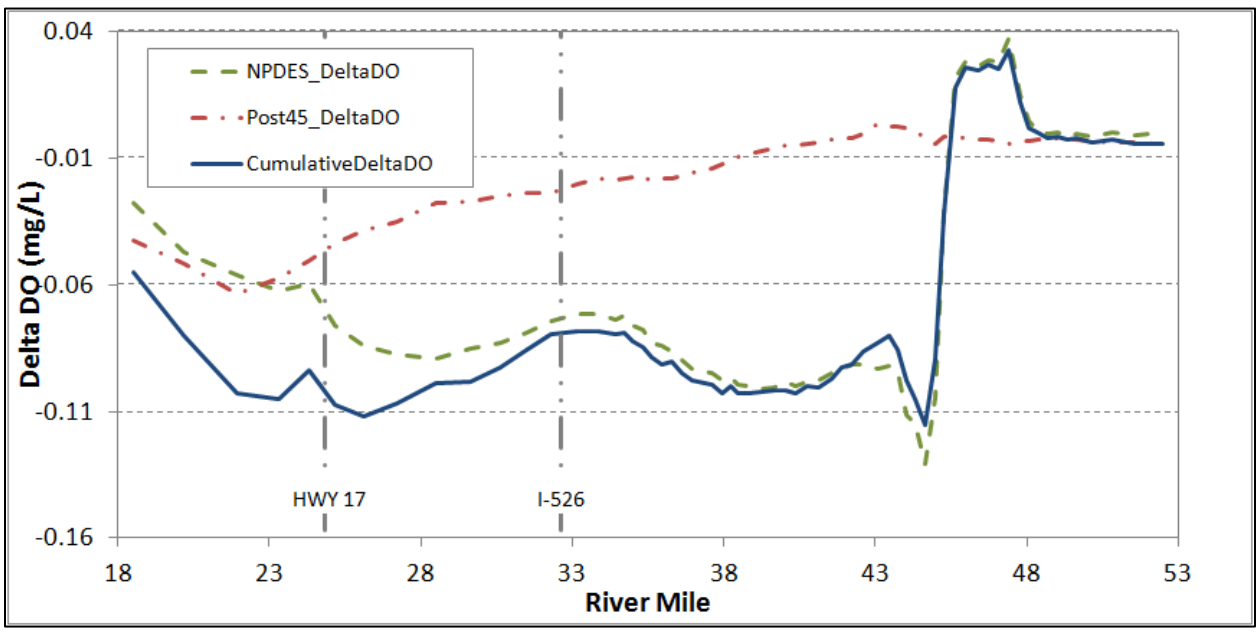


Figure 24. Longitudinal plot of 90th percentile delta DO along the Ashley River

4.1 Mitigation Options for DO Impacts

The following options are only needed if it is determined through monitoring that DO mitigation is need as a corrective action

The predicted magnitude of the project-induced DO reductions are small and would not significantly impact aquatic organisms or require mitigation to comply with the TMDL (see Appendix K on Fish Habitat). However, the impact of the proposed project would represent a significant portion of the

allowable load within the Charleston Harbor system and a long term change in condition that affects all permitted discharges. When distributing the 0.1 mg/L total allowable DO reduction, the impacts could become more important in the future if demands on the system increase. As SCDHEC allocates the remaining assimilative capacity, the amount available for new development and growth could be reduced.

Even though the project's DO impacts are not biologically significant, they are important in regard to 401 Water Quality Certification and thereby potentially cause the project to be tied to future load allocations for the Charleston Harbor TMDL. The Charleston District is committed to monitoring impacts of the project and ensuring that they are within the effects determined by the EFDC model. If monitoring determines that the impacts were greater than predicted, there are a number of ways that the District would consider to mitigate for the DO deficit. USACE would ideally pursue one of the biological mitigation options; however, preliminary discussions and work indicate that modeling and regulatory constraints could prohibit their use.

4.1.1 Reallocation of Waste Loads

There are currently 20 NPDES permitted dischargers within the project area. As a potential option for DO mitigation, the Charleston District could assess the potential and related cost to upgrade the existing discharge systems to meet or exceed water quality standards prior to discharge. Any discharge changes could be assessed with the EFDC water quality model to determine if the changes would offset the project impacts to DO. Consideration was also given to reducing permitted loads at existing NPDES dischargers. Discharger location within the system in relation to where the cumulative impacts exceed 0.15 mg/L would be a primary criterion. Also, only dischargers with a substantial contribution to the DO deficit in the critical segments were considered, and consideration was given to those dischargers that had a significant difference between their actual loads and their allowable maximum loads. It was also decided that public entity dischargers, such as waste water treatment plants, were priority, due to federal limitations involving modification of private property. It was concluded that the best and maybe only option in this category was to reduce loads at the North Charleston Sewer District (NCSD) discharge.

4.1.2 Submerged Aquatic Vegetation Creation

A biological approach would likely be most beneficial to the system; however there are a number of regulatory and modeling constraints that make these approaches difficult to deliver. One option for a biological approach would be to restore some tidal freshwater wetland impoundments to a submerged aquatic vegetation (SAV) stage. Kelley and Tufford (unpublished data) have determined that SAV stage wetlands act as a DO source to the river while later successional stage wetlands act as a DO sink. SAV stage wetlands are a source of DO for a variety of reasons. Photosynthesis results in an input of oxygen into the overlying water by submerged plants (Findley et al., 2006). Joyner (2007) found that Mulberry Field (an SAV stage wetland) exchanged as much as 89% of its total volume on spring tides with an average water exchange of 55% in 2005. There is no vertical stratification in hot weather and no opportunity for large volumes of water to become stagnant and lose DO to biotic respiration. Lastly, the consumption of DO at night due to respiration is balanced by oxygen influx from air across the large

surface to volume ratio on falling tides. Doing this would increase the net DO exchange to the river and potentially offset any DO impacts as a result of the proposed project. Dr. Tufford has determined that reimpounding and grading the Dean Hall field at the "tee" would increase the oxygen loading to the river by 4,350 kg/day. Dr. Joe Kelley and Dr. Dan Tufford have a rough cost estimate of $4,350,500 to restore an approximately 41 acre wetland to the SAV stage. The Dean Hall field is roughly 160 acres (4 times the 41 acre site), and at this time, an estimated cost for implementing this proposed mitigation is $17,000,000. However, if the project is carried forward more detailed costs will be determined. Modeling showed that this load was too small to make much impact on the Cooper River and it made no impact on the Wando; thus, many larger sites would need to be considered to satisfy the modeling requirement. Preliminary discussions with SCDHEC indicate that they would not be supportive of this approach because they do not generally support the conversion of one wetland type to another.

4.1.3 Oyster Reef Creation

Oyster reefs are key marine habitats. Charleston District is exploring the option with the USACE Engineering Research and Development Center (ERDC) Dredging and Operational Technical Support (DOTS) program to help input the water quality benefits of oyster reef creation into the EFDC model. This measure has some biological uncertainty, but oysters generally have the potential to be net sources of oxygen indirectly through the removal of nitrogen, phosphorus, and carbon from the system. Oyster beds also provide significant habitats for various marine flora and fauna. The amount of oyster reefs needed to satisfy the modeling requirements may be prohibitive.

4.1.4 Flow Deflecting Berms

This concept involved the construction of 5 shoreline perpendicular submerged berms that would in theory divert flow on the ebb and flood tides and thereby increase turbulence and aeration. In this manner, the blocking of cells to mimic flow vanes or contraction dikes on the Wando river upstream of the federal channel resulted in no change in the EFDC model. This is not unexpected as any increase in reaeration from increased velocities is localized, and it may be offset decreases in velocities and reaeration in other areas (e.g., reduced velocities along the shorelines). Since the measure was modeled in EFDC and did not contribute to a reduction of the deficit, it will not be pursued any further.

4.1.5 Oxygen Injection

Dissolved oxygen injection at various SCSPA terminal locations on the Cooper and Wando Rivers. Studies undertaken by the Savannah District as part of their port deepening project determined that the most cost-effective method for raising DO levels in the Savannah River was oxygen injection. The Speece Cone was chosen for the project from a field of 25 technologies ranging from physical alterations to oxygen injection and was selected based upon its ability to be quickly and economically deployed and its proven performance in Logan Martin Dam, AL and Camanche Reservior, CA. The Charleston District has modeled a number of scenarios of differing loads of oxygen per day and differing locations. If an impact is determined, the scenarios can be refined to offset the modeled DO deficit.

4.1.6 Aerating Turbines on the Pinopolis Dam

Aerating turbine technology uses low-pressure areas to draw air into the water as power is being generated. At some dams, TVA has modified the existing turbines to draw air into the water. At other dams, TVA has installed new turbines specifically designed for this purpose (http://www.tva.gov/environment/water/rri_oxy.htm). Benefits are not expected to be seen in the potential impacted area (lower Cooper River, lower Wando River), because the measure is too far upstream.

4.1.7 Oxygen Injection at the Pinopolis Dam

At some reservoirs, oxygen is injected into the water before it enters the dam's intake. The system consists of an oxygen tank and evaporators on the bank that are connected to perforated hosing suspended above the reservoir floor upstream of the dam. Gaseous oxygen, instead of water, is pumped through the hosing, creating oxygen bubbles that are released into the river along the length of the hosing (http://www.tva.gov/environment/water/rri_oxy.htm). Benefits are not expected to be seen in the potential impacted area (lower Cooper River, lower Wando River), because the measure is too far upstream.

4.1.8 Aerating Weirs in the Cooper and Wando Rivers

These are small dams designed to mimic a natural waterfall, adding oxygen to the water as it plunges over the top of the weir walls. Aerating weirs are located a short distance downstream from dams. TVA has designed, built, and tested two different kinds: a long W-shaped structure called a labyrinth weir that creates a waterfall, and a more compact structure called an infuser weir that uses a slotted decking to create a series of waterfalls. Weirs also serve to maintain minimum flows when hydroturbines are not operating; pipes near the bottom of the weir allow slow drainage of water from the weir pool (http://www.tva.gov/environment/water/rri_oxy.htm). Depending on the location of these, navigational concerns could prohibit their use.

5.0 Monitoring and Adaptive Management:

5.1 Hardbottom Habitat

5.1.1 Guidance and Conceptual Framework

Based on the Implementation Guidance for Section 2039 of the WRDA 2007, this monitoring plan includes a description of the monitoring activities, the criteria for measuring success, and the estimated cost and duration of the monitoring efforts. Each biological monitoring survey will include underwater documentation surveys of the mitigation area, including both *in situ* data collection and video documentation to record conditions observed during the survey. The monitoring plan will be designed to allow for clear and meaningful comparisons (1) between hardbottom habitat at the mitigation area and that which will directly impacted due to the proposed action, and (2) between hardbottom habitats in the indirect impact area (for both dredging and material ocean disposal sites) and control sites. In the

appropriate subsections below, the schedule of reporting to ICT members is noted, as are adaptive management protocols and corrective actions.

5.1.2 Pre-Construction Impact Refinement and Baseline Monitoring

5.1.2.1 Direct Impact Area

As discussed in the *Hardbottom Impacts, Mitigation, and Habitat Equivalency Analysis Report* (Appendix I of the final IFR/EIS), it is anticipated that up to 28.6 acres of hardbottom habitat may be directly impacted by construction of proposed project. Prior to project construction, hardbottom surveys will be performed in the anticipated direct impact area (shown in Appendix I of the final IFR/EIS). The surveys will consist of detailed side scan sonar, sub-bottom profiling and multibeam data collection. They will be conducted in the same manner as the hardbottom classification study for the Post 45 feasibility study (Gayes et. al., 2013). Additionally, submerged video tows will be conducted using a submersible camera equipped with GPS. The camera should be positioned to look downward and in front of the tow so as to avoid the confounding effects of turbid water trailing from the camera. In some cases, it may be beneficial to ground truth the towed, remote surveys using scientific divers; however logistical challenges may inhibit safe diving in the navigation channel. Once the data quality is verified for accuracy, all video should be reviewed. Changes in bottom type should noted by the unique timestamp on the video feed (ultimately indicative of position). Video should be coded by stopping video tape every five seconds and describing and coding the field of view similar to Table 2.2 in Crow et al. (2006). Data should be processed according to SCDNR specifications for hardbottom interpretation. After the areas of hardbottom are identified, five randomly selected sites will be identified for either diver or Remotely Operated Vehicle (ROV) surveys to further define the habitat. Each site will be surveyed along a 20-meter (m) transect and recorded with a GPS. Surficial sediment thickness will be measured by using a grab sampler. Video data will be analyzed for fish utilization and the sponge/coral communities inhabiting each site. The video camera will be equipped with lights and a measuring stick or calibrated lasers to aid in quantifying invertebrate size. Surveys will be reviewed to assess abundance and diversity (which takes into account richness and evenness) of sessile corals, sponges as well as other benthic components and finfish from the sites. Specifically, presence/absence data should be recorded during each interval for massive sponges including *Ircinia* sp., encrusting sponges, and the soft corals *Leptogorgia* sp. and *Titanideum* sp. The above data will be used (1) to increase the resolution of the direct-impact project footprint and better characterize the resources within the direct footprint and (2) provide data to inform creation of success criteria for mitigation sites. If necessary, these data will be used to refine the HEA due to more area of hardbottom habitat than anticipated or higher quality habitat than anticipated.

5.1.2.2 Coordination

Within 60 days following completion of data collection within the direct impact zone, USACE will provide collected data and a summary report to the ICT. If any adjustments to the direct impact area or level of habitat function provided therein are determined, USACE will modify its compensatory mitigation plan accordingly and supply the ICT with the revised plan.

5.1.2.3 Success Criteria

The purpose of the mitigation reef is to compensate for the lost ecological function of the hardbottom habitat at the impact reef as it pertains to essential fish habitat. Average community characteristics from the 5 sites (transects) in the impacted area will be used to establish detailed performance criteria for the mitigation reef. Criteria for success of the mitigation hardbottom habitat will be based upon a baseline survey of the abundance and diversity of sessile invertebrates at the impact site prior to construction. The success of the mitigation reef will be determined by comparing these parameters at the mitigation reef to the baseline survey results. Appropriate parametric and/or non-parametric statistics shall be employed in order to demonstrate mitigation success. SCDNR recommends that a realistic measure of success is "greater diversity and complexity over time and trending towards similarity with the impacted site pre-construction cover" (SCDNR email dated 20 May 2014). NMFS recommends the following parameters be used for measuring success:

- % cover by sessile invertebrates (i.e., encrusting invertebrates, coral, and sponges)
- Sessile species size, abundance, and diversity (i.e., richness and evenness)
- Fish assemblage abundance and diversity

USACE will meet with representatives from NMFS and SCDNR to define success criteria based on the data collected from the impacted site and to ensure the plan considers all agency comments. If the ecological success criteria are met prior to the completion of four years of monitoring, a meeting will be held with the ICT and monitoring efforts will be ceased. If success criteria are not met at the end of 4 years, USACE will meet with SCDNR and NMFS to determine corrective actions (discussed below). Habitat Equivalency Analysis will be used to determine the amount of additional mitigation needed (see below). USACE will continue monitoring until success criteria are met, i.e., every two years. An additional corrective action would include increasing the monitoring period in order to ensure that resources are fully compensated.

5.1.3 Pre-Construction Mitigation Site Refinement

As discussed in the *Hardbottom Impacts, Mitigation, and Habitat Equivalency Analysis Report* (Appendix I of the final IFR/EIS), it is anticipated that roughly 33 acres of hardbottom habitat will be created to compensate for direct and indirect impacts of the dredging. In addition, seven other 33 acre reefs will be created to generate a diversity of habitat types in the nearshore Charleston area. It is important to ensure that these reefs are not constructed on existing hardbottom habitat or upon an historic resource. Prior to dredging, hardbottom and cultural resource surveys will be performed on either side of the navigation channel to identify eight 33-acre sites on which to construct artificial reefs. The sites must be located such that installation of reef structures will not adversely impact existing resources. Preconstruction mitigation surveys will consist of detailed side scan sonar, sub-bottom profiling, magnetometer and multibeam data collection. The survey will be conducted according to guidelines provided by the South Carolina State Historic Preservation Office, and will reflect the provisions of Section 106 of the National Historic Preservation Act of 1966 (36 CFR 800, *Protection of Historic Properties*) and the Abandoned Shipwreck Act of 1987 (National Park Service 1990). The survey methodology will be designed to identify potential cultural resources in order to avoid those sites for placement of the artificial reefs.

The survey will also be used to compare to future post-construction surveys to evaluate any evidence of post-construction subsidence. Additionally, video tows will be conducted with GPS. The camera should be positioned to look downward and in front of the tow so as to avoid turbid water caused by the camera. After data collection, all video will be reviewed and changes in bottom type will noted by time (which will indicate position). Video should be coded by stopping video tape every five seconds and describing and coding the field of view similar to Table 2.2 in Crow et al. (2006). Data should be processed according to SCDNR specifications for hardbottom interpretation. The least costly (based on construction methods/dredging and disposal costs) candidate locations for the reef sites will be selected within this broader area (noted above) for the mitigation reef. If SCDNR identifies priority sites for reef creation, those sites will be given higher priority for this project as long as they are not further than the distance between the dredge operation and the ODMDS. Similarly, other members of the ICT may identify preferred sites. USACE will use all available data as well as USACE guidance to determine the final mitigation site and share those criteria and final site information with the ICT.

5.1.4 Construction Concurrent Monitoring

5.1.4.1 Direct Impact/Footprint

During construction, the contractor will provide to USACE weekly updates on the extent of dredging (via email or posting to project-specific website). If actual dredging activity extends past the anticipated dredging footprint, USACE will notify the ICT and identify whether any additional mitigation will need to be provided. However, USACE may choose to not take action (i.e., provide additional construction of mitigation features) on any discrepancies until definitive post-construction surveys (below) are completed.

5.1.4.2 ODMDS

A real-time placement monitoring/verification system referred to as “Dredging Quality Management” (DQM) will be used to monitor placement within specific patterns and tolerances as well as monitor how the placement actually occurred. The use of DQM is required for USACE federal navigation projects that use a scow or hopper dredge to dispose of material in an ODMDS. For actual placement, the dredging contractor will be provided specific discharge targets. The contractor will be required to slow for placement. Coming to a complete stop is likely not desirable in that as some motion is required to maintain steerage. Information regarding vessel loads, vessel tracks, and discharge time and location records is recorded and maintained in the DQM system. The DQM system will provide continuous coverage of operations, improve project management and oversight, and create a standard base for avoiding disputes. Weekly reports to USACE will be shared with the ICT on a quarterly basis.

5.1.4.3 Mitigation Sites

Bathymetric surveys will be completed twice during construction of the reefs to ensure that each of the cells in the mitigation reef plan are obtaining a peak vertical relief of 4-5 feet and to document the size and extent of the other seven reefs. If the cells are not reaching the desired relief with the scow loads, additional scows will be directed to those sites. The bathymetric survey results will be provided to the ICT within 90 days of collection.

5.1.5 Mitigation Monitoring

5.1.5.1 As-builts

A post-construction bathymetric (multibeam) and side-scan survey will be conducted within 60 days after all reef mitigation material has been placed in its designated site. A comparison between the pre- and post-construction survey will evaluate if the proper amount of coverage and relief has been achieved. The survey information will be utilized to demonstrate the boundaries of the sites (including total acreages), relief of the sites (provided in a color coded map to distinguish areas of higher and lower), rugosity, and interstitial area (sand versus boulder percent-cover for each reef unit/pile). Surveys will be used to determine relief, rugosity, and interstitial area. The calculations will be performed for each cell, and the overall site average will be determined. Follow up surveys will be conducted at each of the post-construction monitoring events, to ensure continued physical compliance with the design, and a final survey will be conducted during the final recruitment sampling (see below) to document whether material has moved or shifted during the years since installation. Each as-built survey report shall be submitted to USACE within 60 days of the completion of the survey, and to the ICT within 90 days.

5.1.5.2 Recruitment/Mitigation Success.

The first episode of mitigation hardbottom biological monitoring will occur within the first winter period post-construction (for increased visibility). This will establish a baseline against which subsequent monitoring episodes will be compared. Approximately six (or 40% of established cells) of the sixteen mitigation reef cells will be surveyed using methods similar to those described above for Pre-Construction Impact Refinement. The cells will be chosen either randomly or strategically based on input from the ICT. Monitoring will be conducted annually and end after four years to fully account for the anticipated 3.5 years to recovery. A longer monitoring term (i.e., 10 years) is not anticipated due to the nature of the hardbottom assemblage and known colonization and growth rates of dominant species. However, the HEA was run to provide a range of potential recovery times and the compensatory mitigation for that range. The results of this analysis showed that if the recovery took 10 years, 32.5 acres of new reef would be required. Monitoring should be conducted, when possible, during months with the best water-column visibility. Monitoring data will be shared with the ICT following each monitoring event, including the baseline event. In order to monitor benthic colonization and succession, four (4) 20-meter-long *permanent* monitoring transects per monitoring cell shall be monitored similar to the methods described above in Section 5.1.3. Photographs of each quadrat shall be taken to supplement quadrat in situ data along each transect, or video documentation shall be collected along the 20-meter-long transects to supplement the quadrat data and analyzed using standard PointCount99, CPCe, or approved similar method.

While success criteria can be refined during PED based on surveys of the impacted site, success will generally be achieved when the benthic community and colonization of the mitigation reef has been documented to be comparable to the benthic community and species composition documented in the impact area during the preconstruction survey. Successful mitigation shall be defined by the following criteria: 75% of species found in the impact site shall be present in the mitigation site by the time of the completion of the monitoring period; and percent-cover by the major groups of organisms in the

mitigation site shall not be significantly less than at the impact site. Multivariate analyses and Bray-Curtis similarity indices (or other similar, appropriate, statistical techniques) will be used to compare reference and mitigation sites.

5.1.6 Post-Construction Impact Monitoring

Post-construction as-built bathymetric data, based on acoustic surveys, will be provided by the contractor to USACE within a reasonable amount of time following construction. Data will indicate if the extent of direct dredging exceeded the design footprint and impacted more hardbottoms than anticipated. Findings will be shared with the ICT within 60 days of receipt of final report by USACE.

At 2 and 4 years post-construction, the impacted areas will be monitored similar to the methods described in Section 5.1.3. The purpose of this monitoring is to document the recovery of the impacted area of the channel. The HEA used a conservative estimate of no recovery. This information will aid USACE in the knowledge of dredging site recovery. This information could be used in determination of future adaptive management needs, if necessary. Reports shall be submitted to USACE within 90 days of the completion of each annual monitoring event; the report will be furnished to the ICT within 120 days of completion of monitoring.

5.1.6 Reporting

The annual mitigative artificial reef monitoring reports shall be submitted to USACE within 90 days of the completion of each annual monitoring event; the report will be furnished to the ICT within 120 days of completion of monitoring. Each annual report shall document the colonization of the artificial reef and compare the species composition on this reef to that documented in the impact area during the preconstruction survey. Annual monitoring reports shall include the following:

a. A map of the artificial reef with the associated monitoring transects plotted on it;

b. An analysis of the quantitative quadrat data on the benthic biological components of the artificial reef monitoring transects (e.g., percent cover by corals, octocorals, sponges, algae, etc.);

c. A comparative analyses of the mitigative artificial reef and natural hardbottom resources to determine mitigation success;

d. An analysis of succession based on the comparison of benthic communities found on the artificial reef and natural communities (impact site) by comparison of such parameters as densities, size class distribution, etc.;

e. Current acreage, relief, and rugosity of artificial reef (for final report only);

f. Copies of all transect video submitted on electronic media (external hard drives); and,

g. All raw data in the format that was used for the analysis.

5.1.6 Adaptive Management

If the final ecological success criteria are met prior to the completion of four years of monitoring, a meeting will be held with the ICT and monitoring efforts will cease. If success criteria are not met at the end of four years, USACE will meet with the ICT to determine adaptive management requirements. Possible adaptive management measures include creating more artificial reef in coordination with SCDNR Artificial Reef Program, claiming more of the beneficial use reefs as mitigation reefs, or by mitigation reef enhancements based on best available science. Habitat Equivalency Analysis will be used to determine the amount of additional mitigation that is necessary and appropriate. Additional adaptive management could include extending monitoring until success criteria are met, i.e., every two years.

5.2 Wetlands

5.2.1 Conceptual Framework

Determination of indirect impacts to wetlands were based on predicted changes in the salinity regime of the harbor. Models were used in the effects assessment (see Appendices A and L) to make predictions on how the proposed deepening may affect water chemistry and subsequently biological resources (i.e., naturally occurring plant communities and wetland function). There is some uncertainty regarding the modeling process that poses risk that the recommended action could produce greater effects than were identified in the effects assessment. Likewise, effects could also be less extensive than anticipated. In addition to challenges related to modeling harbor water quality and effects due to the project, uncertainty regarding future changes to the environment caused by natural and concurrent processes (such as sea level rise drought, etc.) further complicate human predictive capabilities for harbor water quality dynamics, riparian vegetation community changes, and wetland function. This monitoring and adaptive management plan detailed below addresses how uncertainties that contribute to near-term, unanticipated resource losses can be addressed. The objectives of the plan include:

- Verify the modeling process used in the effects assessment by assuredly quantifying and detecting whether the proposed deepening has negatively affected the salinity regime of the Charleston Harbor system above and beyond that which was predicted by the models, and offset by purchasing conservation lands;
- Include salinity as well as ecological data collection as components of the monitoring plan to confirm or better correlate cause (salinity) and effect (habitat changes);
- Integrate proposed field data collection with other data collection efforts to take advantage of historical and ongoing efforts to avoid redundancy, be cost-effective, and to efficiently build on existing data and studies.
- If needed, integrate modeling within the plan in order to distinguish the impact of project deepening from the impact of other factors (drought, sea level rise, and deepening);

The plan also affords opportunities for additional efficiencies to be gained by utilizing/coordinating with newly established monitoring efforts (i.e., new technologies to better describe wetland vegetation on large spatial scales). Two types of monitoring will take place to meet these objectives. The first is a

characterization of the percent change in the vegetative community. The second is verification of the salinity isopleth changes in the harbor. The below subsection discusses how vegetation monitoring will be carried out. Monitoring water quality, including salinity, is discussed in the water quality section below.

5.2.2 Pre-Construction Vegetation Monitoring

During the feasibility phase of the project, potentially affected wetland habitats in the Cooper, Ashley, and Wando watersheds were characterized, and areas of potential impact were identified. Prior to construction, wetlands will be characterized again using the same methodology as described in the Wetlands Characterization Report (Reif, 2013) to affect an accurate baseline dataset and provide an estimate of natural variability in data collection.

Technical Approach. Two field surveys of the study area will be conducted to collect site data for training (supervised classification) and validation (accuracy assessment) to correspond with the seasonal timeframes of the most up-to-date multispectral imagery (minimum 8-band). Ideally, two seasons (e.g., summer and winter) will be used in order to minimize seasonal differences between field and image data. The following information will be collected:

- latitude and longitude using a Trimble GeoXH 6000,
- dominant wetland plant species within a 1-meter area as determined by a local wetland plant specialist,
- spectral reflectance of the dominant plant species using an ASD FieldSpec Handheld 2 spectroradiometer (visible to near-infrared), and
- GPS tagged photographs using a Ricoh 500se camera with the SE2c GPS Antenna

The equipment described above is presently the state-of-the-art for wetland field monitoring and mapping. Changes to using these tools, however, may occur as new technology is developed and found to be of better value in evaluating the efficacy of the mitigation project.

After pre-processing the imagery, vegetation classifications will be made to rapidly identify different materials or habitat types in the images. Specified pixels in a training site are evaluated, while remaining pixels are then assigned to a matching or corresponding class based on statistics. As indicated in the Reif, 2013 the *maximum likelihood* classification technique will be used as it is the most commonly used classification method in remote sensing image analysis.

These results will be compared to the original results (found in Reif, 2013) to determine the variability within the datasets. For example, in 2013 the area of potential impacts in the Cooper River could have been characterized by having 70% freshwater herbaceous species present, and 30% salt-tolerant species. When the analysis is performed again prior to construction, it is doubtful that the numbers will be exactly the same. If, for example, the pre-construction monitoring shows that 75% of the species are freshwater, we will assume an error of $^{+}/_{-}5\%$ in year to year variability.

Transect stations will also be established at roughly 2000’ intervals within the impacted portions of the Cooper, Ashley, and Wando Rivers. Transects will run inland from the river edge and $1m^2$

quadrants/plots will be placed to identify and tabulate wetland plants and characterize the percent extent of vegetation. Soil samples will be taken from each quadrant along the wetland transect during each survey and analyzed for salinity levels. Field measurements using a soil conductivity probe would also be collected. Freshwater wetland soils are dominated by methanogenic bacteria; therefore, biogeochemical monitoring to determine whether soils are methanogenic or sulfate reducing, i.e. exposed to salt water, would be performed.

The report will be supplied to USACE within 90 days following completion of the efforts described above. Final reports will be shared with the ICT within 30 days thereafter.

5.2.3 Construction-Concurrent Vegetation Monitoring

No vegetation monitoring will be carried out during construction. This is because effects on vegetation are indirect, and are not anticipated to manifest until the growing season subsequent to the completion of construction. However, there may be incremental changes in water chemistry (salinity and dissolved oxygen) during construction. Monitoring those parameters is discussed below in the Water Quality section.

5.2.4 Post-Construction Vegetation Monitoring

Approximately 1, 3, and 5 years after the construction of the project, the same wetland sampling methods noted above will be used to characterize the plant species. Annual monitoring is not proposed because effects will be indirect, and it will take seasons for the affected vegetation communities to demonstrate any changes. In some cases, if vegetation senesces, it may take a year or more for successional vegetation to penetrate decaying material and be detected by remote methods and/or on-site observation. In designated years post-construction, wetland vegetation sampling will occur during the summer and winter months depending on available spatial data. Sampling twice per year is expected to yield more complete data on species composition. Data (particularly the percent-change of freshwater-dominant vegetation) will be compared to the pre-construction vegetation characterizations. Sampling will be limited initially to only five years, and if necessary (see below) an additional five years. This is because of the confounding effect of sea level rise on salinity; effects due to the project are not likely to be detected after ten years (see table for year 2022 in Appendix L of the Final IFR/EIS), which demonstrates the effects of sea level rise alone, i.e., without project impacts. For the years during which sampling will be conducted, annual reports will be generated within 90 days following the conclusion of sampling. Those reports will be shared with the ICT within 30 days following finalization of each report. Monitoring parameters discussed in the above subsections are summarized below in Appendix A.

5.2.5 Mitigation Monitoring

Wetland preservation sites provided as mitigation will not require monitoring; they will be conveyed to the U.S. Forest Service in perpetuity (the wetlands do not require enhancement or restoration prior to conveyance). USFS will bear responsibility for managing the sites to preserve their functional value via use restrictions and any other tools available to the government. Proof of the execution of the conveyance will be available to the ICT. In an effort to document the success of the mitigation, the

USACE will convene field visits with the ICT to qualify whether the functions are still being met. These visits will occur during year 1, 3 and 5 post-construction.

5.2.6 Corrective Action/Adaptive Management

Due to the complexity of the wetland monitoring and data interpretation, it is anticipated that as wetland monitoring progresses and collected data are examined by USACE and the ICT, additional regulatory input and consultation may be needed. USACE expects to receive input from the ICT following issuance of monitoring reports.

If the changes in vegetation communities after five years are within the range of sampling error (as calculated above) then no additional analyses will be completed and monitoring will be deemed complete. This decision will be discussed and confirmed with the ICT, consistent with the conditions of the DHEC 401 Water Quality Certification.

If after five years post-construction, the results of wetland vegetation monitoring indicate that impacts predicted during the feasibility phase of the project (i.e., a 20% change in the vegetative communities) were under-estimated, corrective actions will be implemented. First among them is to conduct additional monitoring/investigations to track any further unanticipated advance of the effects of increased salinity on wetlands. Such monitoring would cease at ten years post-construction. Because of the confounding effects of sea level rise on determining project effects, it may be impossible to determine which adverse effects on vegetation are related to the proposed project. Given that, no further corrective actions regarding indirect impact determination (to wetlands) will be performed after ten years following the termination of construction activities. If additional monitoring is necessary, it will be carried out every other year until it is apparent that impacts have attenuated. The ICT will be provided with the monitoring reports.

If additional mitigation is necessary, corrective actions would then include identification of new/additional sources of mitigation (e.g., new preservation or restoration sites). The process will be coordinated with the ICT to ensure compliance with environmental commitments of the project, USACE guidance, and all applicable federal laws. Following the identification of mitigation options, a determination of the amount of compensatory mitigation will be performed using the UMAM tool, in collaboration with the ICT.

USACE may choose to perform corrective actions after any monitoring period (e.g., after year 1, year 3, or year 5 post-construction) if data show that impacts were drastically under-predicted in Final IFR/EIS. If so, USACE will coordinate additional mitigation in cooperation with the ICT. However, corrective actions are not anticipated to be fully investigated or engaged until after the year five post-construction monitoring event.

Any additional mitigation that becomes necessary as determined through the impact-area monitoring, analysis, and reporting cycle described above will be coordinated with the ICT (most likely after year five of monitoring). Any new/additional mitigation will be evaluated on a biennial basis, and collected biological and physical data pertaining to monitoring efforts will be shared with the ICT within 120 days of data collection.

5.3 Water Quality (Salinity and Dissolved Oxygen)

5.3.1 Conceptual Framework

The EFDC model predicts that dissolved oxygen impacts due to the Post 45 project are *de minimus* as defined in R. 61-68. For salinity, the model predicts that there will be a shift, of slightly increased salinities in some reaches of the harbor's tributary rivers. Monitoring will be carried out to determine the accuracy of these predictions, and to ensure that if the predictions fail, the degree of error is determined, the effects are documented, and suitable corrective actions are taken.

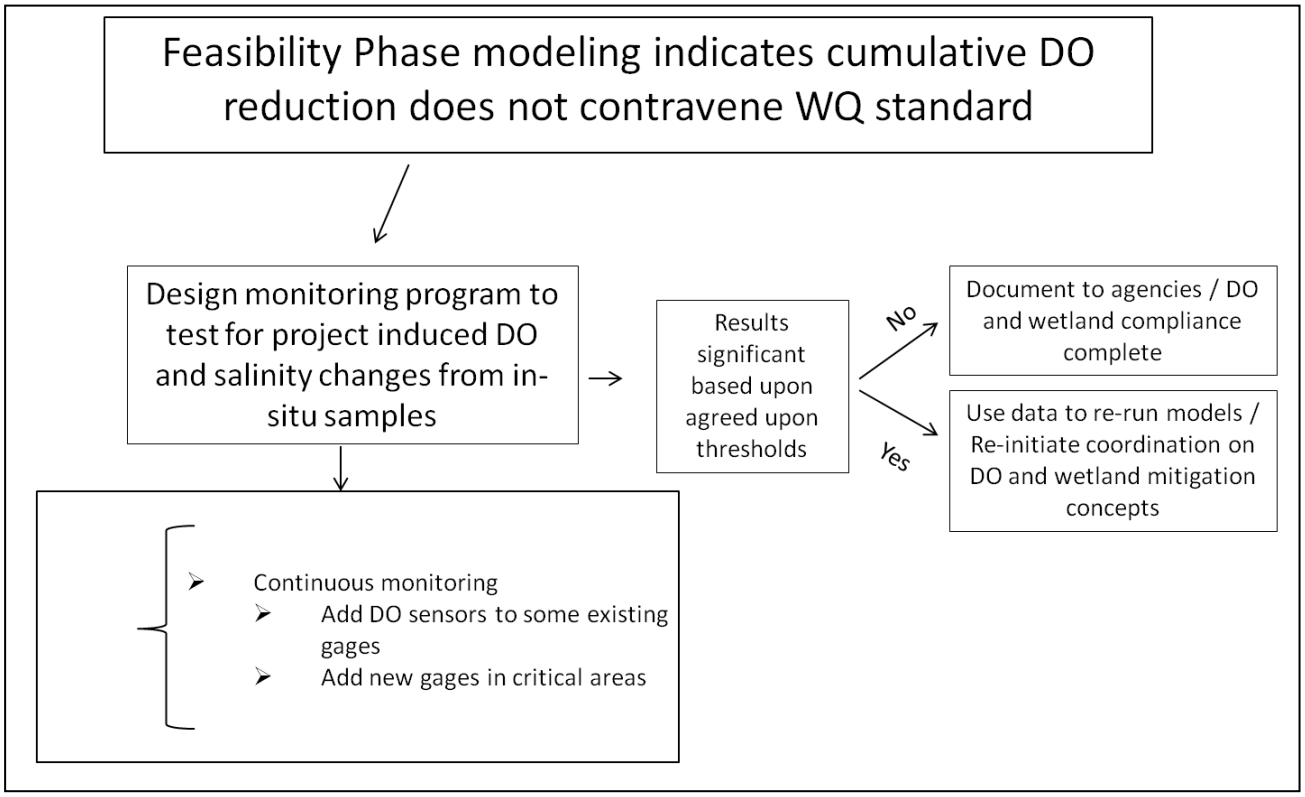


Figure 15. Conceptual framework for water quality (DO and salinity) monitoring

5.3.2 Pre-Construction Monitoring

Prior to construction, a detailed monitoring protocol will be developed in conjunction with the ICT in order to define a spatially and temporally explicit protocol for evaluating water quality impacts resulting from the proposed project. The goal for the pre-construction phase will be to produce baseline data to determine following construction if there were significant differences between the pre- and post-construction conditions, and to also be used (if needed) to provide data for future model application.

The USACE, US Geological Survey, BCDCOG and other cooperators currently operate a system of water quality data collection stations within the Charleston Harbor system using 15-minute data collection at mid-depth (Figure 16). Data collected include velocity, temperature, gage height, specific conductance,

and dissolved oxygen. Information from these stations will be used to evaluate salinity and DO levels in Charleston Harbor (Table 9 and Figure 15).

Table 9. USGS gages and locations

USGS Gage	Description
02172001	Lake Marion near Pinopolis, (Tailrace)
02172002	Lake Moultrie Tail Race at Moncks Corner, SC (upstream boundary condition)
02172020	W Branch Cooper River at Pimlico
02172040	Durham Canal
02172050*	Cooper River near Goose Creek (Dean Hall)
02172053	Cooper River at Mobay
021720677*	Cooper River at I-526 (Filbin Creek)
021720698*	Wando River at I-526 (above Mt P)
021720709*	Cooper River at Hwy 17 (boundary condition)
21720710	Cooper River at Customs House
021720869*	Ashley River at I-526

*Indicates gage with DO

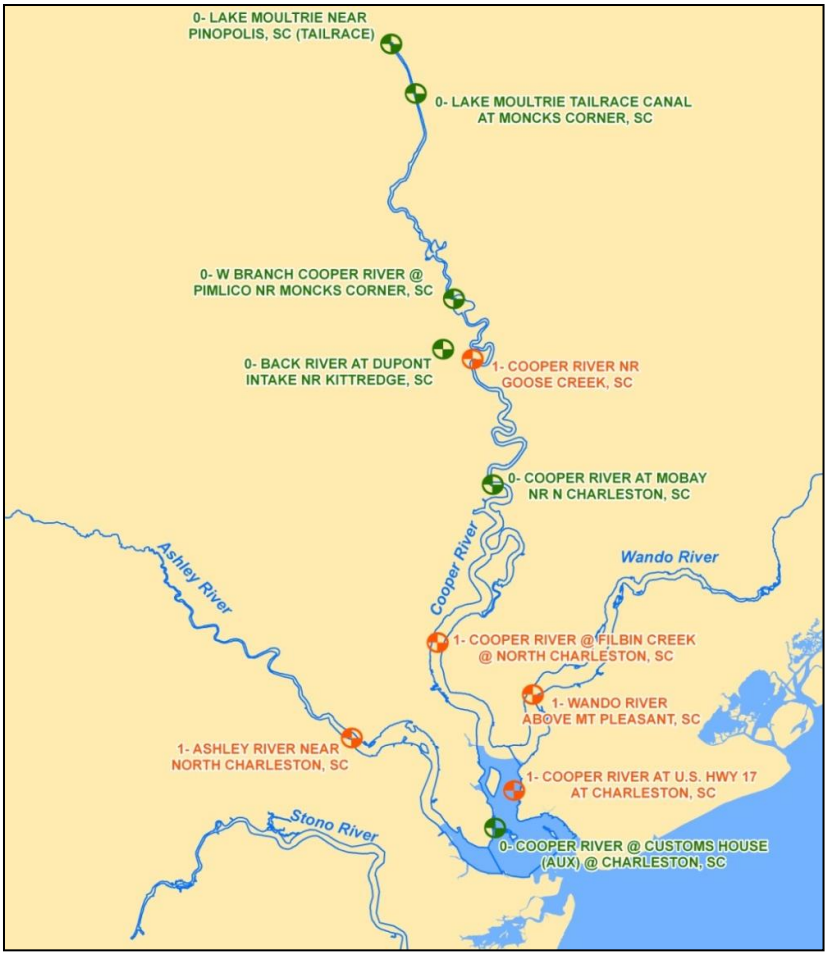


Figure 16. Continuous USGS monitoring gages in operation for 2012 (Orange indicates DO monitoring)

Additional gages will be established in the system. The new gages will be installed as soon as practical after project funding is available, and they will be maintained through construction and for a period of five years after dredging is complete. One gage will be strategically located between the Goose Creek and the Mobay gage to measure salinity in the area of an anticipated significant salinity shift in the Cooper River. Another gage to collect DO will be located in the brackish to freshwater transitional area of the Ashley River. A third gage with DO will be added to the Hwy 41 bridge on the Wando River. A fourth gage with DO will be added between Filbin Creek and Daniel Island on the Cooper River as this is the area that is projected to see the greatest cumulative DO deficit. All gages will be equipped to monitor the following parameters: specific conductivity (from which salinity can be derived), dissolved oxygen, temperature, water level, and pH. New gages would require either an existing structure or the construction of a new structure to mount the monitoring equipment to. Because a new structure would have to consider safe navigation of recreational/commercial boat traffic, the exact locations of new gages that require a structure to be built are unknown at this time, but there general locations are shown in Figure 16. The existing long-term DO gages and the proposed gages in the critical areas for anticipated Post 45 DO impacts will yield a robust dataset for evaluating Post 45 project DO impacts in the Charleston harbor estuary. Continuous data collection at the series of gages of mid-depth and bottom salinity and DO at high and low tides will be collected for at least one year before construction,

throughout construction, and after construction throughout the Charleston Harbor estuary, including the Ashley, Cooper and Wando Rivers.

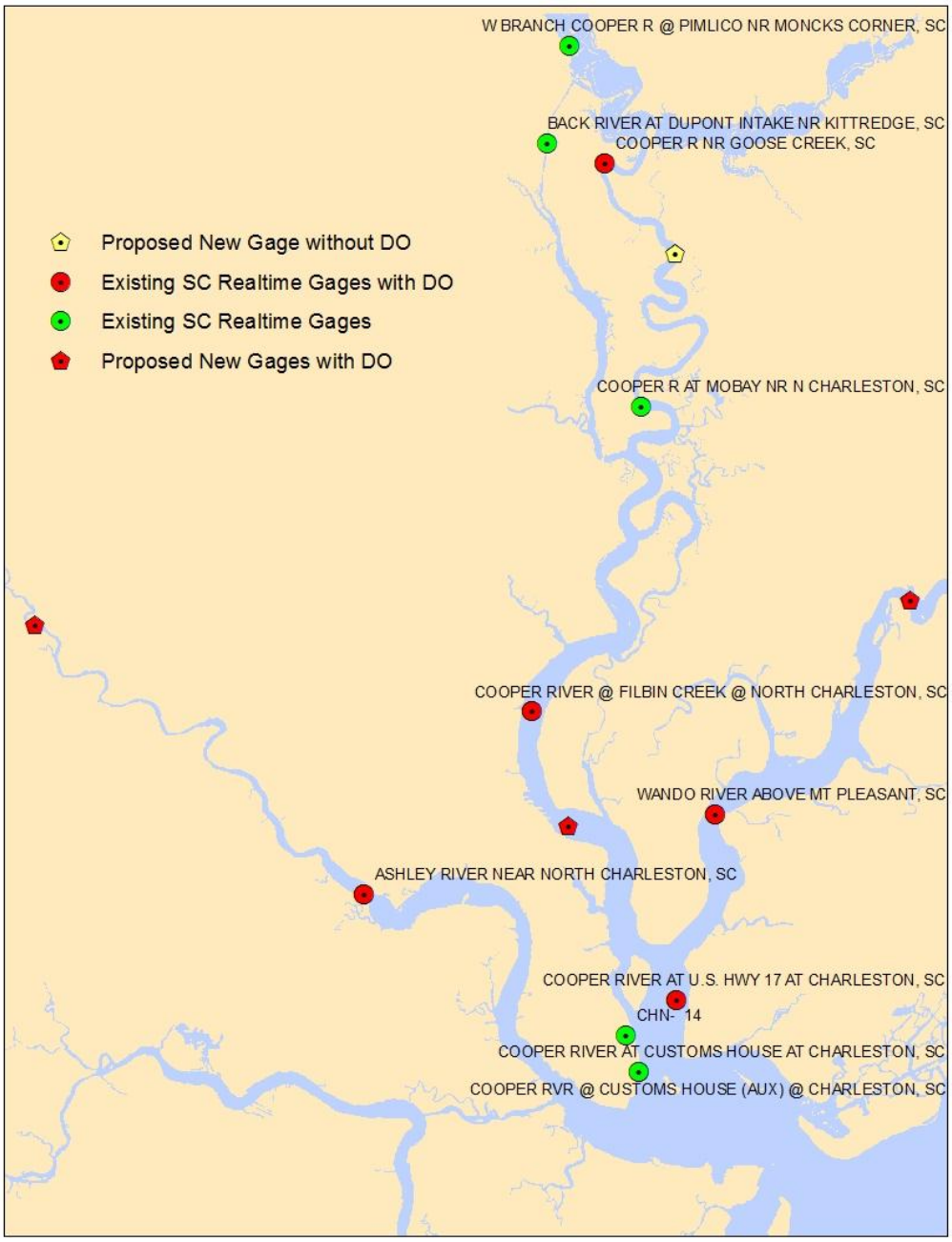


Figure 17. Location of all water quality gages (existing and proposed)

5.3.3 Construction Concurrent Monitoring

During construction, USACE will ensure that the dredging contractor is aware that it is expected that environmentally responsible dredging take place at all times. This is handled through compliance with environmental specifications in all dredging contracts. These specifications can be revised to address specific concerns. Dredging shall be conducted with a hydraulic cutterhead dredge with the dredged

material placed in the Daniel Island, Clouter Creek, and Yellow House CDFs. The disposal site shall have an on-site inspector (this inspector can be an employee of the Dredging Contractor or the "Engineer") that monitors the disposal site and outfall throughout the dredging activity to ensure that the disposal site and outfall are properly maintained and all the requirements of the contract are adhered to. It is noted that increased turbidity will occur with heavy overflow from the disposal area that contains high levels of suspended solids. Therefore, it is essential that care and diligence is taken to assure that the disposal area embankments are not breached, material overflow does not occur, and the spillway is properly and carefully maintained. The material should be pumped into the disposal area at such a rate as to allow settling at the spillway thereby minimizing suspended solids. Effluent that is excessively muddy or water with high levels of suspended solids is not allowed. If this occurs the inspector should require that dredging operations halt immediately, take pictures immediately of the area in the immediate vicinity of the discharge pipe, and contact this office immediately. Monitoring of the pipeline from the dredged site to the CDF will occur for the life of the dredging project. Dredging will cease if any pipeline leaks or breaks occur. The condition of the pipeline will be recorded on the daily construction quality control reports.

Constant monitoring of the dewatering area/CDF will be conducted to ensure that the structural stability of the dikes is not compromised. Should the structural stability of the dikes by compromised, all dredging shall cease, and a course of action will be determined to stabilize the dikes. Dredging shall not resume until the dikes are stabilized. The contractor will visually monitor the water return structure to ensure that the return water does not contain elevated levels of suspended solids.

5.3.3.1 Outfall Monitoring from Upland Disposal Areas.

In addition to the typical visual monitoring, a Hydrolab Datasonde, similar YSI sonde, or other comparable equipment will be used to measure water temperature, DO, pH, conductivity/salinity and turbidity. Because total suspended solids (TSS) is a better indicator of impacts from disposal area effluent, TSS will be analyzed once per week at each station below. Air temperature should be determined using a calibrated thermometer or the nearest available weather station data. When possible, Global Positioning System (GPS) is also required to record sampling stations. Routine monitoring shall occur at the following schedule and locations when discharge of dredge material into the disposal area is occurring.

Station Descriptions:

1) ***Station 1 (Mixing Zone):*** Within the middle of the creek and approximately 100 meters downdrift from the discharge pipe and in the direction of any visible plume. Sample depth should be approximately 0.3 meter below the water surface.

    a. Disposal Site Compliance at Station 1. If more than one point of discharge, the downdrift sample shall be taken approximately 100 meters from the discharge pipe furthest downstream on a dropping tide.

2) ***Station 2 (Background):*** Within the middle of the creek and approximately 150 meters updrift from the discharge pipe and outside of any turbidity generated by the project. Sample depth should be approximately 0.3 meter below the water surface.

a. Disposal Site Background at Station 2. If more than one point of discharge, a background sample shall be taken approximately 150 meters upstream from the discharge pipe furthest upstream on a dropping tide.

3) ***Station 3 (Outfall Monitoring):*** A water sample will be taken at the discharge weir(s) prior to spilling over the weir at approximately 0.1 meter below the water surface.

In order to standardize results, turbidity measurements or turbidity samples and analyses shall be taken once daily from Station 3 between the hours of 1000 and 1600. Water quality and TSS measurements from Stations 1 and 2 shall be taken twice per month during dredging operations and on a dropping (ebbing) tide. Samples shall be taken between one hour after high tide and one hour before low tide. Monitoring reports will be provided to the ICT on a quarterly basis.

5.3.3.2 Adaptive Management

Should elevated solids levels of turbidity occur, boards shall be added to the outfall structure as needed to allow for more settling time. More boards will increase the residence time of water within the disposal area prior to release. If adding boards does not reduce the level of suspended solids in the effluent, dredging shall cease until the suspended solids levels are satisfactorily reduced.

5.3.4 Post-Construction Monitoring

Post-construction monitoring will continue for five years after construction using the same methods described in the pre-construction monitoring section above. USACE will provide to the ICT a written report of the water quality data within 120 days of completion of data collection.

Once sufficient post-project data are available, the data will be analyzed to identify any changes in the DO and salinity regime that may have occurred after deepening (this may or may not occur in less than five years post-construction). During the preconstruction, engineering, and design (PED) phase of the project, USACE will, in consultation with SCDHEC and SCDNR and other ICT staff, and in order to comply with the conditions of the 401 Water Quality Certification, develop a methodology to use the continuous data to test for a statistically significant water quality variables between pre-, during-, and post-construction monitoring years. Detecting change in complex and highly variable estuarine systems can be difficult. Data processing and statistical techniques will be proposed based on initial screening of the data. Monitoring parameters discussed in the above subsections are summarized below in Attachment A.

5.3.5 Corrective Action / Adaptive Management

As described above in the wetland vegetation section, the application of models for predictive purposes necessarily involves the acceptance of some risk of error, particularly when confounding processes such as sea level rise and stochastic environmental events are involved. Depending on the results of the above evaluation, it may be necessary to perform additional modeling to account for environmental variability and other factors in order to establish whether or not any apparent DO or salinity impacts may be attributed to the deepening. If significant impacts are established with reasonable certainty, then initial (for DO) or additional (for wetlands) mitigation options may be necessary.

Salinity. Results of salinity monitoring will help inform the status of wetland impacts (related corrective actions are noted above). If there is a significant increase in salinity beyond the model-predicted changes, the ICT will be apprised of the situation and corrective actions for potential wetland impacts from salinity changes will be identified and carried out (see adaptive management section of wetland vegetation section above). There are no corrective actions for attempts to modify salinity in the water column itself.

Dissolved Oxygen. If the results of post construction monitoring indicate that the project has caused a decrease in DO beyond the predicted decrease in DO that can be attributable to the project and not other changes/variables within the watershed, then USACE and the SCSPA will convene a meeting with DHEC, EPA and other ICT staff to identify potential corrective actions. These actions could consist of any of the identified mitigation measures discussed above.

5.4 Monitoring Shoreline Changes

While each of the project alternatives would allow deeper drafting vessels to transit the harbor, the ability to do so would also allow more cargo to be transported on those vessels and result in fewer vessels calling on Charleston Harbor than the without project condition/No Action Alternative. In general, the larger vessels would generate larger wakes; however, since the ships would not be constrained to arrive and depart only at high tide, the effect of the wakes would be less than the without project condition. Also, the relative infrequency of cargo vessel wakes compared with wind waves makes them a minor factor contributing to shoreline changes and erosion. Because of this, it has been determined that the proposed project would result in lower impacts to shorelines, and no adverse shoreline impacts to Fort Sumter, Castle Pinckney, Patriots Point, etc (see Appendix A for more details).

The USACE analysis is based on the best available information and predicts the most likely outcome based on study information. However, the USACE acknowledges that the actual results of complex wave interactions depend on numerous factors that cannot be precisely forecasted. Based on the uncertainties inherent in the forecasts and the significance of the natural and historical resources within Charleston Harbor, the USACE will perform monitoring before, during and for five years after construction to validate the assumptions and information used in the wave effects analysis and attempt to confirm the associated results.

5.4.1 Bathymetric Changes

Concurrent with surveys of the Federal Navigation Channel, USACE will acquire multibeam data of significant natural and historic resources along the shores of Charleston Harbor. The information will be used to compare to historic surveys and used in conjunction with other monitoring efforts to inform a conclusion about whether or not erosion has increased as a result of the construction. There could be other changes to bathymetry of the harbor resulting from changes in shoaling rates and sedimentation patterns. Surveys will be performed quarterly from the PED phase through 5 years post-construction.

5.4.2 Topographic/Shoreline Changes

Near the shore, use ship-based Lidar system to capture the three-dimensional shoreline around these resources. Surveys will be concurrent with the bathymetric data collection.

5.4.3 Wave and Current Changes Resulting from the Project

USACE will collect data related to wave and current dynamics, specifically targeting ship wakes. The focus of this monitoring will be to measure wave and wake energy propagating from the navigation channel and attempting to associate it with specific vessels that utilize the physical changes associated with the proposed project to varying degrees. This effort would be most appropriate to validate or refute the assumptions used to predict the wave related changes of the undertaking. Data collection would be continuous from one year prior to construction through 5 years post-construction. Potential equipment may include a pressure transducer to measure wave heights and/or an Acoustic Doppler Velocimeter or Acoustic Doppler Current Profiler to measure current dynamics. Cameras will be used to document ships passing in the channel to directly relate measured data to specific vessels, tidal data, as well as vessel draft and cargo data. The Automatic Identification System (AIS) will be used, to the maximum extent practicable, to identify only the transits and associated wave energy imparted by the vessels able to benefit from the proposed project. Baseline wave energy, not resulting from commercial cargo vessels using the channel, would be subtracted from total wave energy to estimate vessel wake energy from the channel.

5.4.4 Reporting

Annual reports, presenting the data collected over a given 12 month period and preliminary analysis will be provided to the ICT after preconstruction monitoring begins (allowing 4 months to retrieve, compile and perform preliminary analysis for the annual report). At the end of the 5th year of post-construction monitoring, USACE will prepare a detailed analysis of the data and submit draft and final reports to the ICT. Important questions to attempt to answer include:

- Does measured erosion exceed the natural variability or the magnitude that can be attributed to variations in sea level or factors other than the project?
- Have wave and current dynamics changed significantly compared to the preconstruction baseline conditions or what would have occurred without the project and can they be attributed to the vessels utilizing the physical changes associated with the project?
- Has the energy attributable to vessel wakes increased more than would have occurred without the project?
- Is any increase in wake energy significant?
- Have the forecasted fleet changes occurred and have the largest vessels utilized the increased depths and distributed the energy from vessel wakes over a wider range of tide stages, as anticipated?

5.5 Threatened and Endangered Species Monitoring

Construction related monitoring for impacts to threatened and endangered species, including sea turtle species, sturgeon species, whales, and manatees will be consistent with the Terms and Conditions presented in the NMFS Biological Opinion (Appendix F2).

5.5 Beneficial Use of Dredged Material Projects

Beneficial uses have been proposed for this project. Options include expanding Crab Bank, expanding/protecting Shutes Folly, nearshore placement off Morris Island, and/or a new bird nesting island off the south jetty (See Section 4 of main report). Since details related to beneficial use have been moved to the Pre-construction, Engineering, and Design (PED) phase of the project, details have not yet been established for these concepts. Monitoring for any of these projects will be coordinated with the resource agencies and will be consistent with the goals of the project and USACE Engineering With Nature principles. Examples of monitoring elements could include annual bathy/topographic surveys, bird surveys, turbidity monitoring, and vegetation monitoring/recovery. Monitoring reports will be shared with relevant agencies, and if any adverse effects are detectable, corrective actions will be taken to provide adequate mitigation. Additional EFH consultation with NOAA may be necessary to ensure that important fishery habitats are not adversely affected.

6.0 References

Crowe, S. E., P. C. Jutte, and R. F. Van Dolah. 2006. An Environmental Monitoring Study of Hard Bottom Reef Areas Near the Charleston Ocean Dredged Material Disposal Site. Marine Resources Research Institute South Carolina Department of Natural Resources. Charleston, SC. 119 pp. Available online at http://myscmap.sc.gov/marine/mrri/environ/pdf/2006HardBottomReef.pdf.

Findlay S, Nieder WC, Fischer DT. 2006. Multi-scale controls on water quality effects of submerged aquatic vegetation in the tidal freshwater Hudson River. Ecosystems 9:84–96.

Gayes, Paul, Cheryl Ward, Jenna Hill, Shinobu Okanu, Jeff Marshall, Brian Johnson, Jamie Phillips, Bradley Craig, Richard Viso. 2013. Hardbottom and Cultural Resource Surveys of the Post 45 Charleston Harbor Project Study Area, Charleston, South Carolina. Prepared by Coastal Carolina University, Burroughs and Chapin Center for Marine and Wetland Studies. Prepared for US Army Corps of Engineers, Charleston District (URL: http://www.sac.usace.army.mil/Portals/43/docs/civilworks/post45/1_CCU%20Charleston%20Harbor%20Post%2045%20final.pdf). Appendices available upon request.

Joyner, D.F. 2007. Characterizing the hydrography and hydrodynamics of breached former tidal rice field wetlands on the Cooper River, South Carolina. Masters thesis. College of Charleston, Charleston, SC.

Kelley, Joe and Dan Tufford. The exchange of dissolved oxygen between tidal former rice fields and the Cooper River, Berkeley County, South Carolina.

NOAA Restoration Center and NOAA Coastal Services Center. Turning the Tide, A tidal hydrology restoration guidance manual for the southeastern United States.

Reif, Molly. 2013. Wetland Classification Study, Cooper River, South Carolina. Final Report to the US Army Corps of Engineers, Charleston District. Prepared by US Army Research and Development Center. Prepared for Charleston District, US Army Corps of Engineers. (URL: http://www.sac.usace.army.mil/Portals/43/docs/civilworks/post45/WetlandClassification_FinalReport_20130718.pdf).

SC Department of Health and Environmental Control – Office of Ocean and Coastal Resource Management (SCDHEC-OCRM). 2000. Charleston Harbor Special Area Management Plan.

USACE. 2010. Guidelines for Preparing a Compensatory Mitigation Plan. Compensatory Mitigation Guidelines, Working Draft, Subject to Change. Last revised October 7, 2010.

ATTACHMENT 1

Post 45

Uniform Mitigation Assessment Method

Data Sheets

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Charleston Harbor Post 45	N/A	Fairlawn Tract B2-B - palustrine forested

FLUCCs code	Further classification (optional)	Impact or Mitigation	Assessment Area Size
N/A	N/A	Mitigation	539.180

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e. OFW, AP, other local/state/federal designation of importance)
Wando or Cooper River watersheds - 8-digit HUC	Wando River is classified SFH from its headwaters to a point 2.5 miles north of its confluence with the	Fairlawn was recently identified as an Important Bird Area by The Audubon Society. As an Important Bird Area, B2-B provides outstanding habitat for

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Fairlawn Tract B2-B is strategically located within the Francis Marion NF proclamation boundary and contains the headwaters of the Wando or Cooper Rivers which drain into the Cooper River watershed. Fairlawn Tract B2-B is surrounded on multiple sides by conservation land, including privately protected properties and federally managed lands. Fairlawn Tract B2-B has had varying degrees of management over the years, and many have been consistently managed for timber production, recreation, and as historic ricefield impoundments. However, conversion to residential development, specifically small lot residential development, and incompatible forestry practices, remain key threats to these parcels.

Assessment area description

These wetlands were delineated using similar methodology to the impact assessment wetlands, and were determined to be greater than 5 feet based on a SCDNR digital elevation model. Since the impacted wetlands were any palustrine wetlands <= 5 ft and this assessment area represents palustrine wetlands > 5 ft, they are considered out-of-kind. Please see Final Mitigation Appendix for details.Fairlawn Tract B2-B has very complex mosaics of upland and wetland communities, with extensive northeast-southwest trending ecotones. Wetlands include both tidal and non-tidal palustrine examples. This assessment area consists of tidal marsh that hosts a mixed community dominated by freshwater marsh species, but with roughly 20-30% salt-tolerant species. Vegetation ranges from salt marsh along brackish portions of tidal creeks and rivers, sometime with inclusions of shrublands, and may also include forests dominated by a small set of salt-tolerant evergreen trees, mainly live oak, upland laurel oak, loblolly pine, and dwarf palmetto. Shrublands dominated by salt-tolerant shrubs such as wax myrtle and yaupon or by stunted trees often occurs at the seaward edge. The assessment area has a channelized stream that runs through it. The property consists of current and former wetlands that were converted to inland ricefields at the time of European settlement, but which have since been left to natural reforestation. These areas are now populated by common palustrine forested wetland trees such as pond cypress, red maple, laurel oak, and sweetgum. Uplands are primarily longleaf pine woodland or savannah, historical longleaf areas converted to loblolly pine plantation, or southern maritime forest.Fairlawn Tract B2-B lies in proximity to one of the largest remaining expanses of longleaf pine forest, a known reservoir for rare, threatened and endangered species. The surrounding Francis Marion National Forest was recently identified as a Significant Geographic Area for the maintenance and restoration of longleaf pine. Fairlawn Tract B2-B is also proximal to the extensive marshes and estuaries of the Cape Romain National Wildlife Refuge, a Class I Wilderness area. The Refuge is recognized as a UNESCO Biosphere Reserve, and a RAMSAR wetland of international significance. These designations are bestowed only on the most significant natural habitats of the world. The Nature Conservancy (2010) developed habitat models for foraging habitat of the red-cockaded woodpecker (federally endangered), pond-breeding amphibians (including the federally threatened flatwoods salamander), and juvenile rearing habitat for swallowtail kites (federal candidate species). Many of these habitat types fall within

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
Francis Marion Natural Forest, Cape Romain National Wildlife Refuge, Cainhoy Ridge	Within the watershed, there are not many large parcels of the quality of some of the parcels left. Francis Marion National Forest was recently identified as a Significant Geographic Area for the maintenance and restoration of longleaf pine. Due to the unique isolated wetland features found in the general area, there is potential habitat for the state endangered/Forest Sensitive Carolina Gopher Frog (Lithobates capito) and federally threatened Frosted Flatwoods Salamander (Ambystoma cingulatum). This portion of Fairlawn is where one of the last reported occurrences of the endangered Bachmans's warbler, which is now likely extinct. The US Fish & Wildlife Service has been petitioned to list the Carolina Gopher Frog under the Endangered Species Act. It and the Frosted Flatwoods Salamander are likely the rarest amphibians on the Francis Marion National Forest, and two of the rarest in the entire state of South Carolina. The Frosted Flatwoods Salamander was actually documented in the general vicinity of B-2B in 1979.

Functions	Mitigation for previous permit/other historic use
water purification, flood protection, shoreline stabilization, groundwater recharge, streamflow maintenance, retention of particles, surface water storage, subsurface storage, nutrient cycling, biodiversity, values to society, and fish and wildlife habitat.	Not used for a mitigation site in the past. Some tracts nearby have been purchased for preservation, but most tracts are either privately owned or USFS land.

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
Typical uses by animals for wetlands. Potential habitat for the red-cockaded woodpecker (federally endangered), pond-breeding amphibians (including the federally threatened flatwoods salamander), and juvenile rearing habitat for swallowtail kites (federal candidate species).Swainson's Warbler (Limnothlypis swainsonii) and Bachman's Sparrow (Aimophila aestivalis). Approximately 12 species of migratory birds listed on the National Audubon's yellow list have been documented on the forest. Due to the surrounding habitats and isolated wetlands, species with high conservation priority such as the Black-throated Green Warbler (Dendroica virens), Swainson's Warbler (Limnothlypis swainsonii), Prothonotary Warbler (Protonotaria citrea), Worm-eating Warbler (Helmitheros vermivora), Brown-headed Nuthatch (Sitta pusilla), RCW, Chuck-will's Widow (Caprimulgus carolinensis), Wood Duck, Yellow-throated Warbler (Dendroica dominica), and Northern Parula (Parula Americana) have the potential to occur on the B2-B parcel.	frosted flatwoods salamander (T), Carolina gopher frog (at-risk species), swallow-tailed kite (SSC), red cockaded woodpecker (E).

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

wading birds, alligators, fox squirrels, waterfowl, kingfisher, raptors

Additional relevant factors:

Fairlawn Tract B2-B is considered by the USFS to be the most important property acquisitions east of the Mississippi River. SCDHEC states that, "There is a high potential for growth projected for this watershed, which contains portions of the Towns of Mt. Pleasant and Awendaw, and the City of Charleston. Some of the major development areas include: Dunes West, Liberty, Rivertowne, Brickyard, Long Point, Belle Hall, and Daniel Island. Water and sewer services are available in all potential growth areas. Some of the areas are favorite areas for the swallow-tailed kite. This portion of Fairlawn is where one of the last reported occurrences of the endangered Bachmans's warbler, which is now likely extinct.

Assessment conducted by:	Assessment date(s):
Mark Messersmith and Jesse Helton with input from: Matt Slagel, Steven Brooks, Mark Caldwell, Priscilla Wendt, Tony Able, Jaclyn Daly, Susan Davis, Colt Bowles, Peggy Jo Nadler, Patrick Moore, Erin Owen, Chuck Hightower, Heather Preston, Brandon Howard	1/29/2015

PART II – Qualification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Post 45 Wetland Mitigation	N/A	Fairlawn Tract B2-B - palustrine forested
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	Mark Messersmith and Jesse Helton with input from: Matt Slagel, Steven Brooks, Mark Caldwell, Priscilla Wendt, Tony Able, Jaclyn Daly, Susan Davis, Colt Bowles, Peggy Jo Nadler, Patrick Moore, Erin Owen, Chuck Hightower, Heather Preston, Brandon Howard	30-Apr-14

Scoring Guidance	Optimal (10)	Moderate (7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetlands/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface water functions	Minimal level of support of wetland /surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 7	with: 9	**Without Preservation:** Fairlawn Tract B2-B has consistently been managed for timber production, recreation, and historic rice field impoundments. However, conversion to residential development, specifically small lot residential development, and incompatible forestry practices, remain key threats to the parcels. Upland areas may be developed which would fragment habitat in the area. Disturbance could cause exotics to colonize the area. Wildlife access would decline if the area is developed due to the fragmented environment. Functions of the wetlands would be reduced due to upland disturbance. Reduction in some functions such as water storage, nutrient retention would have effects downstream too. Land clearing could cause an increase in runoff and lead to sedimentation concerns in fragile emergent wetland environments. Likely development of property could undermine current Forest Service ability to manage longleaf ecosystems with fire. In areas adjacent to Fairlawn Tract B2-B there are active sand mining operations. There are areas within Fairlawn Tract B2-B that could also be mined for sand. **With Preservation:** Preservation would help to avoid habitat fragmentation and enhance landscape support. In addition, conveyance of the land to the USFS would improve upon the existing land management practices and ensure wildlife habitat was enhanced. Downstream areas would receive the same wetland benefits they are currently receiving. Preservation would provide a wildlife cooridor for the adjacent barrier islands that form Cape Romain NWR. The parcels lie in proximity to one of the largest remaining expanses of longleaf pine forest, a known location for rare, threatened and endangered species. Burning provides specific benefits to longleaf pine forests and wetland habitat. Preservation could prevent undesirable development outside the urban growth boundary as defined in the Charleston Century V plan. Preservation would also prent any sand mining from occuring on Fairlawn Tract B2-B
.500(6)(b) Water Environment (n/a for uplands)	w/o pres or current: 5	with: 8	**Without Preservation:** Upland areas are under threat of development. Water quality would be degraded. Water levels and flows to receiving waters could be impacted. Hydrologic stress to native wetland plant communities could occur. Holland et al., (2004) developed a stressor-exposure-response model of impervious cover impacts on a watershed. They find that at 10-20% impervious cover (reasonable development estimate) that the watershed would experience altered hydrography, change in salinity, altered sediment characteristics, increased chemical contaminants and increased bacterial load. Van Dolah et al., (2008) examined the relationships between land cover and various chemical contaminants. Positive correlations were found between land cover and PAH concentrations and fecal coliform bacteria. Their analyses support the hypothesis that estuarine habitat quality reflects upland development patterns at large scales. It is likely that at least 20% of wetlands would be converted if the area was developed. If this happened water flows would be artificially controlled through storm water conveyance. Natural sheet flows to remaining wetlands would be lost. Hydro-period would be altered due to roads, lawns, other impervious surfaces. **With Preservation:** Preservation of any of Fairlawn Tract B2-B will preserve existing water quality on site and downstream and potentially enhance it due to decreased commercial activities (logging, mining, etc.). Water levels and flows would be appropriate for this area and similar to the existing condition. Wetland functions would be fully supported.
.500(6)(c) Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 6	with: 9	**Without Preservation:** Fairlawn Tract B2-B has a very complex mosaics of upland and wetland communities, with extensive northeast-southwest trending ecotones. The structure of these systems would likely be compromised with upland development. These areas are now populated by common forested wetland trees such as pond cypress, red maple, laurel oak, and sweetgum. These species could undergo stress due to stressors from development. Audubon states that, "Currently one of the biggest threats is the limited ability to conduct and maintain prescribed burning for the management of Red-cockaded Woodpeckers (RCWs), chaffseed and other wildlife and plant communities." This threat is from commercial and residential development. Holland et al., (2004) found that at 20-30% impervious cover, living resources could be affected, including reduced shrimp abundances, fewer stress-senstive taxa, altered food webs, and shellfish bed closures. Vegetation and wildlife with the wetalnds could be negativly impacted by increased runoff from development and disturbance. **With Preservation:** Community structure including wetlands and uplands would be protected from development. Land management practices would be enforced by the USFS as the lands would be conveyed to Francis Marion National Forest. Plant species would be expected to be desirable for the area. Exotics could still be present but would be better managed in Forest Service ownership. Age and size distribution would be typical of system with no deviation from normal. Recruitment and regeneration would be normal and natural with higher presence of woody debris. Some channelization and unimproved roads exist within Fairlawn Tract B2-B.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.600	0.867

If preservation as mitigation,	
Preservation adjustment factor* =	0.5
Adjusted mitigation delta =	0.1333

*

For impact assessment areas
FL=delta x acres=

Delta = [with - current]
0.267

If mitigation	
Time lag (t-factor) =	1.14
Risk factor =	1.00

For mitigation assessment areas	
RFG=delta/(t-factor x risk)=	0.117

**This factor is reduced from 1.0 based on its gain of ecological value since the parcel has a high likelihood of preservation because of its value, and because some of the wetlands are partially out kind b/c they are not all tidal. While Fairlawn B2B is in the same 8-digit HUC as the impacted wetlands, it is in the Wando basin, not Cooper.Additional input on preservation adjustment factor came from the ICT during the field visit.*

	Preservation adjustment factor	
1	extent to which mgt activities promote natural conditions	0.9
2	ecological and hydrological relationship between wetlands and uplands	1
3	scarcity	0.9
4	proximity to other preserved areas	0.9
5	extent and likelihood of impacts if not preserved	0.8
average		0.9
out-of-kind adjustment		0.5

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Charleston Harbor Post 45	N/A	Fairlawn Tract B2-B Mayrant's Reserve

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
N/A	N/A	Mitigation	167.370

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e. OFW, AP, other local/state/federal designation of importance)
Wando or Cooper River watersheds - 8-digit HUC (03050201-04)	Wando River is classified SFH from its headwaters to a point 2.5 miles north of its confluence with the Cooper River. Upper Cooper River along the east branch is classified as FW.	Fairlawn was recently identified as an Important Bird Area by The Audubon Society. As an Important Bird Area, Fairlawn Tract B2-B provides outstanding habitat for avian species, especially species which are dependent upon freshwater wetlands. Nearby Cape Romain NWR is a Class I Air Quality Zone

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

The north west portion of the Fairlawn Tract B2B generally drains to Mayrant's Reserve. Mayrant's Reserve drains to a series of wetlands in the south east portion of the Fairlawn Tract. Mayrant's Reserve is the remnant of a historic water retention area for rice field irrigation. Functioning water control structures still exist at Mayrant's Reserve and water levels are occasionally manipulated to attract water fowl. Currently Mayrant's Reserve is hydrologically well connected to the surrounding area and feeds an extensive series of wetlands.

Assessment area description

Mayrant's Reserve which is a lake created by an old water impoundment contructed to provide water to inland rice fields. Mayrant's Reserve drains to a series of wetlands in the south east portion of the Fairlawn Tract. Mayrant's Reserve is the remnant of a historic water retention area for rice field irrigation. Functioning water control structures still exist at Mayrant's Reserve and water levels are occasionally manipulated to attract water fowl. Currently Mayrant's Reserve is hydrologically well connected to the surrounding area and feeds an extensive series of wetlands. It contains a variety of habitat types. Predominate habitat types found within Maryant's Reserve include baldcypress and swamp tupelo swamp, open water, and emergent wetland areas. In some areas phragmites (invasive reed grass) stands are present. Water levels within Mayrant's Reserve can be manipulated in order to obtain desired ecosystem functions or for wildlife management. Mayrant's Reserve provides a stopover for migratory bird species and currently is a rookery for several spices of wading birds.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
Francis Marion Natural Forest, Cape Romain National Wildlife Refuge, Cainhoy ridge	USFS staff have noted that Mayrant's Reserve provides some of the best waterfowl and wading bird habitat in this portion of Charleston County.

Functions	Mitigation for previous permit/other historic use
water purification, flood protection, shoreline stabilization, groundwater recharge, streamflow maintenance, retention of particles, surface water storage, subsurface storage, nutrient cycling, biodiversity, values to society, and fish and wildlife habitat.	None aware of

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
Tundra Swan (Cygnus columbianus), Snow Goose (Chen caerulescens), Canada Goose (Branta Canadensis), Wood Duck (Aix sponsa), Green-winged Teal (Anas crecca), American Black Duck (Anas rubripes), American Coot (Fulica Americana), Mottled Duck (Anas fulvigula), Mallard (Anas platyrhynchos), Northern Pintail (Anas acuta), Blue-winged Teal (Anas discors), Northern Shoveler (Anas clypeata), Gadwall (Anas strepera), American Wigeon (Anas americana), Canvasback (Aythya valisineria), Redhead (Aythya americana), Ring-necked Duck (Aythya collaris), Lesser Scaup (Aythya affinis), Bufflehead (Bucephala albeola), Black-bellied Whistling-Duck (Dendrocygna autumnalis), Hooded Merganser (Mergus cucullatus), Red-breasted Merganser (Mergus serrator), and Ruddy Duck (Oxyura jamaicensis)	wood stork (E), swallow-tailed kite (SSC),

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Wading bird rookery, American alligators, multiple species of ducks, records of historic wood stork rookery

Additional relevant factors:

The Francis Marion serves as an important stopover and wintering ground for waterfowl. In terms of year-round residents, palustrine and riverine wetlands found on Fairlawn Tract B2-B are ideal foraging and nesting habitats for the wood duck (Aix sponsa). Several wood duck cavities occur in hollow tupelo (Nyssa spp.) and pond cypress (Taxodium ascendens) trees throughout the property. There is also an historical wading bird rookery at Mayrant's Reserve. Mayrant's Reserve has been well known by ornithologists due to the important avian habitat that it provides. Fairlawn Tract B2-B falls within the South Atlantic Joint Venture's CAWS Basin Sub-Focus Waterfowl Area. It is highly conceivable that the freshwater wetlands such as Mayrant's Reserve could become a woodstork rookery again in the future. In addition to having one of the last reported occurrences of Bachman's Warbler, unique species such as the sandhill crane (Grus Canadensis), have also been reported from areas near Mayrant's Reserve in the past.

Assessment conducted by:	Assessment date(s):
Mark Messersmith and Jesse Helton with input from: Matt Slagel, Steven Brooks, Mark Caldwell, Priscilla Wendt, Tony Able, Jaclyn Daly, Susan Davis, Colt Bowles, Peggy Jo Nadler, Patrick Moore, Erin Owen, Chuck Hightower, Heather Preston, Brandon Howard	1/29/2015

PART II – Qualification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Post 45 Wetland Mitigation	N/A	Fairlawn Tract B2-B Mayrant's Reserve
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	Mark Messersmith and Jesse Helton with input from: Matt Slagel, Steven Brooks, Mark Caldwell, Priscilla Wendt, Tony Able, Jaclyn Daly, Susan Davis, Colt Bowles, Peggy Jo Nadler, Patrick Moore, Erin Owen, Chuck Hightower, Heather Preston, Brandon Howard	30-Apr-14

Scoring Guidance	Optimal (10)	Moderate (7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetlands/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface water functions	Minimal level of support of wetland /surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 7	with: 9	**Without Preservation:** The north west portion of the Fairlawn Tract B2-B generally drains to Mayrant's Reserve. Mayrant's Reserve drains to a series of wetlands in the south east portion of the Fairlawn Tract. Mayrant's Reserve is the remnant of a historic water retention area for rice field irrigation. Functioning water control structures still exist at Mayrant's Reserve and water levels are occasionally manipulated to attract water fowl. Currently Mayrant's Reserve is hydrologically well connected to the surrounding area and feeds an extensive series of wetlands. Areas within the Reserve do have significant stands of phragmites. No major barriers exist in the area to impede the movement of wildlife into and out of the area. Current land use around Mayrant's Reserve (timber production) is not optimal managment for the area. Key threats to this area included development of the upland areas surrounding Marant's Reserve. Conversion of the uplands surrounding the reserve to small lot residential properties would likely have impacts to the area. Currently the only area with development plans is the Nebo tract which is located downsteam of the Fairlawn Tract. During the field visit ICT members noted that disturbance could cause exotics to further colonize the area. Wildlife access would decline if the area is developed due to the fragmented environment. Land clearing could cause sedimentation concerns in fragile emergent wetland environments. Current permiting regualtions would likely prevent develpment within the footprint of Mayrant's Reserve. Reduction in some functions such as water storage and nutrient retention would have effects downstream as well. **With Preservation:** Conveyance of the land to the USFS would improve upon the existing land management practices and ensure wildlife habitat was enhanced. The area could be managed under the USFS Forest Plan to provide habitat for endangered wood storks and other bird species. The risk of the upland surrounding Mayrant's Reserve being developed would be eliminated. Preservation could prevent undesirable development outside the urban growth boundary as defined in the Charleston Century V plan. ICT members noted that sub-optimal forestry practices within the drainage area of the reserve would also be eliminated. Downstream areas would receive the same wetland benefits they are currently receiving.
.500(6)(b) Water Environment (n/a for uplands)	w/o pres or current: 5	with: 8	**Without Preservation:** Upland areas are under threat of development. Water front lots are likely to be installed if the area is developed. Development in the uplands would result in impacts to water quality, increase in sedimentation, altered hydrology, and increased nutrients entering the system. The reserve would likely be converted into a storm water control feature, though no direct fill is likely to occur. Water levels and flows to receiving waters could be impacted. Hydrologic stress to native wetland plant communities could occur. Holland et al., (2004) developed a stressor-exposure-response model of impervious cover impacts on a watershed. They find that at 10-20% impervious cover (reasonable development estimate) that the watershed would experience altered hydrography, change in salinity, altered sediment characteristics, increased chemical contaminants and increased bacterial load. Van Dolah et al., (2008) examined the relationships between land cover and various chemical contaminants. Positive correlations were found between land cover and PAH concentrations and fecal coliform bacteria. Functions of the wetlands would be reduced due to upland disturbance and increased runoff. **With Preservation:** Preservation of any of the Fairlawn Tract B2-B will preserve and possibly enhance water quality on site and downstream. The hydrology of Mayrant's Reserve could be manipulated to support threatened and endangered species and other target species. Wetland functions would be fully supported. Invasive species management/eradication could be carried out if identified in the USFS Forest
.500(6)(c) Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 5	with: 8	**Without Preservation:** If the Fairlawn Tract B2-B is developed nutrient loads would likely increase leading to increases in invasive species such as phragmites and cattails. Changes could also impact the benthic community of Mayran's Reserve. If homes are built on lakeside lots utilization by wildlife (especially birds) of the area would likely greatly decrease. Increased lighting on the Reserve could also impact migratry birds. Additionally, the upland parcels that feed Mayrant's reserve have very complex mosaics of upland and wetland communities, with extensive northeast-southwest trending ecotones. The structure of these systems would likely be compromised with upland development. These areas are now populated by common forested wetland trees such as pond cypress, red maple, laurel oak, and sweetgum. These species could undergo stressors from development. **With Preservation:** Community structure including connected wetlands and uplands would be protected from development. Land management practices would be enforced by the USFS as the lands would be conveyed to Francis Marion National Forest. Plant species would be expected to be desirable for the area. Exotics would still be present but would be better managed in Forest Service ownership. Age and size distribution would be typical of the system with no deviation from normal. Continued use of the lake as a rookery, for some species of wading birds, would likely continue.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.567	0.833

If preservation as mitigation,	
Preservation adjustment factor* =	0.5 *
Adjusted mitigation delta =	0.1333

For impact assessment areas
FL=delta x acres=

Delta = [with - current]
0.267

If mitigation	
Time lag (t-factor) =	1.14
Risk factor =	1.00

For mitigation assessment areas	
RFG=delta/(t-factor x risk)=	0.117

**While Mayrants Reserve is one of the more desirable habitat features of the Fairlawn B2B parcel, the preservation factor has been reduced from 1.0 based on its gain of ecological value when compared to the impacted wetlands. Other reasons are because the parcel has a high likelihood of preservation because of its value, and because the habitat is partially out-of-kind. ICT members agreed that dropping this value could account for these concerns.*

	Preservation adjustment factor	
1	extent to which mgt activities promote natural conditions	0.8
2	ecological and hydrological relationship between wetlands and uplands	1
3	scarcity	1
4	proximity to other preserved areas	0.9
5	extent and likelihood of impacts if not preserved	0.8
average		0.9
out-of-kind adjustment		0.5

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Charleston Harbor Post 45	N/A	Fairlawn Tract B2-B tidal marsh

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
N/A	N/A	Mitigation	19.200 acres

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e. OFW, AP, other local/state/federal designation of importance)
Wando or Cooper River watersheds - 8-digit HUC (03050201-04)	Wando River is classified SFH from its headwaters to a point 2.5 miles north of its confluence with the Cooper River. Upper Cooper River along the east branch is classified as FW.	Fairlawn Tract B2-B was recently identified as an Important Bird Area by The Audubon Society. As an Important Bird Area, B2-B provides outstanding habitat for avian species, especially species which are dependent upon freshwater wetlands. Nearby Cape Romain NWR is a Class I Air Quality Zone

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Fairlawn Tract B2-B is strategically located within the Francis Marion NF proclamation boundary and contains the headwaters of the Wando or Cooper Rivers which drain into the Cooper River watershed. Fairlawn Tract B2-B is surrounded on multiple sides by conservation land, including privately protected properties and federally managed lands. Fairlawn Tract B2-B has had varying degrees of management over the years, and many have been consistently managed for timber production, recreation, and as historic ricefield impoundments. However, conversion to residential development, specifically small lot residential development, and incompatible forestry practices, remain key threats to these parcels.

Assessment area description

Fairlawn Tract B2-B has very complex mosaics of upland and wetland communities, with extensive northeast-southwest trending ecotones. Wetlands include both tidal and non-tidal palustrine examples. On the site visit, ICT members noted that the marsh community was relatively freshwater species with some mixed salt-tolerant species. Roughly 20-30% salt-tolerant species. Vegetation ranges from salt marsh along brackish portions of tidal creeks and rivers, sometime with inclusions of shrublands, and may also include forests dominated by a small set of salt-tolerant evergreen trees, mainly live oak, upland laurel oak, loblolly pine, and dwarf palmetto. Vegetation seen on the site visit consists of panicum, juncus, distichlis, etc. Shrublands dominated by salt-tolerant shrubs such as wax myrtle and yaupon or by stunted trees often occurs at the seaward edge. Salt marsh is dominated by saltmarsh cordgrass (Spartina alterniflora), and black needlerush (Juncus roemerianus) may dominate along brackish portions of tidal creeks and rivers. Example of salt marsh systems may support inclusions of shrublands dominated by yaupon, stunted live oak, groundsel tree, or seaside oxeye. A few of the most sheltered areas near the northern end of the range have forests with deciduous species such as American beech and Southern Red Oak. Also included within these ecosystems are embedded freshwater depressional wetlands dominated by shrubs or small trees. Communities tend to be low in species richness, with all strata limited to a set of salt-tolerant species. These ecosystems provide connectivity to Cape Romaine National Wildlife Refuge to the east. Given their relatively rarity on the forest, their associated shell mounds, marine and estuarine systems, and function as migratory pathways for migrant birds, they are some of the most valuable ecosystems on the coastal fringe.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
Francis Marion Natural Forest, Cape Romain National Wildlife Refuge, Cainhoy Ridge	The Tidal Marsh and adjcent forest foud within the tract provides. These areas are particularly vulnerable to urban development, to salt water intrusion and sea level rise, and to the force of hurricanes Maritime forests and salt marsh are relatively uncommon on the forest (1.5% of forested acres) and would be maintained, improved or restored where they occur.

Functions	Mitigation for previous permit/other historic use
Tidal marshes provide the following functions: water purification, flood protection, shoreline stabilization, groundwater recharge, streamflow maintenance, retention of particles, surface water storage, subsurface storage, nutrient cycling, biodiversity, values to society, and fish and wildlife habitat.	Not used for a mitigation site in the past. Some tracts nearby have been purchased for preservation, but most tracts are either privately owned or USFS land.

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
Typical uses by animals for wetlands. woodstork (federally threatened),and juvenile rearing habitat for swallowtail kites (federal candidate species).	wood stork (E), frosted flatwoods salamander (T), Carolina gopher frog (at-risk species), swallow-tailed kite (SSC), red cockaded woodpecker (E).

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

wading birds, alligators, fox squirrels, waterfowl, kingfisher, raptors

Additional relevant factors:

Fairlawn Tract B2-B is considered by the USFS to be the most important property acquisitions east of the Mississippi River. SCDHEC states that, "There is a high potential for growth projected for this watershed, which contains portions of the Towns of Mt. Pleasant and Awendaw, and the City of Charleston. Some of the major development areas include: Tupelo Forest, Dunes West, Liberty, Rivertowne, Brickyard, Long Point, Belle Hall, and Daniel Island. Water and sewer services are available in all potential growth areas. Adjacent Nebo Tract has a development plan and the Awendaw annexation denial is under appeal. Some of the areas are favorite areas for the swallow-tailed kite. Painted bunting is a focal species within these systems.

Assessment conducted by:	Assessment date(s):
Mark Messersmith and Jesse Helton with input from: Matt Slagel, Steven Brooks, Mark Caldwell, Priscilla Wendt, Tony Able, Jaclyn Daly, Susan Davis, Colt Bowles, Peggy Jo Nadler, Patrick Moore, Erin Owen, Chuck Hightower, Heather Preston, Brandon Howard	1/29/2015

PART II – Qualification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Post 45 Wetland Mitigation	N/A	Fairlawn Tract B2-B tidal marsh
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	Mark Messersmith and Jesse Helton with input from: Matt Slagel, Steven Brooks, Mark Caldwell, Priscilla Wendt, Tony Able, Jaclyn Daly, Susan Davis, Colt Bowles, Peggy Jo Nadler, Patrick Moore, Erin Owen, Chuck Hightower, Heather	30-Apr-14

Scoring Guidance	Optimal (10)	Moderate (7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetlands/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface water functions	Minimal level of support of wetland /surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	**Without Preservation:** Fairlawn Tract B2-B has consistently been managed for timber production, recreation, and historic rice field impoundments. However, conversion to residential development, specifically small lot residential development, and incompatible forestry practices, remain key threats to the parcels. Upland areas may be developed which would fragment habitat in the area. Disturbance could cause exotics to colonize the area. Wildlife access would decline if the area is developed due to the fragmented environment. Functions of the wetlands would be reduced due to upland disturbance. Reduction in some functions such as water storage, nutrient retention would have effects downstream too. Land clearing could cause sedimentation concerns in fragile emergent wetland environments. ICT noted that downstream impacts could increase from urbanization. Adjacent forest is subject to logging even if no development occurs. This is evidenced by the timber sale on the land, and the reasonable assumption that economic activity would continue to take place. The tidal creek itself has been channelized but is still well connected to the adjacent wetlands. While direct development in the marsh area is not anticipated, houses and docks/piers will fragment the landscape and increase stormwater runoff into the marsh area. This runoff will create additional water quality concerns discussed in "water environment".	w/o pres or current: 8 / with: 9
	With Preservation: Preservation of Fairlawn Tract B2-B would help to avoid habitat fragmentation and enhance landscape support. In addition, conveyance of the land to the USFS would improve upon the existing land management practices and ensure wildlife habitat was enhanced. Downstream areas would receive the same wetland benefits they are currently receiving. Preservation would provide a wildlife corridor for the adjacent barrier islands that form Cape Romaine NWR. The parcels lie in proximity to one of the largest remaining expanses of longleaf pine forest, a known location for rare, threatened and endangered species. Burning provides specific benefits to longleaf pine forests and wetland habitat. Preservation could prevent undesirable development outside the urban growth boundary as defined in the Charleston Century V plan. ICT noted that it's not optimum habitat due to the channelization. Additionally timber contract may be acquired if the tract is purchased for mitigation before the logging occurs.	
.500(6)(b) Water Environment (n/a for uplands)	**Without Preservation:** Upland areas are under threat of development. Water quality would be degraded. Water levels and flows to receiving waters could be impacted. Hydrologic stress to native wetland plant communities could occur. Holland et al., (2004) developed a stressor-exposure-response model of impervious cover impacts on a watershed. They find that at 10-20% impervious cover (reasonable development estimate) that the watershed would experience altered hydrography, change in salinity, altered sediment characteristics, increased chemical contaminants and increased bacterial load. Van Dolah et al., (2008) examined the relationships between land cover and various chemical contaminants. Positive correlations were found between land cover and PAH concentrations and fecal coliform bacteria. Their analyses support the hypothesis that estuarine habitat quality reflects upland development patterns at large scales. ICT noted that development could degrade water quality, specifically with nutrient loading. ICT noted that an assumption is that no fill would occur within the marsh but it would occur within the forest. The degree of water quality impacts would be dependent on the type and amount of development/impervious cover.	w/o pres or current: 7 / with: 9
	With Preservation: Preservation of any of these parcels will preserve water quality on site and downstream and potentially enhance it because regular timber harvesting would cease. Water levels and flows would be appropriate for this area and similar to the existing condition. Wetland functions would be fully supported. ICT noted that the surrounding area is in an active forestry management area. The area is pretty natural. It is tidal. Tidal exchanges are more significant than upland draining.	
.500(6)(c) Community structure 1. Vegetation and/or 2. Benthic Community	**Without Preservation:** The vegetation and benthic structure of the march habitat could be compromised with upland development. These areas are now populated by common emergent wetland vegetation. While the species mix will stay generally the same, the potential for exotics could increase and the increase in nutrient loading could affect the distribution of the plants. Audubon states that, "Currently one of the biggest threats is the limited ability to conduct and maintain prescribed burning for the management of Red-cockaded Woodpeckers (RCWs), chaffseed and other wildlife and plant communities." This threat is from commercial and residential development. Holland et al., (2004) found that at 20-30% impervious cover, living resources could be affected, including reduced shrimp abundances, fewer stress-senstive taxa, altered food webs, and shellfish bed closures. ICT noted that vegetation would likely stay the same but development would increase nutrient loading. Aquatic species would still be able to access it. Land based or avian species may use the marsh less. Minor shift in community makeup (structure). Benthic communites in the marsh would also likelty be impacted and altered.	w/o pres or current: 8 / with: 9
	With Preservation: Community structure including wetlands and uplands would be protected from development. Land management practices would be enforced by the USFS as the lands would be conveyed to Francis Marion National Forest. Plant species would be expected to be desirable for the area. Exotics could still be present but would be better managed in Forest Service ownership. Age and size distribution would be typical of system with no deviation from normal. Recruitment and regeneration would be normal and natural with a higher presence of woody debris. This area could be considered to currently have near optimum community structure and the community structure would remain unchanged with preservation.	

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.767	0.900

If preservation as mitigation,	
Preservation adjustment factor* =	0.9 *
Adjusted mitigation delta =	0.12

For impact assessment areas
FL=delta x acres=

Delta = [with - current]
0.133

If mitigation	
Time lag (t-factor) =	1.14
Risk factor =	1.00

For mitigation assessment areas	
RFG=delta/(t-factor x risk)=	0.105

**This factor is reduced from 1.0 based on its gain of ecological value since the parcel has a high likelihood of preservation because of its value.*

	Preservation adjustment factor	
1	extent to which mgt activities promote natural conditions	0.9
2	ecological and hydrological relationship between wetlands and uplands	1
3	scarcity	1
4	proximity to other preserved areas	0.9
5	extent and likelihood of impacts if not preserved	0.6
average		0.9

Mitigation Determination Formulas
(See Section 62-345.600(3), F.A.C.)

For each impact assessment area:
(FL) Functional Loss = Impact Delta X Impact acres

For each mitigation assessment area:
(RFG) Relative Functional Gain = Mitigation Delta (adjusted for preservation, if applicable/((t-factor)(risk))

(a) Mitigation Bank Credit Determination

The total potential credits for a mitigation bank is the sum of the credits for each assessment area where assessment area credits equal the RFG times the acres of the assessment area scored

Bank Assessment Area	RFG	X	Acres	=	Credits
example					
a.a.1	0.105263				
a.a.2					
total					

(b) Mitigation needed to offset impacts, when using a mitigation bank

The number of mitigation bank credits needed, when the bank or regional offsite mitigation area is assessed in accordance with this rule, is equal to the summation of the calculated functional loss for each impact assessment area.

Impact Assessment Area	FL	=	Credits needed
example			
a.a.1	-35.966		-35.966
a.a.2			
total			

(c) Mitigation needed to offset impacts, when not using a bank

To determine the acres of mitigation needed to offset impacts when not using a bank or a regional offsite mitigation area as mitigation, divide functional loss (FL) by relative functional gain (RFG). If there are more than one impact assessment area or more than one mitigation assessment area, the total functional loss and the total relative functional gain is determined by summation of the functional loss (FL) and relative functional gain (RFG) for each assessment area.

	FL	/	RFG	=	Acres of Mitigation Needed
CooperMarsh	-35.96600		0.105	=	-342.53
Cooper Forested	-33.69867		0.117	=	-288.02
Ashley Marsh	-2.63200		0.105	=	-25.07
Ashley Forested	-1.16267		0.117	=	-9.94
				Sum	**-665.560114**

Form 62-345.900(3), F.A.C. [effective date]

Functional loss from the project vs. functional gain from the prefered mitigation parcel

	Wetland Type	FL	<	FG	
Impact	emergent marsh	-38.59800			
	forested wetlands	-34.86133			
Mitigation	tidal marsh			2.016	FG = (RFG * acreage)
	forested wetlands			63.08406	
	Mayrants reserve			22.26021	
Summation		**-73.4593**		**87.36027**	

FG = (RFG * acreage)

ATTACHMENT 2

PROPOSED MONITORING ELEMENTS

AND REPORTING SCHEDULE

PROPOSED MONITORING ELEMENTS AND REPORTING SCHEDULE

Relevant Resource	Project Phase	Area	Zone	Method	Parameters	Reporting deadline to USACE CO	Reporting deadline to ICT
Hardbottom	Preconstruction	Impact	Direct	Acoustic	Hardbottom substrates	90 days following survey	120 days following survey
Hardbottom	Preconstruction	Impact	Direct	Camera tows, ROV, diver	Benthic diversity, abundance, coverage, fishes	90 days following sampling	120 days following sampling
Hardbottom	Preconstruction	Impact	Direct	Grab sampler	Hardbottom substrates	90 days following sampling	120 days following sampling
Hardbottom	Preconstruction	Mitigation	Outside Navigation Channel	Acoustic	Hardbottom substrates	90 days following survey	120 days following survey
Hardbottom	Preconstruction	Mitigation	Outside Navigation Channel	Camera tows, ROV, diver	Benthic diversity, abundance, coverage, fishes	90 days following sampling	120 days following sampling
Hardbottom	Construction	Impact	Direct	Dredge GPS	Bathymetry	Weekly	As needed
Hardbottom	Construction	Impact	ODMDS	DQM	Dredged material	Weekly	As needed
Hardbottom	Construction	Mitigation	N/A	Acoustic	Bathymetry	2x; 60 days following each survey	2x; 90 days following each survey
Hardbottom	Post-construction 1	Mitigation	N/A	Acoustic	Bathymetry (and perhaps video/diver) Relief, interstitial sand, rugosity	60 days following survey	90 days following survey
Hardbottom	Post-construction 2 (if necessary)	Mitigation	N/A	Acoustic	Bathymetry (and perhaps video/diver) Relief, interstitial sand, rugosity	60 days following survey	90 days following survey
Hardbottom	Post-construction (annual, four consecutive years)	Mitigation	N/A	Camera tows, ROV, diver	Benthic diversity, abundance, coverage, fishes	90 days following survey	120 days following survey
Hardbottom	Post-construction 3 (if necessary)	Mitigation	N/A	Acoustic	Bathymetry (and perhaps video/diver)	90 days following survey	120 days following survey
Hardbottom	Construction	Impact	Direct	Acoustic	Bathymetry	TBD	60 days following receipt by USACE

Hardbottom	Post-construction (Yrs 2 and 4)	Impact	Direct	Acoustic	Bathymetry	90 days following survey	120 days following survey
Hardbottom	Post-construction (Yrs 2 and 4)	Impact	Direct	Camera tows, ROV	Benthic diversity, abundance, coverage, fishes	90 days following survey	120 days following survey
Wetland	Preconstruction (2x = seasonal)	Impact	Indirect	Remote sensing/ ground truthing	Wetland coverage and dominant species	90 days following survey	120 days following survey
Wetland	Preconstruction (2x = seasonal)	Impact	Indirect	Transects/Soil samples	Pore-water salinity, plant identification, percent coverage	90 days following survey	120 days following survey
Wetland	Post-construction (Yrs 1, 3 & 5)	Impact	Indirect	Remote sensing/ ground truthing	Wetland coverage and dominant species	90 days following survey	120 days following survey
Wetland	Post-construction (Yrs 1, 3 & 5)	Impact	Indirect	Transects/Soil samples	Pore-water salinity, plant identification, percent coverage	90 days following survey	120 days following survey
Water quality	Preconstruction (1-yr, continuous)	Impact	Indirect	Fixed water sensors	Mid-depth, 15-min interval for velocity, temp, specific cond, water level, pH, and DO	90 days following completion	120 days completion
Water quality	Construction	Impact	Upland disposal discharge	Portable data sonde	Temp, DO, pH, conductivity/salinity, turbidity, TSS	Weekly	Quarterly
Water quality	Post-construction (annual, 5 yrs)	Impact	Indirect	Fixed water sensors	Mid-depth, 15-min interval for velocity, temp, specific cond, water level, pH, and DO	90 days following completion	120 days following completion
Shoreline changes	Pre-construction	Impact	Indirect	Acoustic	Bathymetry	Annual reports	30 days after receipt of report
Shoreline changes	Construction	Impact	Indirect	Acoustic	Topographic/shoreline changes (ship-based lidar)	Annual reports	30 days after receipt of report
Shoreline changes	Post-construction (annually for 5 years)	Impact	Indirect	Fixed sensors	Pressure transducer, Acoustic Doppler Velocimeter, Acoustic Doppler Current Profiler, or other technology to measure current dynamics. Automatic Information System to measure ship transits	Annual reports	30 days after receipt of report

TBD	Preconstruction	Benfl use material	N/A	TBD	TBD	TBD	TBD
TBD	Construction	Benfl use material	N/A	TBD	TBD	TBD	TBD
TBD	Post-construction	Benfl use material	N/A	TBD	TBD	TBD	TBD

ATTACHMENT 2

PROPOSED MONITORING ELEMENTS

AND REPORTING SCHEDULE

PROPOSED MONITORING ELEMENTS AND REPORTING SCHEDULE

Relevant Resource	Project Phase	Area	Zone	Method	Parameters	Reporting deadline to USACE CO	Reporting deadline to ICT
Hardbottom	Preconstruction	Impact	Direct	Acoustic	Hardbottom substrates	90 days following survey	120 days following survey
Hardbottom	Preconstruction	Impact	Direct	Camera tows, ROV, diver	Benthic diversity, abundance, coverage, fishes	90 days following sampling	120 days following sampling
Hardbottom	Preconstruction	Impact	Direct	Grab sampler	Hardbottom substrates	90 days following sampling	120 days following sampling
Hardbottom	Preconstruction	Mitigation	Outside Navigation Channel	Acoustic	Hardbottom substrates	90 days following survey	120 days following survey
Hardbottom	Preconstruction	Mitigation	Outside Navigation Channel	Camera tows, ROV, diver	Benthic diversity, abundance, coverage, fishes	90 days following sampling	120 days following sampling
Hardbottom	Construction	Impact	Direct	Dredge GPS	Bathymetry	Weekly	As needed
Hardbottom	Construction	Impact	ODMDS	DQM	Dredged material	Weekly	As needed
Hardbottom	Construction	Mitigation	N/A	Acoustic	Bathymetry	2x; 60 days following each survey	2x; 90 days following each survey
Hardbottom	Post-construction 1	Mitigation	N/A	Acoustic	Bathymetry (and perhaps video/diver) Relief, interstitial sand, rugosity	60 days following survey	90 days following survey
Hardbottom	Post-construction 2 (if necessary)	Mitigation	N/A	Acoustic	Bathymetry (and perhaps video/diver) Relief, interstitial sand, rugosity	60 days following survey	90 days following survey
Hardbottom	Post-construction (annual, four consecutive years)	Mitigation	N/A	Camera tows, ROV, diver	Benthic diversity, abundance, coverage, fishes	90 days following survey	120 days following survey
Hardbottom	Post-construction 3 (if necessary)	Mitigation	N/A	Acoustic	Bathymetry (and perhaps video/diver)	90 days following survey	120 days following survey
Hardbottom	Construction	Impact	Direct	Acoustic	Bathymetry	TBD	60 days following receipt by USACE

Hardbottom	Post-construction (Yrs 2 and 4)	Impact	Direct	Acoustic	Bathymetry	90 days following survey	120 days following survey
Hardbottom	Post-construction (Yrs 2 and 4)	Impact	Direct	Camera tows, ROV	Benthic diversity, abundance, coverage, fishes	90 days following survey	120 days following survey
Wetland	Preconstruction (2x = seasonal)	Impact	Indirect	Remote sensing/ ground truthing	Wetland coverage and dominant species	90 days following survey	120 days following survey
Wetland	Preconstruction (2x = seasonal)	Impact	Indirect	Transects/Soil samples	Pore-water salinity, plant identification, percent coverage	90 days following survey	120 days following survey
Wetland	Post-construction (Yrs 1, 3 & 5)	Impact	Indirect	Remote sensing/ ground truthing	Wetland coverage and dominant species	90 days following survey	120 days following survey
Wetland	Post-construction (Yrs 1, 3 & 5)	Impact	Indirect	Transects/Soil samples	Pore-water salinity, plant identification, percent coverage	90 days following survey	120 days following survey
Water quality	Preconstruction (1-yr, continuous)	Impact	Indirect	Fixed water sensors	Mid-depth, 15-min interval for velocity, temp, specific cond, water level, pH, and DO	90 days following completion	120 days completion
Water quality	Construction	Impact	Upland disposal discharge	Portable data sonde	Temp, DO, pH, conductivity/salinity, turbidity, TSS	Weekly	Quarterly
Water quality	Post-construction (annual, 5 yrs)	Impact	Indirect	Fixed water sensors	Mid-depth, 15-min interval for velocity, temp, specific cond, water level, pH, and DO	90 days following completion	120 days following completion
Shoreline changes	Pre-construction	Impact	Indirect	Acoustic	Bathymetry	Annual reports	30 days after receipt of report
Shoreline changes	Construction	Impact	Indirect	Acoustic	Topographic/shoreline changes (ship-based lidar)	Annual reports	30 days after receipt of report
Shoreline changes	Post-construction (annually for 5 years)	Impact	Indirect	Fixed sensors	Pressure transducer, Acoustic Doppler Velocimeter, Acoustic Doppler Current Profiler, or other technology to measure current dynamics. Automatic Information System to measure ship transits	Annual reports	30 days after receipt of report

TBD	Preconstruction	Benfl use material	N/A	TBD	TBD	TBD	TBD
TBD	Construction	Benfl use material	N/A	TBD	TBD	TBD	TBD
TBD	Post-construction	Benfl use material	N/A	TBD	TBD	TBD	TBD

ATTACHMENT 3

COOPERATIVE LAND USE AGREEMENT

CONSERVATION LAND USE AGREEMENT

BETWEEN

U.S. ARMY CORPS OF ENGINEERS, CHARLESTON DISTRICT
AND
THE U.S. DEPARTMENT OF AGRICULTURE,
U. S. FOREST SERVICE
FRANCIS MARION AND SUMTER NATIONAL FORESTS

ARTICLE I – PURPOSE AND AUTHORITY

This Conservation Land Use Agreement ("Agreement") is entered into by and between the U.S. Army Corps of Engineers, Charleston District ("Corps"), and the Department of Agriculture, U.S. Forest Service ("Forest Service"), for the purpose of establishing a mutual framework whereby compensatory mitigation requirements associated with Department of the Army (DA) permits may be used: (1) to restore or enhance aquatic resources located on suitable lands comprising the National Forest System; and/or (2) to contribute suitable lands to be incorporated within the National Forest System. The Forest Service and the Corps are collectively referred to as the "Parties".

The Corps is charged with carrying out the Department of the Army permitting authority under Section 404 of the Clean Water Act (CWA), 33 U.S.C. § 1344; Sections 9 and 10 of the Rivers & Harbors Act of 1899 (RHA), 33 U.S.C. §§ 401, 403; and the associated implementing regulations at 33 C.F.R. §§ 320-332. Under its permitting authority, the Corps may require of applicants for Department of the Army permits ("DA permits") what is known as "compensatory mitigation" to offset unavoidable adverse impacts to waters of the United States, including wetlands, that remain after all appropriate and practicable avoidance and minimization has been achieved. Compensatory mitigation projects include the restoration, enhancement, and/or in certain circumstances, the preservation of aquatic resources implemented through a permittee-responsible mitigation plan, or by a mitigation bank or an in-lieu fee program.

The Forest Service is charged with the administration of lands and interests in lands comprising the National Forest System, which is defined by law as follows:

> Congress declares that the National Forest System consists of units of federally owned forest, range, and related lands throughout the United States and its territories, united into a nationally significant system dedicated to the long-term benefit for present and future generations, and that it is the purpose of this section to include all such areas into one integral system. The "National Forest System" shall include all national forest lands reserved or withdrawn from the public domain of the United States, all national forest lands acquired through purchase, exchange, donation, or other means, the national grasslands and land utilization projects administered under title III of the Bankhead-Jones Farm Tenant Act, and other lands, waters, or interests therein which are administered

by the Forest Service or are designated for administration through the Forest Service as a part of the system. Notwithstanding the provisions of the Act of June 4, 1897, no land now or hereafter reserved or withdrawn from the public domain as national forests pursuant to the Act of March 3, 1891, or any act supplementary to and amendatory thereof, shall be returned to the public domain except by an act of Congress. 16 U.S.C. § 1609(a).

Components of the National Forest System are subject to various laws and regulations further defined herein. As a lead Federal agency in natural resource conservation, the Forest Service provides leadership in the protection, management, and use of the Nation's forest, rangeland, and aquatic ecosystems. Through implementation of land and resource management plans, the Forest Service ensures sustainable ecosystems by restoring and maintaining species diversity and ecological productivity that helps provide recreation, water, timber, minerals, fish, wildlife, wilderness and aesthetic values for current and future generations of people.

ARTICLE II – RESTORATION OR ENHANCEMENT OF AQUATIC RESOURCES ON EXISTING FOREST SERVICE PROPERTY / ACQUISITION OF PROPERTY BY THE FOREST SERVICE

At the discretion of the Corps, compensatory mitigation requirements associated with DA permits may be satisfied by cooperating third-parties, including but not limited to DA permit holders, by: (1) restoring or enhancing aquatic resources located on suitable lands comprising the National Forest System; and/or (2) contributing to the National Forest System by conveying to the Forest Service suitable lands within and adjacent to the boundaries of units of the National Forest System. Suitable land(s) serving as compensatory mitigation for DA permits are referred to herein as "Property" and/or "Properties".

A. ACQUISITION BY THE FOREST SERVICE

The Forest Service has an active land acquisition program for the purpose of acquiring lands and interests in lands within and adjacent to National Forest boundaries. Such lands are acquired by purchase, donation or exchange, using appropriated or donated funds when applicable. The purpose of acquisition is to acquire lands for national forest purposes, which will contribute to the scenic and natural values of the national forests, provide for public recreation, and will preserve and protect wildlife species and habitats. Properties may be donated, or sold in whole or part, to the Forest Service under existing Forest Service land acquisition authorities including: the Weeks Act of 1911 (16 U.S.C. § 515); the Wilderness Act of 1964 (16 U.S.C. § 1134); the Wild and Scenic Rivers Act (16 U.S.C. § 1277); the National Trails System Act (16 U.S.C. § 1246); and the Act of August 3, 1956 (7 U.S.C. § 428a).

The Parties agree that the Forest Service is an appropriate recipient of Properties acquired in whole or part as compensatory mitigation associated with the Corps' issuance of DA permits. The Parties also agree that the conveyance of such Properties to the Forest Service may be used to satisfy compensatory mitigation to offset unavoidable impacts to waters of the United States authorized through the Corps' issuance of DA permits pursuant to CWA

Section 404 and/or RHA Sections 9 or 10. The Parties further agree that in any land acquisition, the Forest Service will utilize its existing laws, regulations and policies regarding land valuation, acceptable title, survey and land descriptions, and closing and financing procedures. Nothing in this Agreement is intended to affect normal Forest Service acquisition policies and procedures.

B. RESTORATION OR ENHANCEMENT

The Parties agree that the Forest Service is an appropriate land manager/owner of Properties that are restored or enhanced as compensatory mitigation associated with the Corps' issuance of DA permits. The Parties agree that the restoration or enhancement of aquatic resources located on Properties comprising the National Forest System may be used to satisfy compensatory mitigation to offset unavoidable impacts to waters of the United States authorized through the Corps' issuance of DA permits pursuant to CWA Section 404 and/or RHA Sections 9 or 10.

ARTICLE III – PROPERTIES IDENTIFIED AS COMPENSATORY MITIGATION PROPERTY

The Parties agree that Properties acquired by the Forest Service and set aside as compensatory mitigation pursuant to DA permits shall be managed for the purposes of preserving streams, creeks, wetlands and their buffers to the extent consistent with all laws rules and regulations applicable to the administration and management of National Forest System lands. Further, that upon acquisition, Properties shall not be utilized again as mitigation for any future DA permit.

Similarly, the Parties agree that Properties associated with the restoration or enhancement of aquatic resources as compensatory mitigation pursuant to DA permits shall be managed for the purposes of preserving streams, creeks, wetlands and their buffers to the extent consistent with all laws rules and regulations applicable to the administration and management of National Forest System lands. Further, that upon acquisition, Properties shall not be utilized again as compensatory mitigation for any future DA permit.

ARTICLE IV – MANAGEMENT OF COMPENSATORY MITIGATION PROPERTIES BY THE FOREST SERVICE

For any Properties conveyed to the United States for administration and management by the Forest Service, the Forest Service agrees that:

(a) The Property will be administered and managed as "National Forest System lands" subject to all the laws, rules, and regulations applicable thereto including, but not limited to: the Weeks Act of 1911, the Multiple Use Sustained Yield Act of 1960, the National Forest Management Act of 1976, the Endangered Species Act, the Clean Water Act, and the National Environmental Policy Act.

(b) The Property will be administered and managed as an area of multiple use as

defined by the Multiple Use Sustained Yield Act of 1960 (16 U.S.C. §§ 528-531), and that Act defines watershed and wildlife and fisheries as among the several National Forest uses.

(c) The Property will be administered and managed in accordance with all applicable Executive Orders, including Executive Order 11988 pertaining to floodplain management, and Executive Order 11990 pertaining to protection of wetlands.

(d) The Property will be administered and managed pursuant to a National Forest Land and Resource Management Plan, which, among other things:

(1) provides for coordination of watersheds, wildlife and fish, 16 U.S.C. § 1604(e)(1);

(2) ensures consideration of watersheds, wildlife, and fish, 16 U.S.C. § 1604(g)(3)(A);

(3) ensures that timber harvests, if any, will not irreversibly damage soil, slopes, or other watershed conditions, 16 U.S.C. § 1604(g)(3)(E)(i);

(4) provides that streams, stream banks, shorelines, lakes, wetlands, and other bodies of water will be protected from detrimental changes in water temperatures, blockages of water courses, and deposits of sediment due to timber harvests, 16 U.+S.C. § 1604(g)(3)(E)(iii).

(e) Regarding access to Properties, because the Properties will have National Forest status upon acquisition by the Forest Service, it is understood that the Properties will be generally open to the public and available for inspection by the Corps, at reasonable times and upon notice. It is understood that Properties are always subject to Forest Service rules and regulations, including the right of the Forest Service to close the Properties to public access in emergency situations.

(f) If changes in statute, regulation, or agency needs or mission of the Forest Service result in an incompatible use on the Property, the Forest Service is responsible for providing alternative compensatory mitigation that is acceptable to the Corps for any loss in aquatic resource functions and services resulting from the incompatible use.

ARTICLE V – FUTURE DISPOSITION OF THE COMPENSATORY MITIGATION PROPERTY BY THE FOREST SERVICE

It is the expectation of the Forest Service that the Properties acquired, restored, or enhanced pursuant to this Agreement as compensatory mitigation for DA permits will be perpetually managed for National Forest purposes. Similarly, it is the expectation of the Forest

Service that compensatory mitigation involving the restoration or enhancement of aquatic resources located on Properties comprising the National Forest System will result in such restored or enhanced Properties being perpetually managed for National Forest purposes.

As of the effective date of this Agreement, the Forest Service has no general sale authority, and a very limited authority to sell less than 10 acres under the Small Tracts Act solely to resolve encroachments under color of title (16 U.S.C. §§ 521c-521i). Another authority to dispose of the Properties would be by exchange. For exchanges, the Forest Service would have to determine that the land is suitable for transfer out of federal ownership (43 U.S.C. § 1716(b)), and that lands acquired in exchange would become part of the National Forest System. It is the intent of the Forest Service that the value of any land conveyed by exchange would be offset by lands acquired.

In the unlikely event that the Forest Service sells, conveys, disposes of, transfers, and/or exchanges a Property, the Forest Service will use its best efforts to ensure that such Property is protected by Corps-approved deed restrictive covenants or conservation easements that are consistent with this Agreement. The Forest Service agrees to provide 60-day advance notification to the Corps before any action is taken to sell, convey, dispose of, transfer, and/or exchange a Property. To the extent the Forest Service is unable to execute Corps-approved deed restrictive covenants or conservation easements prior to the incompatible use (*e.g.*, sale, conveyance, disposal, transfer, and/or exchange of a Property), the Forest Service agrees to provide and/or arrange for alternative compensatory mitigation, for any loss in aquatic resource functions and services resulting from the incompatible use, that is acceptable to the Corps prior to taking such action. In addition, the Forest Service must consider the preservation of aquatic resources on the lands or substitution of such resources consistent with Executive Orders 11988 and 11990. These objectives may be accomplished by reservation of a conservation easement, the imposition of restrictive covenants, or acquiring like resources to offset any loss of aquatic resources on the Property.

ARTICLE VI – GENERAL PROVISIONS

This Agreement is an interagency agreement that may be amended, terminated or revoked by mutual agreement of the Parties. Where such aforementioned action is initiated and/or proposed by the Forest Service, a 60-day advance notification shall be provided to Corps.

Any disagreement over the interpretation or implementation of this Agreement shall be discussed between the Forest Supervisor, Francis Marion and Sumter National Forests and the Commander, U.S. Army Engineer District, Charleston. If the disagreement remains unresolved, it may be elevated to the next higher-level line officer within the organizational structure of each of the Parties and may ultimately be referred to the Chief of the U.S. Army Corps of Engineers and the Chief of the Forest Service for resolution.

Nothing herein shall be construed to obligate the expenditure of funds not already appropriated.

Nothing herein shall be construed as conferring rights or causes of action on any third-party.

This Agreement may be executed in multiple counterpart originals, each of which shall constitute one and the same instrument, provided that each of the Parties hereto signs at least one of the counterpart originals.

This Agreement shall be effective on the date of the last signatory thereto.

U. S. ARMY CORPS OF ENGINEERS

Date 10 JUL 13

EDWARD P. CHAMBERLAYNE, P.E.
Lieutenant Colonel, EN
Commander, U.S. Army Engineer District, Charleston

DEPARTMENT OF AGRICULTURE
U.S. FOREST SERVICE

Date 7/10/2013

JOHN RICHARD LINT
Forest Supervisor
Francis Marion and Sumter National Forests