U.S. Army Corps of Engineers
Charleston District

APPENDIX P

CHARLESTON HARBOR POST 45

CHARLESTON, SOUTH CAROLINA

Mitigation, Monitoring, and Adaptive Management

03 October 2014

Contents

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 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. This appendix also 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.

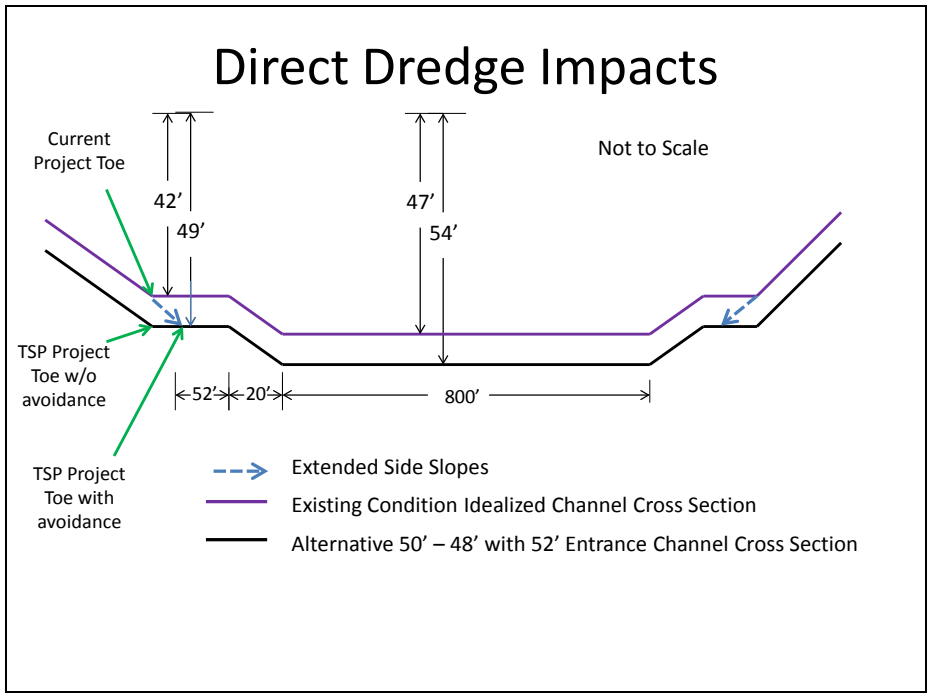

Figure 1. Proposed Side Slope Extension to Avoid Hardbottom Areas

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 Preliminary 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.

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 Crab Bank and Shutes Folly. 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 Wetland Impact Summary

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 EPA 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. Indirect impacts are expected to occur through a shift from fresh/brackish marsh to brackish/salt marsh as a function of salinity changes altering vegetative composition, soils, and habitat

function 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 at the time of construction. As identified in Appendix L, the wetland impacts at the time of construction are less than the impacts based on the future without project condition in 2071 (50 year project). However, time of construction was recommended by the ICT in order to determine compensatory mitigation, since the salinity stress on vegetation will start to be felt immediately.

Table 1. Incremental indirect wetland impacts for each alternative compared to the condition at the time of construction completion in 2022.

Alternatives: Impacts at Time of Construction (Year 2022)			
Wetland Impacts	**48/48**	**50/48**	**52/48**
Ashley River forested wetlands	3.35 acres	4.88 acres	6.13 acres
Ashley River marsh wetlands	8.05 acres	11.71 acres	14.73 acres
Cooper River forested wetlands	45.09 acres	76.59 acres	107.34 acres
Cooper River marsh wetlands	64.17 acres	108.99 acres	152.76 acres
Total	**120.66 acres**	**201.77 acres**	**280.96 acres**

2.2 Functional Loss Model Selection and Analysis

The challenge with determining appropriate mitigation for wetland impacts resulting from the Post 45 project is that the predicted salinity intrusion impacts 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]). 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. The

Charleston District coordinated various methods through the ICT and the USACE Vertical Team. 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 and the USACE Vertical Team. Ultimately, the Charleston District recommended the use of UMAM as the tool of choice, and the ICT and Vertical Team accepted this approach. After selecting UMAM (description provided in Section 2.3), a two-day UMAM training and field work exercise with ICT participation was conducted. 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.

2.3 Description of Uniform Mitigation Assessment Method (UMAM)

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.

2.4 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 – 63.76 units. For details on the UMAM scoring and to see the sheets used to develop these scores please see the UMAM sheets at the end of this document.

Table 2. 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	107.34	-28.62
Cooper River - Marsh	0.8	0.6	-0.2	152.76	-30.55
Ashley River - Forested	0.77	0.5	-0.27	6.13	-1.64
Ashley River - Marsh	0.77	0.57	-0.2	14.73	-2.95
TOTAL					**-63.76**

In order to assess the adequacy of mitigation options, the functional loss calculated using UMAM (-63.76 units) should be compared to the functional gain calculated following review of mitigation options and selection of a preferred mitigation option. Mitigation options evaluated and an analysis of functional gains for the selected option are provided in the following section

2.5 Mitigation Options for Indirect Wetland Impacts

Prior to using the 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 proposed impacts are not available. There is a lack of available areas for in-kind wetland restoration in the targeted system, which limits the opportunities for in-kind PRM. Within the developed greater Charleston area, a large amount of the original wetland system has been converted into residential, urban, and industrial development, mostly during pre-Clean Water Act years. 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:

2.5.1 Restoration Options

2.5.1.1 Ashley River Restoration Sites (NOAA identified)

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 over 100 NOAA identified sites for opportunities for freshwater wetland mitigation. After examining the data, three sites were identified in the Ashley River watershed that could be explored as potential restoration sites. The sites were identified by NOAA as Ashley River 1, Ashley River 2, and Ashley River 3 (Table 3). Real estate information was documented for each parcel (Table 3).

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 3. Ashley 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

2.5.1.2 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.

2.5.2 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.

2.5.3 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. Identifying the parcels specifically could complicate real estate transactions as the project progresses; therefore, all descriptions will be general in nature. All properties are strategically located within the Francis Marion NF proclamation boundary and within the Cooper River Basin (HUC 03050201) (Figure 2). 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 SPA 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

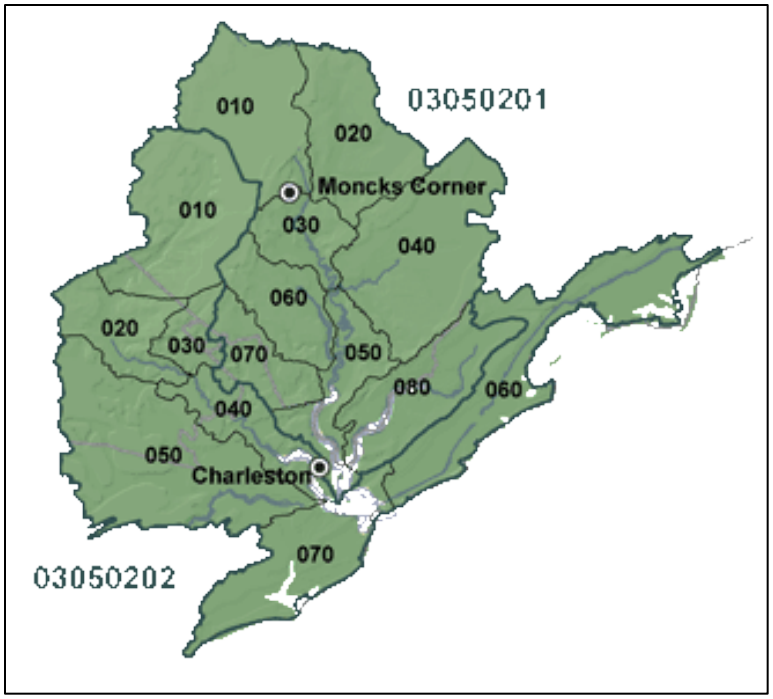

Figure 2. General location of preservation parcels for the conveyance to USFS within HUC 03050201 – Cooper River Basin

2.5.4 Cainhoy Plantation Protection

This property is in the heart of the Cooper/Wando watershed, and is a component of a controversial development project (Figure 3). 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.

Figure 3. Cainhoy Location Map

2.5.5 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 (Figure 4), that, if acquired, would potentially meet the project's mitigation needs. According to the National Wetlands Inventory 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.

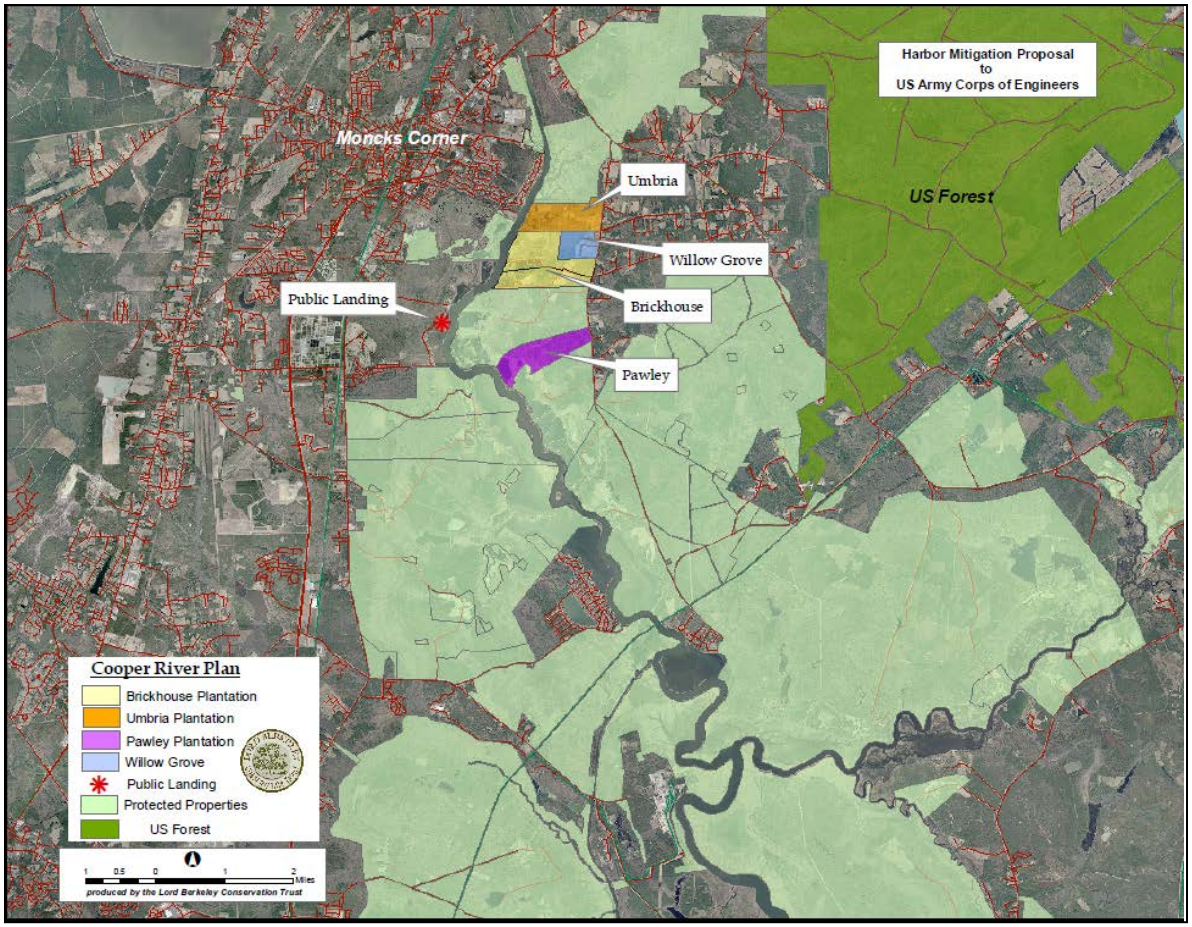

Figure 4. West Branch Cooper River Wetland Conservation Locations

2.6 Selected Alternative for Mitigation and UMAM Calculations

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 wetlands as a result of salinity intrusion, do not squarely fit with the Charleston District's regulatory guidelines for compensatory mitigation plans. Table 4 provides wetland mitigation measure outputs in acres and estimated costs.

Preservation of the USFS tracts 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 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. 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 4. Wetlands Mitigation Measures and Costs

Alternative Preservation / Restoration Measures	**Plan Outputs Acres**	**Plan Costs**	**$ Costs / Acre**	**Additional Cost for Restoration**
No Action Plan	0	$0	$0	$0
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	??	??	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 5).

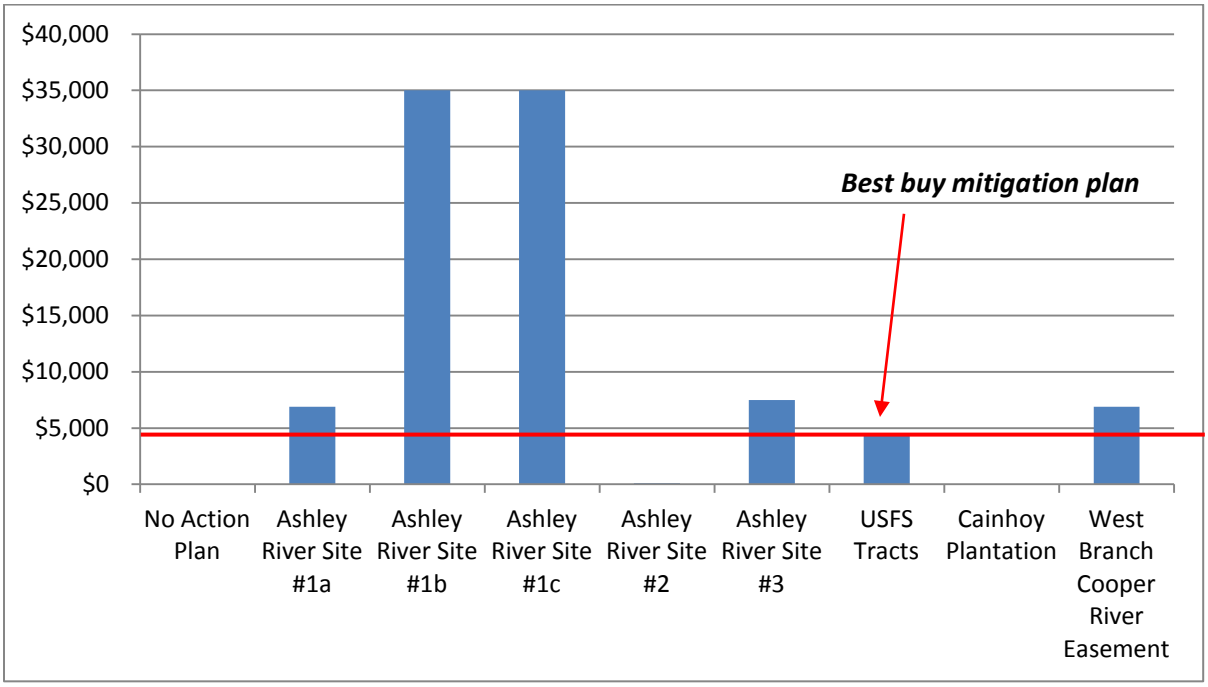

Figure 5. Cost per unit acre for mitigation alternatives

To apply UMAM calculations in determining compensatory mitigation for planning purposes, a representative parcel within the proclamation boundary for the Francis Marion National Forest was used as the mitigation site. Due to complexities in the real estate transactions and because of the uncertainty of property availability, the Charleston District will not disclose the parcel location used for this planning document. When authorization and funding becomes available USACE will assess available properties and re-run the UMAM analysis for the proposed parcel. Results will be coordinated again with resource agencies to ensure that assumptions in the UMAM are appropriate and meet the environmental commitments of the project. The example parcel is located within the same 8-digit HUC as the impacted wetlands (HUC 03050201). This HUC consists of 8 different 11-digit HUCS, and the example site is located in 03050201-080 (Wando River) (Figure 6). Additional parcels are located within 03050201-040 (Figure 7). National Wetlands Inventory data was used to determine the amount and type of wetlands within the parcel boundary (Table 5).

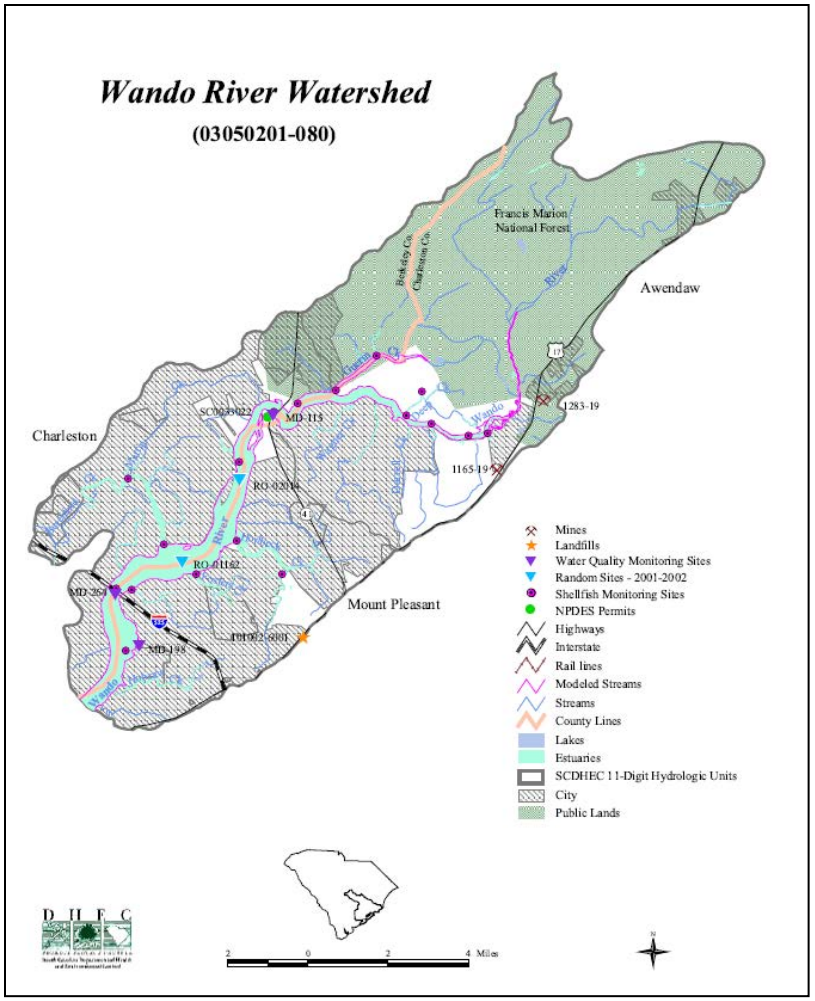

Figure 6. 11-digit HUC where example wetland preservation site used for the UMAM analysis is located.

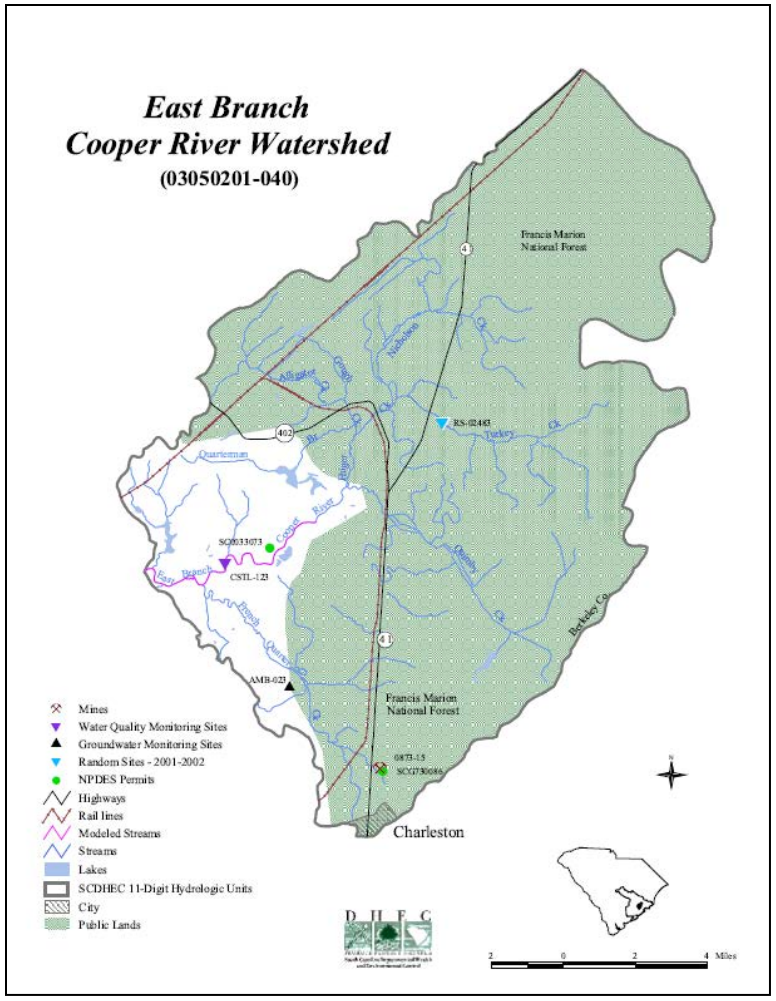

Figure 7. 11-digit HUC where additional properties could be purchased for wetland preservation and conveyed to USFS

Table 5. Acreage and type of wetlands on example property used in UMAM calculations

Wetland Type	Acreage determined from NWI data
Freshwater Emergent Wetlands	129 acres
Freshwater Forested Wetlands	487 acres
Freshwater Pond	4 acres

As it is refined, the final mitigation plan will continue to meet the requirements for civil works mitigation and of the 2008 Mitigation Rule.

2.7 UMAM Analysis for Mitigation Planning

The UMAM functional loss analysis presented above identified a total functional loss of 63.76 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). A summary of the UMAM scoring for the theoretical mitigation site is provided in Table 6.

Table 6. UMAM analysis for required mitigation acreage using hypothetical preservation site information.

UMAM Results for Required Mitigation using Hypothetical Preservation Site										
Wetland Type	**UMAM score for baseline condition**	**UMAM score for with project condition**	**Delta**	**Preservation Adjustment Factor**	**Adjusted Mitigation Delta**	**Time Lag Factor**	**Risk Factor**	**Relative Functional Gain**	**Functional Loss**	**Required Mitigation Acreage***
Emergent marsh	0.6	0.9	0.3	0.5	0.15	0.5	1	0.132	33.50	254.59
Forested wetlands	0.6	0.9	0.3	0.5	0.15	0.5	1	0.132	30.26	229.96
Total	0.6	0.9	0.3	0.5	0.15	0.5	1	0.132	63.76	484.55

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

Using these assumptions for the hypothetical mitigation site, 484.55 acres of the example wetlands would need to be preserved to offset the functional loss from the impacted wetland areas. This represents a ratio of roughly 1.72 : 1. Other alternatives resulted in UMAM ratios of 1.74 : 1, so that is

ultimately used in the cost estimating and is slightly more conservative. Because the availability of the theoretical parcel discussed above is not certain, the Charleston District applied a high contingency of 70% to estimate mitigation costs. Table 7 documents the process to calculate the mitigation acreage and costs. This cost estimating contingency considers the following factors: 1. USACE cannot guarantee the availability of any parcel prior to acquisition, 2. The parcel(s) available may not result in the same RFG as used in the UMAM results presented here, 3. The preservation adjustment factor may change[1], and 4. The quality of the wetlands on the parcel may vary. The estimated cost/acre was determined by real estate personnel within the USACE to be $4500/acre of wetland. As stated above, when funding becomes available, UMAM scoring will be performed on the selected parcel to ensure that the functional gain equals or exceeds the functional loss. The USACE will cost share the parcel acquisition with the local sponsor (SPA) based on the UMAM outcome. If the selected parcel contains more acreage than is required by UMAM, the non-federal sponsor will be responsible for 100% of the cost for the additional acreage.

In summary, the Charleston District is assuming that roughly 831 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 52'/48' alternative (proposed project/Locally Preferred Plan) (Table 7).

Table 7. Wetland impacts and mitigation needs for proposed project

Wetland Impacts	**52/48**
Ashley River forested wetlands	6.13 acres
Ashley River marsh wetlands	14.73 acres
Cooper River forested wetlands	107.34 acres
Cooper River marsh wetlands	152.76 acres
Total acres impacted	**281 acres**
UMAM Required Mitigation Acreage	**484.55**
UMAM Modeled Adjustment Factor	**1.74:1**
Contingency	**70%**
Total acres of mitigation required (total acres impacted X adjustment factor + contingency) and used in cost estimating	**831**

[1] Preservation adjustment factor could change due to lower/higher risk of development, in-kind/out-of-kind wetlands, relationship to wetlands in the watershed, potential for gain in ecological value. Current preservation factor is a 0.5 since the hypothetical parcel has a high likelihood of preservation by some entity due to its development risk and the ecological value of the property and it is slightly out-of-kind.

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 DEIS. 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 DEIS).

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 "L" shaped berm (i.e., artificial reef) along the south and west perimeter of the Offshore Dredged Material Disposal Area (ODMDS) (Figure 8). This area represents approximately 73 acres of the ODMDS. The dimensions would be roughly 15,000 ft x 16,000 ft x 600 ft wide x 10 ft high. The ideal reef design to mitigate for hardbottom impacts 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 9). 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.

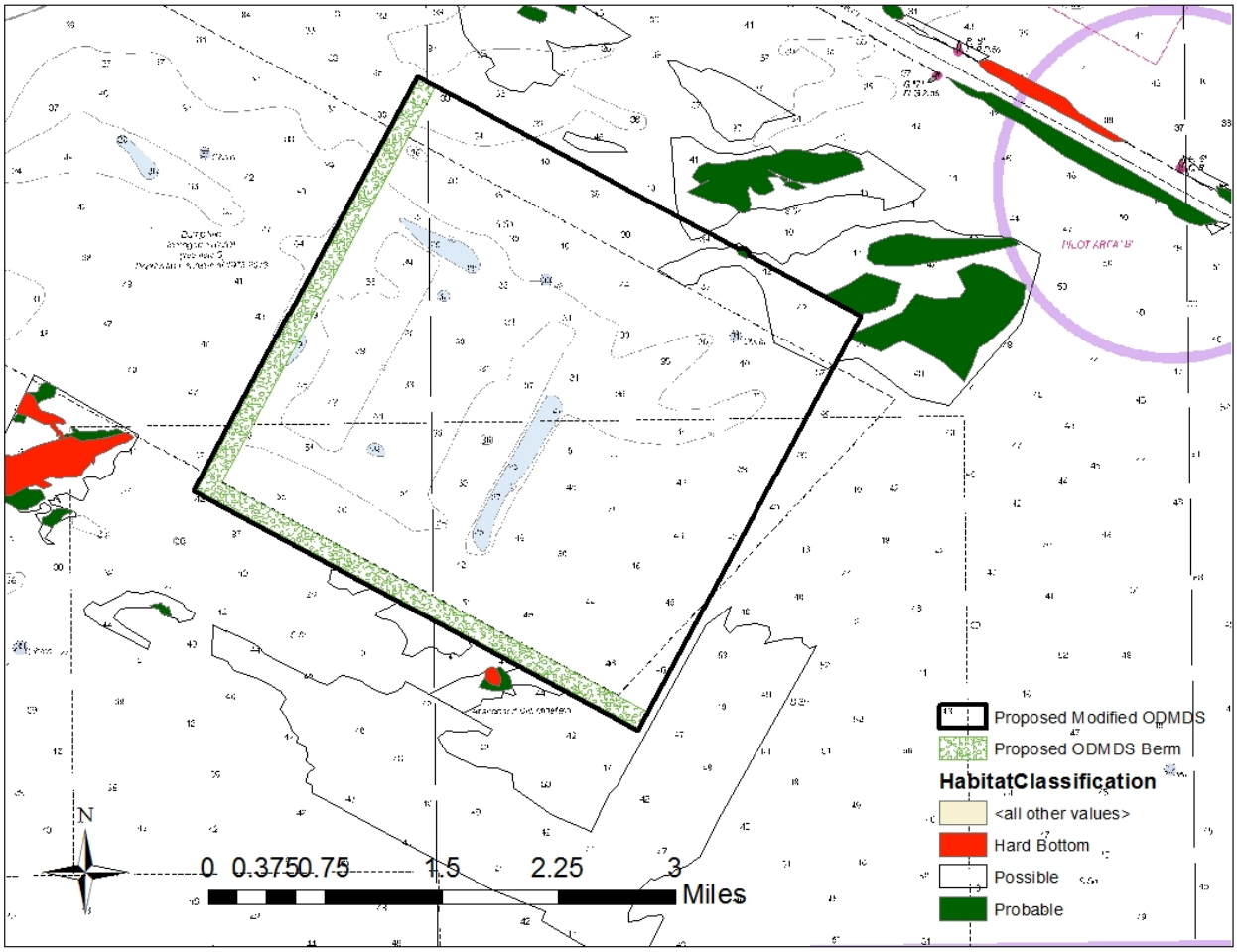

Figure 8. Proposed ODMDS and location of hardbottom habitat and the habitat berm

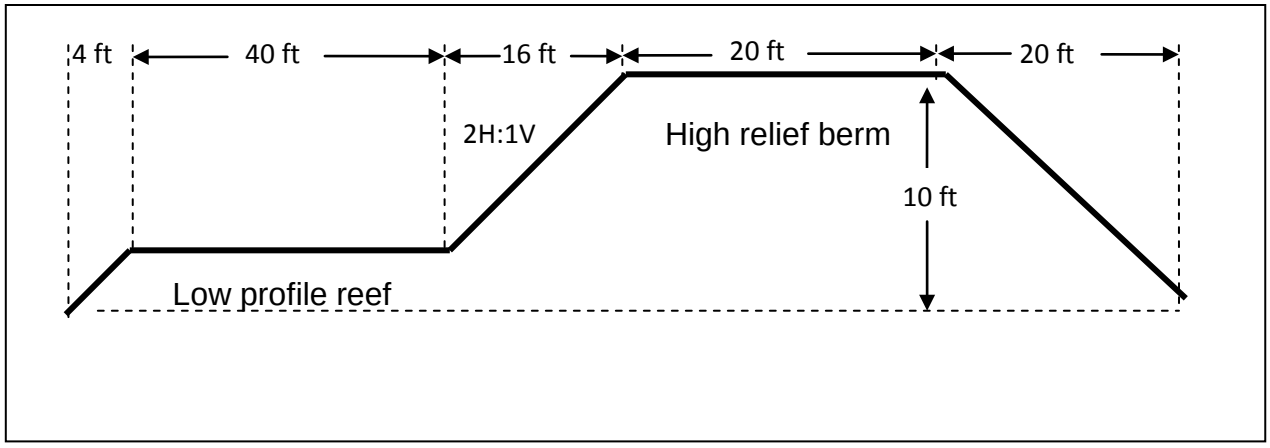

Figure 9. Preliminary Idealized Hardbottom Reef Design

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. While vertical relief is usually highly desirable, the harbottoms being impacted by the entrance channel dredging are not high relief reefs to begin with.

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 10 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, 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).

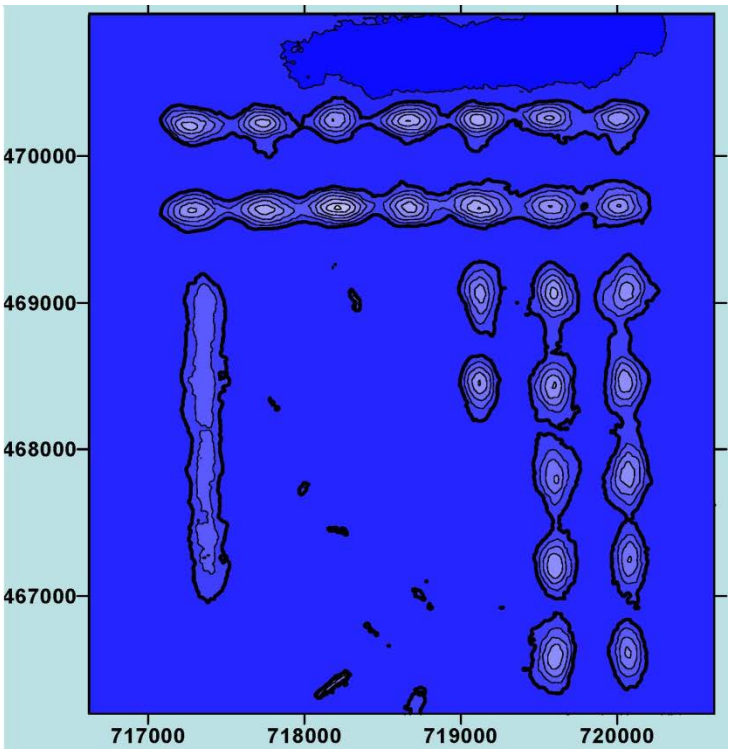

Figure 10. Bathymetry of Shark River Reef mounds, Constructed of rock dredged material.

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 11). 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.

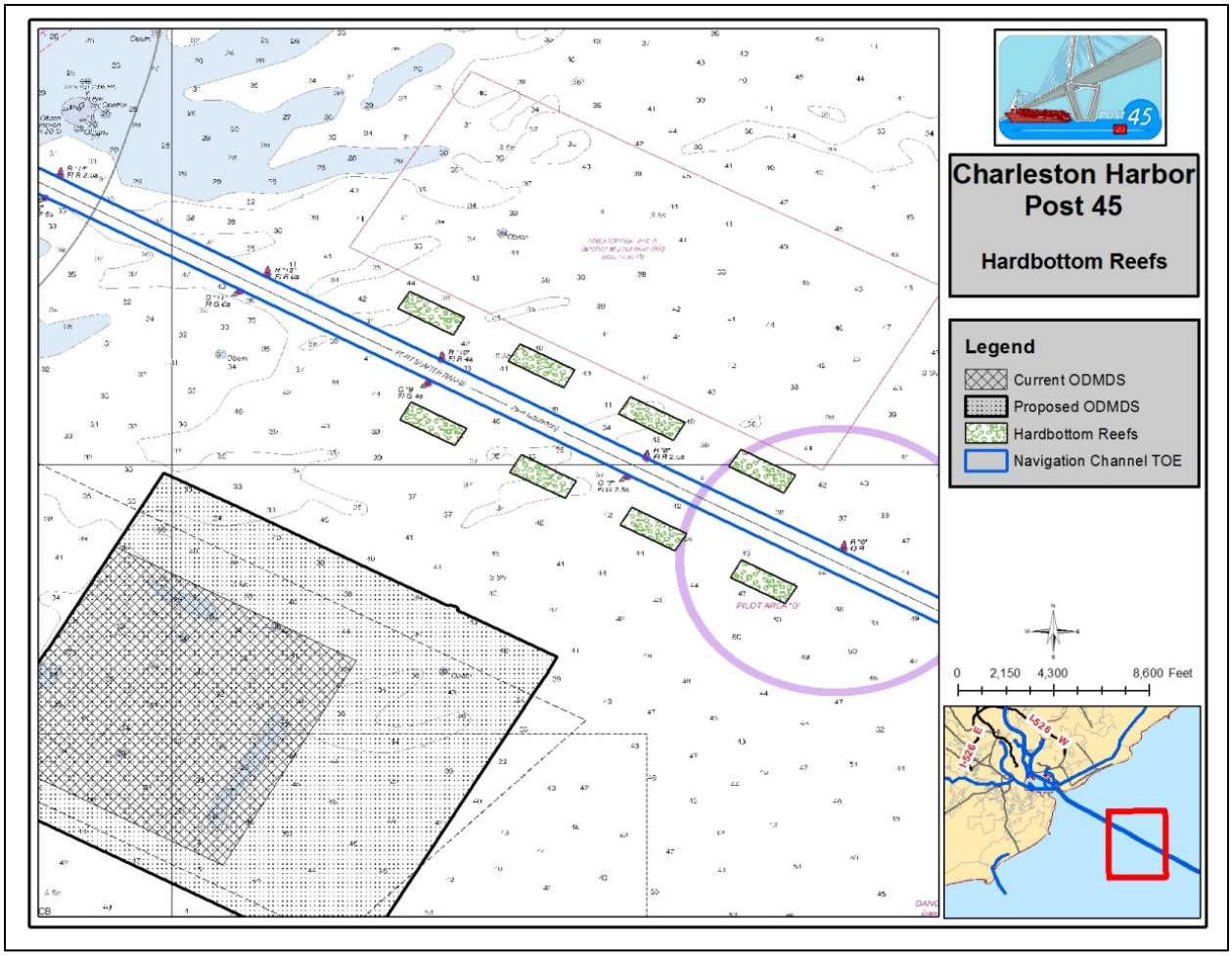

Figure 11. Location of hardbottom habitat reefs

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 12-14). 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 12-14, 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.

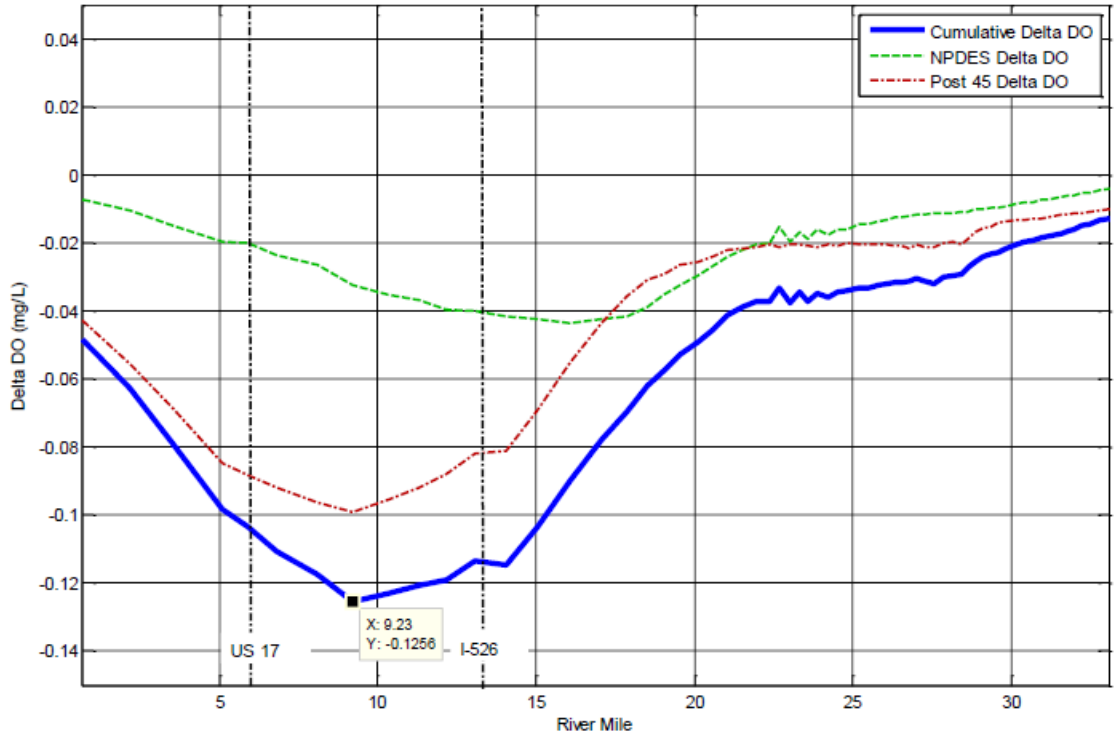

Figure 12. Longitudinal plot of 90th percentile delta DO along the Cooper River

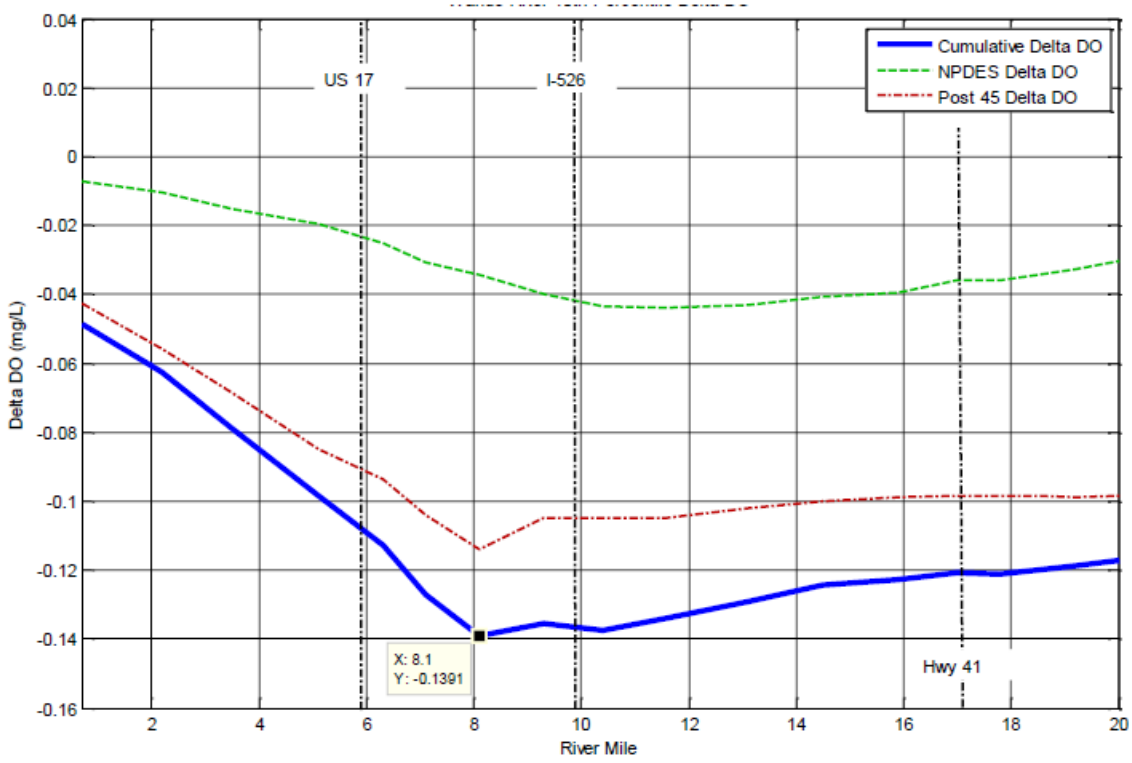

Figure 13. Longitudinal plot of 90th percentile delta DO along the Wando River

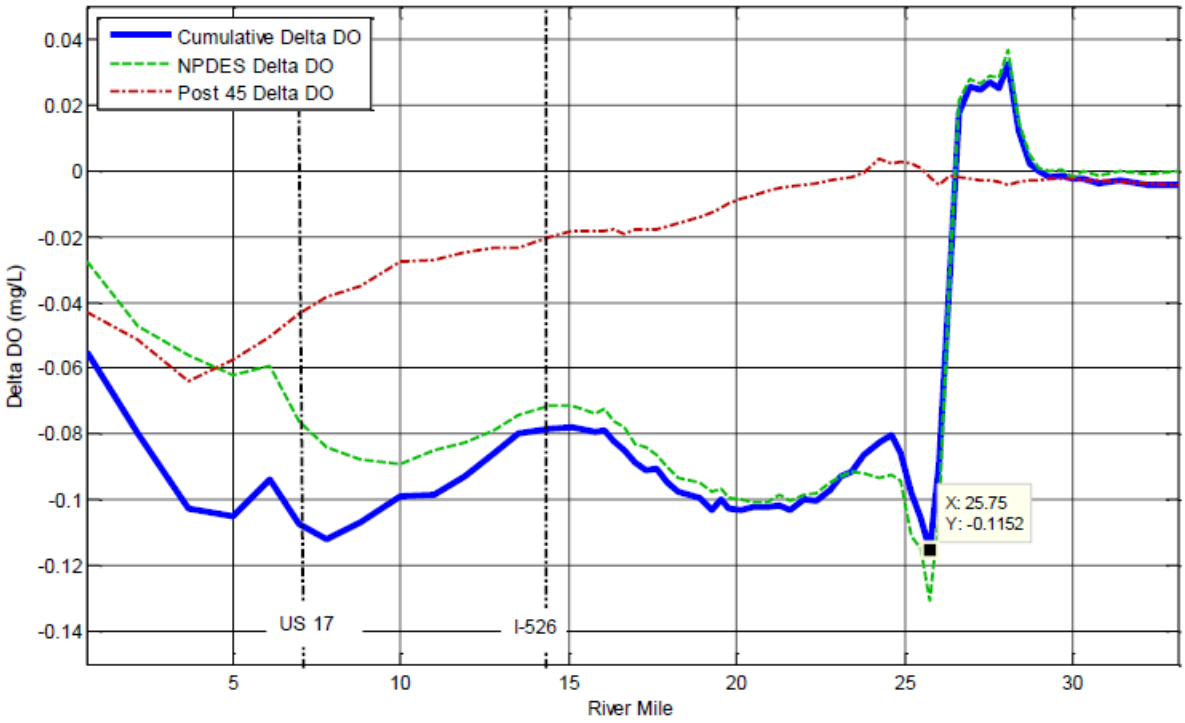

Figure 14. Longitudinal plot of 90th percentile delta DO along the Ashley River

4.1 Mitigation Options for DO Impacts (only if needed for Adaptive Management – see Section 5.3, below)

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. 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.

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.

4.1.3 Oyster Reef Creation

Oyster reefs are key marine habitats. Charleston District is exploring the option with ERDC DOTS help to 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. It's the same type of hosing that's used in gardens for irrigation. 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:

Models were used in the effects assessment to make predictions on how the proposed deepening may affect biological resources. As with any predictive model that uses actual and historical data to project future affects, there is a relative degree of uncertainty regarding the modeling process that poses risk that the recommended action could actually produce greater effects than were identified in the effects assessment. Uncertainty in this case is defined as a question faced during planning or implementation regarding the best assessment of potential project effects, which cannot be fully answered with these models. The uncertainty is derived from assumptions related to sea level rise and use of a limited data set for model development and no new dissolved oxygen data collection.

5.1 Hardbottom Habitat

5.1.1 Mitigation Monitoring Plan

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 success, and the estimated cost and duration of the monitoring. 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 the habitat at the mitigation area to be compared to the impact area.

5.1.1.1 Pre-Construction Impact Refinement

As discussed in the Hardbottom Impacts, Mitigation, and Habitat Equivalency Analysis Report (Appendix I of the FR/EIS), it is anticipated that 28.6 acres of hardbottom habitat could be impacted by the proposed project. Prior to project construction, hardbottom surveys will be performed in the anticipated impact area (shown in Appendix I). 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, 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 turbid water from disturbance. In some cases, it may be beneficial to ground truth the towed, remote surveys using scientific divers. Once the data quality is verified for accuracy, all video should be reviewed. Changes in bottom type should noted by time (position). Video should be coded by stopping video tape every 5 seconds and describing and coding the field of view similar to table 2.2 in the following report: http://myscmap.sc.gov/marine/mrri/environ/pdf/2006HardBottomReef.pdf. Data should be processed according to SCDNR and Coastal Carolina University specifications for hardbottom interpretation. After the areas of hardbottom are identified, 5 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 m transect line 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.

5.1.1.2 Pre-Construction Mitigation Site Refinement

As discussed in the Hardbottom Impacts, Mitigation, and HEA Report, it is anticipated that roughly 30 acres of habitat will be created to compensate for the in-channel impacts. Prior to project construction, hardbottom and cultural resource surveys will be performed between the ODMDS and the Navigation Channel to locate a 30 acre site that will not impact existing resources. The surveys will consist of detailed side scan sonar, sub-bottom profiling and multibeam data collection. 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 from disturbance. After data collection, all video should be reviewed. Changes in bottom type should noted by time (position). Video should be coded by stopping video tape every 5 seconds and describing and coding the field of view similar to table 2.2 in the following report: http://myscmap.sc.gov/marine/mrri/environ/pdf/2006HardBottomReef.pdf. Data should be processed according to SCDNR and Coastal Carolina University specifications for hardbottom interpretation. The least costly (based on construction methods/dredging and disposal costs) 30 acre location will be selected within this broader area 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 travel distance to the ODMDS.

5.1.1.3 Monitoring during Construction

A real-time placement monitoring/verification system (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 24/7 coverage of operations, improve project management and oversight, and create a standard base for avoiding disputes.

Bathymetric surveys will be completed twice during construction of the reef to ensure that each of the cells in the mitigation reef plan are obtaining a peak vertical relief of 4-5 feet. If the cells are not reaching the desired relief with one scow load, additional scows will be directed to those sites.

5.1.1.4 Post-Construction Monitoring

20% (~6 cells) of the mitigation reef cells will be analyzed similar to the methods described above in "Pre-Construction Impact Refinement". The cells will be chosen either randomly or strategically based on input from SCDNR and NMFS. Monitoring will occur within 6 months of completion of the reef and will continue once a year for 4 years in order to fully account for the anticipated 3.5 years to recovery. Monitoring should be completed, when possible, during the winter months to take advantage of better water column visibility. If the ecological success criteria are met prior to the completion of four years of monitoring, a meeting will be held with the resource agencies 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 corrective action / adaptive management needed.

5.1.1.5 Success Criteria

The goal 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 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 the abundance and diversity of sessile invertebrates at the impact site. The success of the mitigation reef will be determined by comparing these parameters to the impact site. 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 refine success criteria and to ensure the plan is considers all agency comments.

5.1.2 Adaptive Management

If success criteria are not met at the end of 4 years, USACE will meet with SCDNR and NMFS to determine corrective actions. Possible corrective actions include creating more artificial reef in coordination with SCDNR Artificial Reef Program or by possible mitigation reef enhancements based on best available science. Habitat Equivalency Analysis will be used to determine the amount of corrective action / adaptive management needed. It should be noted that any additional artificial reefs created as a result of the proposed project can, and should, be factored into the HEA to determine adaptive management needs.

5.2 Wetlands

5.2.1 Mitigation Monitoring Plan

Impacts to wetlands were based upon changes in the salinity regime of the harbor. Models were used in the effects assessment to make predictions on how the proposed deepening may affect biological resources. There is a relative degree of uncertainty regarding the modeling process that poses risk that the recommended action could produce greater or fewer effects than were identified in the effects assessment. There is also uncertainty regarding future changes to the environment caused by natural drivers, such as sea level rise, drought, and the bio-physical responses that will occur as a result of changes in the environment and this project. This monitoring and adaptive management plan addresses uncertainties, and complies with USACE Environmental Operating Principles which state that projects must mutually support economic and environmentally sustainable solutions, and that the USACE should hold itself accountable for activities which may impact human and natural environments. 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);

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. It is anticipated that as monitoring progresses and is examined by USACE and the resource agencies, additional regulatory and consultation requirements/monitoring may be needed. There are also opportunities for additional efficiencies to be gained by utilizing/coordinating with newly established monitoring efforts.

The preservation sites will not require monitoring, as they will be conveyed to the USFS for perpetuity.

5.2.2 Vegetation Monitoring

5.2.2.1 Pre-Construction Monitoring

Prior to construction, wetlands in the Cooper River will be characterized again using the same methodology as described in the Wetlands Characterization Report. Briefly, 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 Appendix L of the Main Report (Wetland Characterization), 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 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 characterize the percent extent of vegetation.

Bi-annual sampling would be conducted, and would occur during the beginning portion of the growing season (April-May) and again towards the end of the growing season (September-October). Sampling twice a year is expected to yield more complete data on species composition. Soil samples would be taken from each wetland 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. Stations (nested plots) would be established at each wetland, and all plants within the stations would be identified and tabulated during each bi-annual survey.

5.2.2.2 Post-Construction Monitoring

Approximately 2 and 4 years after the construction of the project, the same methods will be used to characterize the plant species again. Data will be compared to the characterizations pre construction. The percent change of freshwater dominant vegetation will be compared in the impact assessment reaches. Reports will be generated and coordinated with the resource agencies. If the results are significantly greater than the % change of vegetation predicted (20%), then additional mitigation sites will be identified to compensate for those unaccounted for impacts. The Uniform Mitigation Assessment Method will be used to determine the amount of adaptive management mitigation needed. If the changes are within the range of error then no additional analyses will be completed and monitoring will be deemed complete.

5.3 Water Quality (Salinity and DO) Monitoring

The model predicts that DO impacts due to the Post 45 project are *de minimus* as defined in R. 61-68. Additionally, salinity impacts on wetlands were predicted based on modeling results. This monitoring and adaptive management plan will be implemented to confirm that Post 45 project DO and salinity impacts actually realized after deepening the harbor are consistent with current model predictions.

The objective of the water quality monitoring effort for this study will be to determine if there is a significant difference between pre- and post-construction water quality data. If there is a significant increase beyond the model predicted changes, consultation with resource agencies will resume and additional model runs may be performed to determine adaptive management measures for DO and indirect wetland impacts from salinity changes. The following figure (Figure 15) outlines the conceptual framework for the water quality monitoring.

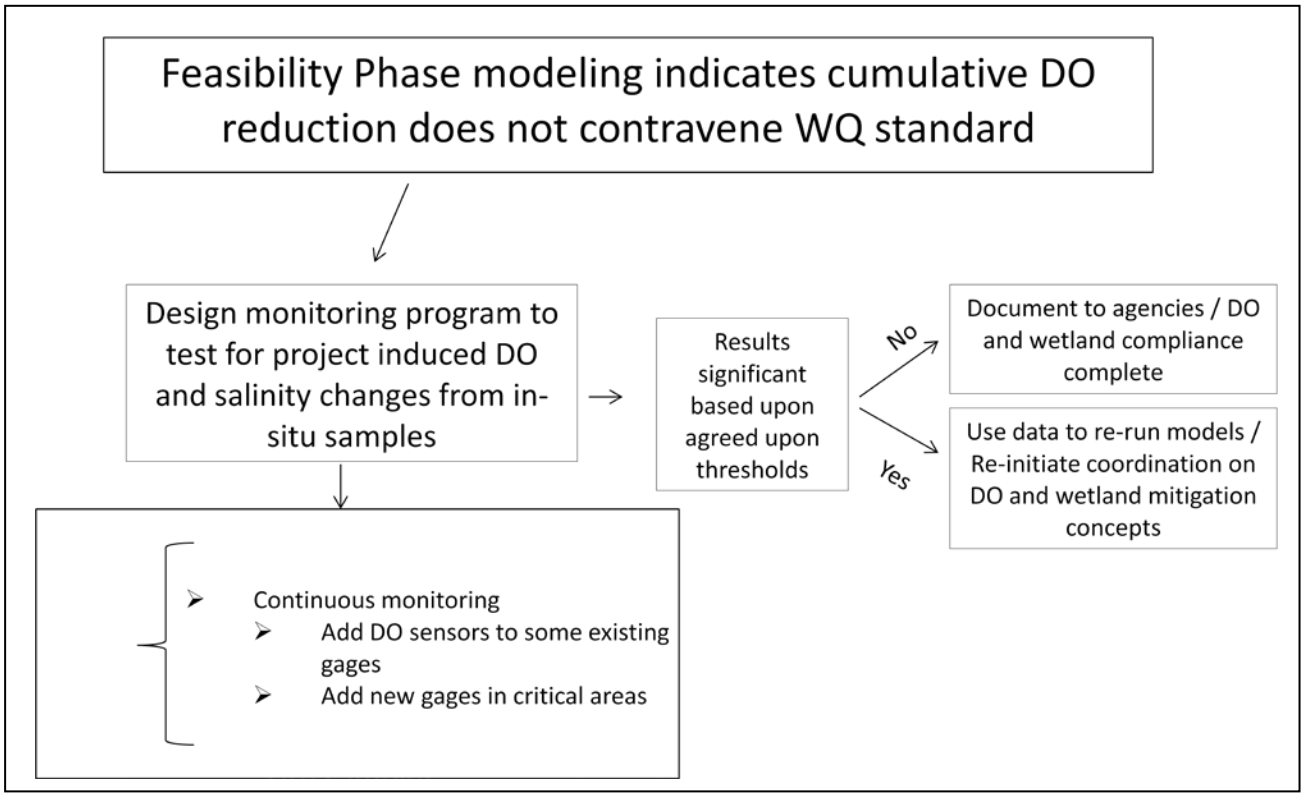

Figure 15. Conceptual framework for water quality (DO and salinity) monitoring

5.3.1 Pre-Construction Monitoring

Prior to construction a detailed monitoring protocol will be developed in conjunction with SCDHEC and other agencies in order to define spatially and temporally explicit protocol for evaluating water quality impacts resulting from the proposed project. The goals will be to provide baseline data to determine if there are significant differences between the pre- and post-construction conditions, and to also be used (if needed) to provide data to future iterations modeling iterations.

The USACE, US Geological Survey, BCDCOG and other cooperators currently operate a system of water quality data collection station within the Charleston Harbor system using 15-minute data collection at mid-depth (Figure 16). Data collected includes velocity, temperature, gage height, specific conductance, and dissolved oxygen. Information from these stations will be used to evaluate future salinity and DO levels in Charleston Harbor (Table 9).

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

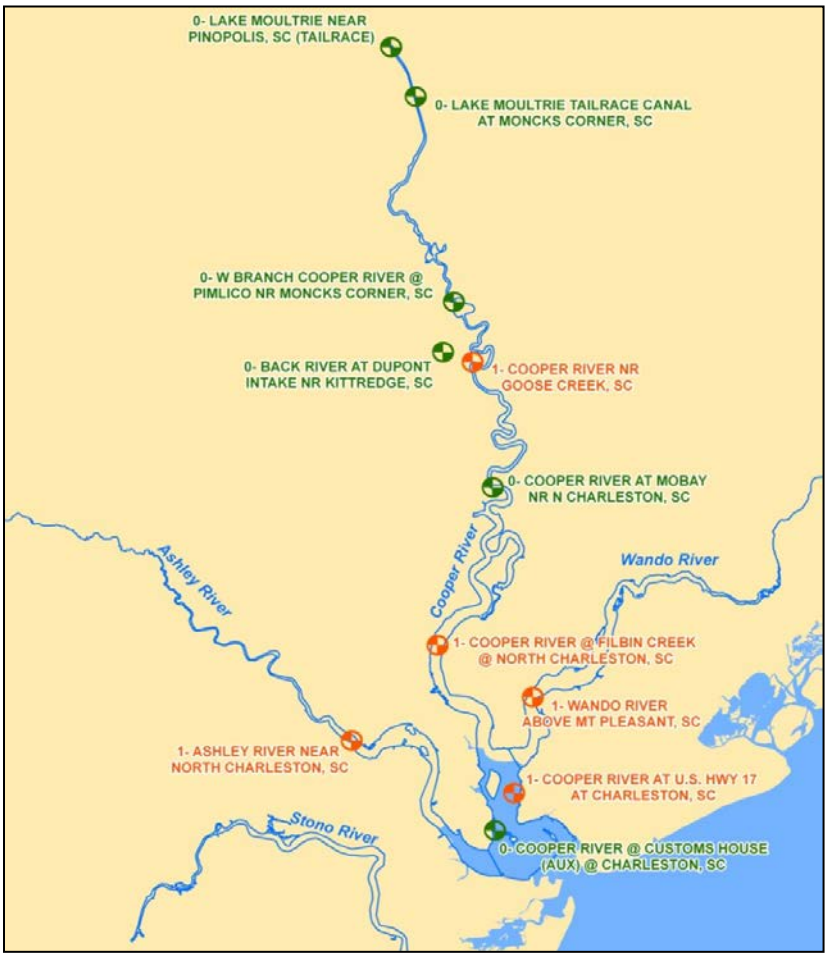

Figure 16. Continuous USGS monitoring gages in operation for 2012 (Orange indicates DO monitoring)

Additional gages will be established in the system. The new gages will be installed as soon as project funding is authorized, and they will be maintained through construction and for a period 5 years after dredging is complete. One gage will be strategically located between the Goose Creek and the Mobay gage in order to capture salinity in the area of an anticipated 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 (salinity can be derived from sp. Cond.), 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 17. The existing long-term DO gages plus the new gages in the critical areas for Post 45 DO impacts will give a complete dataset for evaluating Post 45 project DO impacts in the Charleston harbor estuary.

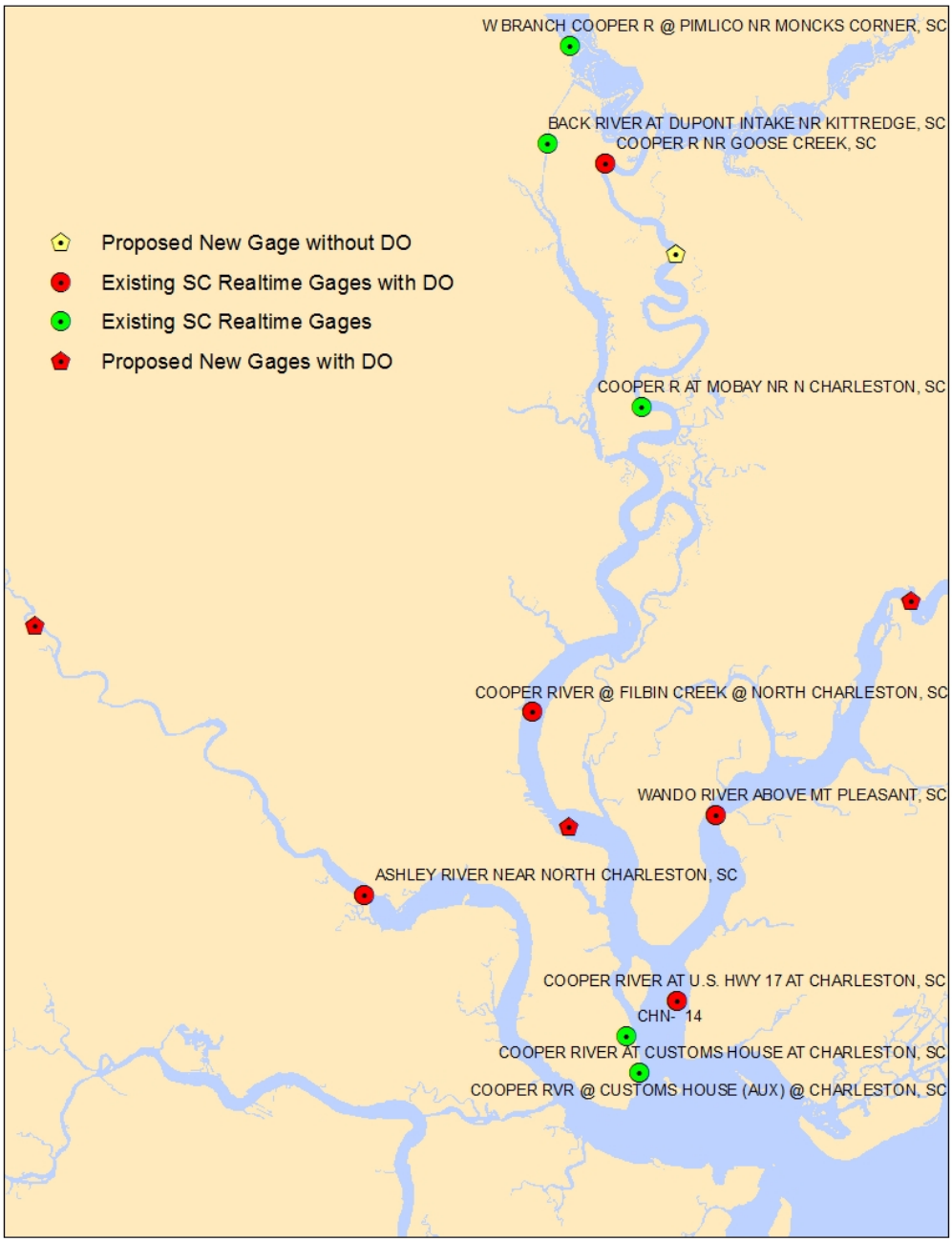

Figure 17. Location of all proposed gages (existing and new)

Continuous data collection of mid-depth and bottom salinity and DO at high and low tides will be collected for at least one year before construction, during construction, and after construction throughout the Charleston Harbor estuary, including the Ashley, Cooper and Wando Rivers.

5.3.3 Monitoring During Construction

Outfall Monitoring from Upland Disposal Areas:

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 (Compliance 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 1 hour after high tide and 1 hour before low tide. Monitoring reports will be provided to SCDHEC on a monthly basis.

5.3.2 Post-Construction Monitoring

Post-Construction monitoring will continue for 5 years after construction using the same methods described in the pre-construction monitoring section. USACE will provide a written report of the water quality data that the District collects during a given fiscal year. The reports will be provided to the resource agencies for review and comment.

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. USACE, in consultation with SCDHEC and SCDNR will develop a methodology to use the continuous data to test for a statistically significant

drop in DO 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.

Depending on the results of this evaluation, it may be necessary to do 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 additional mitigation options may be necessary.

5.4 Monitoring for 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. Monitoring could include annual bathy/topographic surveys, bird surveys, vegetation monitoring/recovery, etc.

5.5 Adaptive Management for Increased Wetland Impacts resulting from Salinity Intrusion

If the results of project monitoring indicate that the impacts anticipated during the planning phase of the project were under-predicted, adaptive management procedures will be implemented. Adaptive management will consist of determining new sources of mitigation (e.g., new preservation/restoration sites). The process will be coordinated with the environmental resource agencies to ensure compliance with environmental commitments of the project. It is anticipated that new mitigation would be determined through the use of the UMAM tool collaboratively with the agencies.

5.6 Adaptive Management for contravening the DO TMDL

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 SPA will convene a meeting with DHEC, EPA and other agencies to address adaptive management considerations. These measures could consist of any of the identified mitigation measures discussed above.

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ATTACHMENT 1

Post 45

Uniform Mitigation Assessment Method

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	Cooper River Tidal FW marshes

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
N/A	N/A	Impact	152.760

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e. OFW, AP, other local/state/federal designation of importance)
Cooper River (03050201-050)	SB areas are defined by SCDHEC as tidal saltwaters suitable for primary and secondary contact recreation, crabbing, and fishing, except harvesting of clams, mussels, or oysters for market purposes or human consumption or human consumption. Also suitable for the survival and propagation of a balanced indigenous aquatic community of marine fauna and flora (SCDHEC Classification).	N/A

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

The estimated impacted area of tidal freshwater wetlands are located along the Cooper River south of the junction of the east and west branches of the Cooper River. These wetlands are predominantly impacted by tidal fluctuations. Freshwater releases from the Pinopolis dam upstream of these wetlands also affects the hydrology of the area. Upland runoff can also impact these areas. The watershed is predominantly undeveloped; however, the presence of large industrial complexes are noted within the watershed. There are sizeable parcels of protected lands upstream and adjacent to these wetlands.

Assessment area description

Typically tidal freshwater wetlands/marshes have more plant diversity than their brackish or saltwater counterparts. In the Cooper River, tidal freshwater marsh species include white marsh/cutgrass (Zizaniopsis miliacea), wild rice (Zyzania aquatica), sawgrass (Cladium sp.) and bulrush (Scirpus sp.). Also present and often mixed in with these common freshwater plants are big cordgrass (Spartina cynosuiroides), black needlerush (Juncus roemarianus), and salt-marsh bulrush (Bolboshcoenus robustus). These wetlands frequently have an understory of green arrow arum (Peltandra virginica), water-primrose (Ludwigia sp.), water hyacinth (Eichhornia sp.), pickerel weed (Pontederia sp.), sensitive fern (Onoclea sensibilis), arrowhead/duck potato (Sagittaria sp.), water hemlock (Cicuta sp.), lizard's tail (Saururus cernuus), alligator weed (Alternanthera philoxeroides), obedient plant (Physostegia virginiana), spider lily (Lycoris radiata), smartweed (Polygonum sp.), beard grass (Andropogon sp.), false indigo (Amorpha sp.) and groundnut (Apios americana). Submerged aquatic vegetation primarily includes Hydrilla (Hydrilla verticillata), Brazilan elodea (Egeria densa), Pondweed (potamogeton sp.) and cabomba sp. While floating leaf vegetation primarily included species such as water-primrose (Ludwigia sp.), water hyacinth (Eichornia sp.), pickerel weed (Pontederia sp.) and smartweed (Polygonum sp.)

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
These wetlands are associated with the Cooper River. Industrial complexes at Bushy Park are close by. Cooper River has NDPES dischargers. Pinopolis Dam provides the majority of freshwater input to the river at a weekly average of 4500 cfs.	Tidal wetlands in South Carolina are not necessarily rare, but tidal freshwater marshes are studied extensively because they are noted to be most susceptible to sea level rise when compared to other wetland types, including salt marshes. Along the waterbody, there are numerous historic ricefield impoundments which DNR and DHEC noted as being particularly rare. NMFS staff indicated that tidal wetlands in regulatory SOP receive the highest score for rarity (maybe called "priority area").

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)
Typical species that use tidal wetlands including migratory birds, small mammals, amphibians, reptiles, fish and macroinvertebrates.	shortnose sturgeon (E), Atlantic sturgeon (E), manatee (E), feeding and possible roosting area for wood storks (E). Kirtland's warbler (E), pondberry (E).

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

On an April 17 site visit with members of USACE, USFWS, NMFS, EPA, DHEC, SCDNR the team noted the following species: bald eagles, ospreys, various fish species, double-crested cormorants, black and turkey vultures, gulls, and terns. While not observed, ICT members indicated that a variety of reptiles and amphibians utilize these areas.

Additional relevant factors:

It is important to note that SCDHEC classifies the affected portion of the river (the section in this evaluation) as SB (tidal saltwater). SCDHEC assigns this classification to, "That portion of the river below a point approximately 30 miles above the junction of Ashley and Cooper Rivers to the junction of Ashley and Cooper Rivers". This definition corresponds to the confluence of the east and west branches of the Cooper River. Above this point is classified as FW (freshwater). The history of water management in the Santee-Cooper system has resulted in large ecosystem changes. Historically the Cooper River was a tidal slough with predominantly tidal saltwater marshes along it's length. In the 1940's, water was diverted from the Santee River to the Cooper via a series of lakes. This dramatically increased freshwater flows and water elevations. In the 1980's, water was rediverted back to the Santee River, resulting in the current 4500cfs weekly averaged which is required to minimize shoaling and keep saltwater out of the Bushy Park reservoir.

Assessment conducted by:	Assessment date(s):
Mark Messersmith (USACE), Jesse Helton (USACE), Mark Caldwell (USFWS), Jaclyn Daly (NMFS), Kelly Laycock (EPA), Jaime Higgins (EPA), Steve Brooks (SCDHEC-OCRM), Priscilla Wendt (SCDNR)	4/17/2014

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
Charleston Harbor Post 45	N/A	Cooper River Tidal FW marshes
Impact or Mitigation	**Assessment conducted by:**	**Assessment date:**
Impact	ICT	17-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: 9 with: 7	**Without Project Condition:** Relatively undeveloped area, but does have some evidence of wildlife barriers due to large industrial complexes. The landscape supports almost a full range of habitats for wildlife species. There is evidence of invasive species present in the area, but not in large coverages. The area provides benefits to hydrologically connected areas and minimal impediments or flow restrictions exist. Much of the surrounding environment is protected, but the Bushy Park area is susceptible to future development. **With Project Condition:** Some aquatic species may experience a minor change in accessibility due to a minor salinity increase. The team determined that this would be a salinity barrier. NMFS indicated that tidal freshwater marshes are EFH for white shrimp and that this utilization could be affected by minor increases in salinity. The team determined that a drop of 1 or 2 points was acceptible.
.500(6)(b) Water Environment (n/a for uplands) w/o pres or current: 7 with: 5	**Without Project Condition:** Water flows are heavily regulated within the waterbody by the inflows from Pinopolis Dam. While they maintain a 4500cfs weekly average, freshwater inputs can range from 0 to greater than 4500 cfs. Existing water quality data indicate that the water body doesn't meet state standards. Because of this the dischargers in the waterbody are regulated by a TMDL to provide reasonable assurance that DO will not be compromised. **With Project Condition**: Water salinity may experience a slight increase, but not more than the natural interannual variability. There may also be a slight decrease in DO due to the salinity change. None of these changes are significant enough to warrant a drop greater than 1 to 2 points.
.500(6)(c) Community structure 1. Vegetation and/or 2. Benthic Community w/o pres or current: 8 with: 6	**Without Project Condition:** The freshwater assessment reach contains woody mix (41.27%), intertidal freshwater mix (28.08%), itertidal freshwater mix with salt-tolerant species present (27.78%), floating leaf vegetation (0.42%), submerged aquatics (0.88%), itertidal big cordgrass (0.43%), big cordgrass mix (0.38%), black needlerush dominant (0.50%), black needlerush mix (0.26%). Details on these categories can be found in the wetlands characterization report. **With Project Condition:** Vegetative commuinity will shift upstream. The team agreed to use the wetland characterization study to determine the percent that freshwater species might be replaced by salt tolerant species. The analysis determined that approximatley there was 20% (19.96%) less coverage of freshwater species in the brackish-freshwater transition assessment reach than the freswater assessment reach. Therefore, the with project score was dropped by 2 points (80% of 8 is 6.4).

Score = sum of above scores/30 (if uplands, divide by 20)	If preservation as mitigation,	For impact assessment areas
current or w/o pres: 0.800 with: 0.600	Preservation adjustment factor = Adjusted mitigation delta =	FL=delta x acres= -30.5520

Delta = [with - current]	If mitigation	For mitigation assessment areas
-0.200	Time lag (t-factor) = Risk factor =	RFG=delta/(t-factor x risk)=

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	Cooper River Palustrine Forested Wetlands

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
N/A	N/A	Impact	107.340

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e. OFW, AP, other local/state/federal designation of importance)
Cooper River (03050201-050)	SB areas are defined by SCDHEC as tidal saltwaters suitable for primary and secondary contact recreation, crabbing, and fishing, except harvesting of clams, mussels, or oysters for market purposes or human consumption or human consumption. Also suitable for the survival and propagation of a balanced indigenous aquatic community of marine fauna and flora (SCDHEC Classification).	N/A

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

The estimated impacted area of palustrine freshwater wetlands are located along the Cooper River south of the junction of the east and west branches of the Cooper River. These wetlands are predominantly influenced by tidal fluctuations, but some receive the majority of freshwater from rainfall. Freshwater releases from the Pinopolis dam upstream of these wetlands also affects the hydrology of the area. Upland runoff can also impact these areas. The watershed is predominantly undeveloped; however, the presence of large industrial complexes are noted within the watershed. There are sizeable parcels of protected lands upstream and adjacent to these wetlands.

Assessment area description

Also present along the freshwater portion of these river systems are bottomland hardwood forests. These areas are similar to palustrine freshwater forested wetlands and occur at the interface of tidal aquaitc and terrestrial ecosystems (James et al., 2012). James et al., (2012) indicate that tidal palustrine wetlands exist at the landward extent of the head of tide and above the saltwater-freshwater interface, which is defined as waters less than 0.5 ppt salinity. Field et al., (1991) conservatively estimated that there are 40,000 hectares of tidal freshwater wetlands in South Carolina. EPA defines these systems as river swamps. “They are found along rivers and streams of the southeast and south central United States, generally in broad floodplains. These ecosystems are commonly found wherever streams or rivers at least occasionally cause flooding beyond their channel confines. They are deciduous forested wetlands, made up of different species of Gum (Nyssa sp.) and Oak (Quercus sp.) and Bald Cypress (Taxodium distichum), which have the ability to survive in areas that are either seasonally flooded or covered with water much of the year. Identifying features of these wetland systems are the fluted or flaring trunks that develop in several species, and the presence of knees, or aerial roots.” (http://water.epa.gov/type/wetlands/bottomland.cfm). Also observed in the affected area were tupelo, red maple, eastern red cedar, Atlantic white cedar, wax myrtle, sweet bay, red bay, pine, magnolias, etc. These wetlands offer many ecosystem services including storm water runoff mitigation, storm surge protection, and structure and support for animal habitats (James et al., 2012).

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
These wetlands are associated with the Cooper River. Industrial complexes at Bushy Park are close by. Cooper River has NDPES dischargers. Pinopolis Dam provides the majority of freshwater input to the river at a weekly average of 4500 cfs.	Palustrine wetlands in South Carolina are not necessarily rare, but tidal freshwater forested wetlands are studied extensively because they are noted to be susceptible to salinity stress from sea level rise. Along the waterbody, there are numerous historic ricefield impoundments which DNR and DHEC noted as being particularly rare.

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)
Typical species that use tidal wetlands including migratory birds, small mammals, amphibians, reptiles, fish and macroinvertebrates.	feeding and possible roosting area for wood storks (E). kirkland's warbler (E), pondberry (E).

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

On an April 17 site visit with members of USACE, USFWS, NMFS, EPA, DHEC, SCDNR the team noted the following species: bald eagles, ospreys, various fish species, double-crested cormorants, black and turkey vultures, gulls, and terns. While not observed, ICT members indicated that a variety of reptiles and amphibians utilize these areas.

Additional relevant factors:

It is important to note that SCDHEC classifies the affected portion of the river (the section in this evaluation) as SB (tidal saltwater). SCDHEC assigns this classification to, "That portion of the river below a point approximately 30 miles above the junction of Ashley and Cooper Rivers to the junction of Ashley and Cooper Rivers". This definition corresponds to the confluence of the east and west branches of the Cooper River. Above this point is classified as FW (freshwater).

Assessment conducted by:	Assessment date(s):
Mark Messersmith (USACE), Jesse Helton (USACE), Mark Caldwell (USFWS), Jaclyn Daly (NMFS), Kelly Laycock (EPA), Jaime Higgins (EPA), Steve Brooks (SCDHEC-OCRM), Priscilla Wendt (SCDNR)	4/17/2014

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
Charleston Harbor Post 45	N/A	Cooper River Palustrine Forested Wetlands
Impact or Mitigation	**Assessment conducted by:**	**Assessment date:**
Impact	ICT	17-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: 9	with: 7
	Without Project Condition: Relatively undeveloped area, but does have some evidence of wildlife barriers due to large industrial complexes. The landscape supports almost a full range of habitats for wildlife species. There is evidence of invasive species present in the area, but not in large coverages. The area provides benefits to hydrologically connected areas and minial impediments or flow restrictions exist. Much of the surrounding environment is protected, but the Bushy Park area is susceptible to future development.	
	With Project Condition: The team determined that this would be a salinity barrier. NMFS indicated that tidal freshwater forested wetlands are EFH for white shrimp and that this utilization could be affected by minor increases in salinity. The team determined that a drop of 1 or 2 points was acceptible.	
.500(6)(b) Water Environment (n/a for uplands)	w/o pres or current: 7	with: 5
	Without Project Condition: Water flows are heavily regulated within the waterbody by the inflows from Pinopolis Dam. While they maintain a 4500cfs weekly average, freshwater inputs can range from 0 to greater than 4500 cfs. Existing water quality data indicate that the water body doesn't meet state standards. Because of this the dischargers in the waterbody are regulated by a TMDL to provide reasonable assurance that DO will not be compromised.	
	With Project Condition: Water salinity may experience a minor increase, but not more than the natural interannual variability. There may also be a slight decrease in DO due to the salinity change. None of these changes are significant enough to warrant a drop greater than 1 to 2 points.	
.500(6)(c) Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 8	with: 4
	Without Project Condition: Palustrine freshwater forested wetlands exist at the landward extent of the head of tide and above the saltwater-freshwater interface, which is defined as waters less than 0.5 ppt salinity. These wetlands include species such as Gum (Nyssa sp.) and Oak (Quercus sp.), Bald Cypress (Taxodium distichum), Tupelo, Red maple, Eastern red cedar, Atlantic white cedar, Wax myrtle, Sweet bay, Red bay, Pine, Magnolias, etc. To a lesser extent, these species are also found in the brackish-freshwater assessment reach. Many of the identified forested wetlands are actually schrub-scrub plants such as wax myrtles. The habitat is patchy across the assessment reach, with some areas represented only by single trees along the water's edge.	
	With Project Condition: Plants that are not adapted to tolerate higher salinities will generally succumb and be replaced by those with higher tolerances. Increases in salinity resulting from sea level rise or other factors has shown to cause vegetation stress, mortality, and retreat of tidal freshwater forested wetland communities which are then replaced by freshwater or brackish marsh vegetation. The project could reduce the likelihood of invasives by increasing salt content; however, Phragmites is salt tolerant and could be established. The team identified that the brackish-freshwater reach was an obvious transitional area with a mix of fresh and halophytic species. The impact of the project could slightly extend this transitional range.	

Score = sum of above scores/30 (if uplands, divide by 20)		
current or w/o pres: 0.800	with: 0.533	

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas	
FL=delta x acres=	-28.6240

Delta = [with - current]
-0.267

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

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

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	Ashley River Tidal FW marshes

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
N/A	N/A	Impact	14.730

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e. OFW, AP, other local/state/federal designation of importance)
Ashley River Watershed - 8-digit HUC (0305201)	The Ashley River is classified FW from its origin to Bacon Bridge and SA from Bacon Bridge to Church Creek, where it changes to SA* (DO not less than 4 mg/l) to the entrance of Orangegrove Creek. Downstream of Orangegrove Creek, the Ashley River returns to its classification of SA.SA are tidal saltwaters suitable for primary and secondary contact recreation, crabbing, and fishing, except harvesting of clams, mussels, or oysters for market purposes or human consumption and uses listed in Class SB. Also suitable for the survival and propagation of a balanced indigenous aquatic	The Ashley River was designated as a SC Scenic River in June 1998. The designation extends from Sland's Bridge (US Hwy 17-A) near Summerville to the Mark Clark expressway (I-526) bridge in Charleston.

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

The estimated impacted area of tidal freshwater wetlands are located along the Ashley River south of the Fort Dorchester. The Ashley River originates in the coastal plain and flows into the western part of Charleston Harbor, generally from northwest of Charleston (Dorchester County). Areas of the river are bordered by historic plantations, but a large portion of the lower Ashley River Basin is now occupied by residential or commercial development. The river comprises approximately 30 miles of tidal slough, which, under low-flow conditions, contributes little to no freshwater input to the harbor system. These wetlands are predominantly impacted by tidal fluctuations, as there are very low freshwater flows upstream. Most freshwater is derived from overland runoff and groundwater discharge. Expansive wetlands are adjacent to the Ashley River. The watershed is heavily developed by residential areas on the north side of the river and primarily rural on the south side along the area of potential impacts.

Assessment area description

The lower boundary of the assessment reach marks the beginning of a lengthy (~4.0 river miles) transition from brackish to freshwater marsh dominance along the Ashley River. This transition is characterized by the decline of black needlerush as the dominant interior marsh species and the establishment and proliferation of a diverse assemblage of freshwater species. Concurrently, the sharply-defined vegetation zones that characterize the lower marshes give way to a patchy mosaic of mixed brackish and freshwater vegetation. Marshes associated with the lower portion of sub-reach are characterized by three poorly defined vegetation zones: 1) a discontinuous series of smooth cordgrass clumps along the edge of the river channel; 2) a narrow big cordgrass zone with a consistent series of wild rice clumps and a diverse assemblage of other low percent cover freshwater species; and 3) a broad interior black needlerush zone with scattered big cordgrass and a diverse assemblage of low percent cover freshwater species. Marshes associated with the central portion of sub-reach are characterized by high variability in terms of both composition and structure. Generally, marshes adjoining the river channel are dominated by variable combinations of big cordgrass, narrow-leaved cattail, and black needlerush; with a diverse and variable assemblage of freshwater species. The interior marsh is generally dominated by black needlerush with large monospecific patches of narrow-leaved cattail (Typha angustifolia), low to moderate densities of big cordgrass, and a diverse assemblage of low percent cover freshwater species. Marshes along the upper portion of the sub-reach generally lack distinguishable vegetation zones. The marsh community is generally dominated by variable combinations of big cordgrass, narrow-leaved cattail, and black needlerush; with scattered patches of sawgrass and a diverse assemblage of freshwater species; including bull-tongue arrowhead (Sagittaria lancifolia), pickerelweed (Pontederia cordata), arrow-arum, wild rice, sawgrass (Cladium jamaicense), Olney's three-square (Schoenoplectus americanus), dotted smartweed, marsh mallow (Kosteletzkya pentacarpos), salt-marsh fleabane (Pluchea odorata), salt-marsh water-hemp (Amaranthus cannabinus), water primrose, bur-marigold, and salt-marsh aster.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
These wetlands are associated with the Ashley River. Much of the Ashley River has suburban development within it's watershed. Some areas along a 8-10 mile stretch of the south side of the River have historic plantations along the banks.	Tidal wetlands in South Carolina are not necessarily rare, but tidal freshwater marshes are studied extensively because they are noted to be most susceptible to sea level rise when compared to other wetland types, including salt marshes. NMFS staff indicated that tidal wetlands in regulatory SOP receive the highest score for rarity (maybe called "priority area").
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.	There have been numerous property protection measures, such as deed restrictions and easements (http://www.dnr.sc.gov/water/envaff/river/pdf/ashleyriverfactsheet.pdf).
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 species that use tidal wetlands including migratory birds, small mammals, amphibians, reptiles, fish and macroinvertebrates.	manatee (E), feeding and possible roosting area for wood storks (E). Kirtland's warbler (E), pondberry (E).

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

On 10 October 2013, a field survey was conducted by USACE and Dial Cordy and Associates, Inc. The survey covered a 15-mile reach of the Ashley River beginning at the Highway 526 Bridge and terminating just north of the Kings Grant boat landing. Survey methods included a combination of boat-based observations and pedestrian surveys along transects oriented perpendicular to the river channel. The team noted the following species: ospreys, brown pelicans, various fish species, white-tailed deer (swimming across the river), cormorants, turkey vultures, gulls, and terns.

Additional relevant factors:

It is important to note that SCDHEC classifies the affected portion of the river (the section in this evaluation) as SA (tidal saltwater). SCDHEC assigns this classification to, "That portion of the river from Bacon Bridge to Church Creek". Above Bacon Bridge is classified as FW (freshwater). DO is very low within this portion of the Ashley River. DHEC has determined that this is due to natural conditions. The project will not significantly alter DO within this portion of the river. These waters have a standard for DO of a daily average not less than 5.0mg/L with a low of 4.0mg/L.

Assessment conducted by:	Assessment date(s):
Mark Messersmith (USACE)	4/29/2014

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
Charleston Harbor Post 45	N/A	Cooper River Tidal FW marshes
Impact or Mitigation	**Assessment conducted by:**	**Assessment date:**
Impact	ICT	29-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: 8	with: 6

Without Project Condition: Mixed use of residential, historic properties and open space. The landscape supports almost a full range of habitats for wildlife species. There is evidence of invasive species present in the area, but not in large coverages. The area provides benefits to hydrologically connected areas and there are some impediments or flow restrictions as identified by a NMFS tidal connectivity project. Much of the surrounding environment is susceptible to future development. In fact SCDNR states that, "Historical growth trends in the Ashley River region show a 250% change in land use and a 40% increase in popula-tion during the time period of mid-1970s to the mid-1990s. These numbers provide something called a “sprawl ratio” of 6:1, and indicate that land use is far exceeding population growth. Researchers also forecast 800,000 new residents to the tri-county area in the next 30 years. If previous development patterns are continued, the area’s developed land will consume over 800 square miles by 2030 (http://www.dnr.sc.gov/water/envaff/river/pdf/ashleyriverfactsheet.pdf)."

With Project Condition: Some aquatic species may experience a minor change in accessibility due to a minor salinity increase, which would be a salinity barrier. NMFS indicated that tidal freshwater marshes are EFH for white shrimp and that this utilization could be affected by minor increases in salinity.

.500(6)(b) Water Environment (n/a for uplands)	w/o pres or current: 7	with: 5

Without Project Condition: The river comprises approximately 30 miles of tidal slough, which, under low-flow conditions, contributes little to no freshwater input to the harbor system. These wetlands are predominantly impacted by tidal fluctuations, as there are very low freshwater flows upstream. Most freshwater is derived from overland runoff and groundwater discharge. Expansive wetlands are adjacent to the Ashley River. The watershed is heavily developed by residential areas on the north side of the river and primarily rural on the south side along the area of potential impacts. Existing water quality data indicate that certain stretches of the water body don't meet state standards. Impairments are for such parameters as DO, turbidity, phosphorus, and fecal coliform bacteria. SCDHEC developed a TMDL to provide reasonable assurance that DO will not be compromised.

With Project Condition: Water salinity may experience a slight increase, but not more than the natural interannual variability. There may also be a slight decrease in DO due to the salinity change. However, because of the minimal nature of these impacts and the fact that the waterbody is impaired for reasons unrelated to the proposed project, these changes are not significant enough to warrant a drop greater than 2 points.

.500(6)(c) Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 8	with: 6

Without Project Condition: Large monospecific patches of sawgrass and narrow-leaved cattail are a prominent feature of the freshwater marsh. The intervening marsh areas are dominated by a variable assemblage of sawgrass, narrow-leaved cattail, big cordgrass, and a diverse array of freshwater species

With Project Condition: Vegetative commuinity will shift upstream. While detailed information on the vegetative shift in the Ashley River is unavailable, detailed data on the percent that freshwater species might be replaced by salt tolerant species was available for the Cooper River. It is reasonable to assume that similar changes could occur within the Ashley River. The analysis determined that approximatley there was 20% (19.96%) less coverage of freshwater species in the brackish-freshwater transition assessment reach than the freswater assessment reach. Therefore, the with project score was dropped by 2 points (80% of 8 is 6.4).

Score = sum of above scores/30 (if uplands, divide by 20)		
current or w/o pres: 0.767		with: 0.567

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas	
FL=delta x acres=	-2.9460

Delta = [with - current]
-0.200

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

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

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	Ashley River Palustrine Forested Wetlands

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
N/A	N/A	Impact	6.130

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e. OFW, AP, other local/state/federal designation of importance)
Ashley River Watershed - 8-digit HUC (0305201)	The Ashley River is classified FW from its origin to Bacon Bridge and SA from Bacon Bridge to Church Creek, where it changes to SA* (DO not less than 4 mg/l) to the entrance of Orangegrove Creek. Downstream of Orangegrove Creek, the Ashley River returns to its classification of SA.SA are tidal saltwaters suitable for primary and secondary contact recreation, crabbing, and fishing, except harvesting of clams, mussels, or oysters for market purposes or human consumption and uses listed in Class SB. Also suitable for the survival and propagation of a balanced indigenous aquatic	The Ashley River was designated as a SC Scenic River in June 1998. The designation extends from Sland's Bridge (US Hwy 17-A) near Summerville to the Mark Clark expressway (I-526) bridge in Charleston.

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

The estimated impacted area of palustrine freshwater wetlands are located along the Ashley River south of the Fort Dorchester. The Ashley River originates in the coastal plain and flows into the western part of Charleston Harbor, generally from northwest of Charleston (Dorchester County). Areas of the river are bordered by historic plantations, but a large portion of the lower Ashley River Basin is now occupied by residential or commercial development. The river comprises approximately 30 miles of tidal slough, which, under low-flow conditions, contributes little to no freshwater input to the harbor system. These wetlands are predominantly impacted by tidal fluctuations, as there are very low freshwater flows upstream. Most freshwater is derived from overland runoff and groundwater discharge. Expansive wetlands are adjacent to the Ashley River. The watershed is heavily developed by residential areas on the north side of the river and primarily rural on the south side along the area of potential impacts.

Assessment area description

Also present along the freshwater portion of these river systems are bottomland hardwood forests. These areas are similar to palustrine freshwater forested wetlands and occur at the interface of tidal aquaitc and terrestrial ecosystems (James et al., 2012). James et al., (2012) indicate that tidal palustrine wetlands exist at the landward extent of the head of tide and above the saltwater-freshwater interface, which is defined as waters less than 0.5 ppt salinity. Field et al., (1991) conservatively estimated that there are 40,000 hectares of tidal freshwater wetlands in South Carolina. EPA defines these systems as river swamps. “They are found along rivers and streams of the southeast and south central United States, generally in broad floodplains. These ecosystems are commonly found wherever streams or rivers at least occasionally cause flooding beyond their channel confines. They are deciduous forested wetlands, made up of different species of Gum (Nyssa sp.) and Oak (Quercus sp.) and Bald Cypress (Taxodium distichum), which have the ability to survive in areas that are either seasonally flooded or covered with water much of the year. Identifying features of these wetland systems are the fluted or flaring trunks that develop in several species, and the presence of knees, or aerial roots.” (http://water.epa.gov/type/wetlands/bottomland.cfm). Also observed in the affected area were tupelo, red maple, eastern red cedar, Atlantic white cedar, wax myrtle, sweet bay, red bay, pine, magnolias, etc. These wetlands offer many ecosystem services including storm water runoff mitigation, storm surge protection, and structure and support for animal habitats (James et al., 2012).

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
These wetlands are associated with the Ashley River. Much of the Ashley River has suburban development within it's watershed. Some areas along a 8-10 mile stretch of the south side of the River have historic plantations along the banks.	Palustrine wetlands in South Carolina are not necessarily rare, but tidal freshwater forested wetlands are studied extensively because they are noted to be susceptible to salinity stress from sea level rise. NMFS staff indicated that tidal wetlands in regulatory SOP receive the highest score for rarity (maybe called "priority area").
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.	There have been numerous property protection measures, such as deed restrictions and easements (http://www.dnr.sc.gov/water/envaff/river/pdf/ashleyriverfactsheet.pdf).
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 species that use tidal wetlands including migratory birds, small mammals, amphibians, reptiles, fish and macroinvertebrates.	feeding and possible roosting area for wood storks (E). kirkland's warbler (E), pondberry (E).

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

On 10 October 2013, a field survey was conducted by USACE and Dial Cordy and Associates, Inc. The survey covered a 15-mile reach of the Ashley River beginning at the Highway 526 Bridge and terminating just north of the Kings Grant boat landing. Survey methods included a combination of boat-based observations and pedestrian surveys along transects oriented perpendicular to the river channel. The team noted the following species: ospreys, brown pelicans, various fish species, white-tailed deer (swimming across the river), cormorants, turkey vultures, gulls, and terns.

Additional relevant factors:

It is important to note that SCDHEC classifies the affected portion of the river (the section in this evaluation) as SA (tidal saltwater). SCDHEC assigns this classification to, "That portion of the river from Bacon Bridge to Church Creek". Above Bacon Bridge is classified as FW (freshwater). DO is very low within this portion of the Ashley River. DHEC has determined that this is due to natural conditions. The project will not significantly alter DO within this portion of the river. These waters have a standard for DO of a daily average not less than 5.0mg/L with a low of 4.0mg/L.

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
Charleston Harbor Post 45	N/A	Ashley River Palustrine Forested Wetlands
Impact or Mitigation	**Assessment conducted by:**	**Assessment date:**
Impact	ICT	29-Apr-14

Scoring Guidance
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed

Optimal (10)	Moderate (7)	Minimal (4)	Not Present (0)
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

	w/o pres or current	with	
.500(6)(a) Location and Landscape Support	8	6	**Without Project Condition:** Relatively undeveloped area, but does have some evidence of wildlife barriers due to large industrial complexes. The landscape supports almost a full range of habitats for wildlife species. There is evidence of invasive species present in the area, but not in large coverages. The area provides benefits to hydrologically connected areas and minial impediments or flow restrictions exist. Much of the surrounding environment is susceptible to future development. In fact SCDNR states that, "Historical growth trends in the Ashley River region show a 250% change in land use and a 40% increase in popula-tion during the time period of mid-1970s to the mid-1990s. These **With Project Condition:** Some aquatic species may experience a minor change in accessibility due to a minor salinity increase, which would be a salinity barrier. NMFS indicated that tidal freshwater marshes are EFH for white shrimp and that this utilization could be affected by minor increases in salinity.
.500(6)(b) Water Environment (n/a for uplands)	w/o pres or current: 7	with: 5	**Without Project Condition:** The river comprises approximately 30 miles of tidal slough, which, under low-flow conditions, contributes little to no freshwater input to the harbor system. These wetlands are predominantly impacted by tidal fluctuations, as there are very low freshwater flows upstream. Most freshwater is derived from overland runoff and groundwater discharge. Expansive wetlands are adjacent to the Ashley River. The watershed is heavily developed by residential areas on the north side of the river and primarily rural on the south side along the area of potential impacts. Existing water quality data indicate that certain stretches of the water body don't meet state standards. Impairments are for such parameters as DO, turbidity, phosphorus, and fecal coliform bacteria. SCDHEC developed a TMDL to provide reasonable assurance that DO will not be compromised. **With Project Condition**: Water salinity may experience a slight increase, but not more than the natural interannual variability. There may also be a slight decrease in DO due to the salinity change. However, because of the minimal nature of these impacts and the fact that the waterbody is impaired for reasons unrelated to the proposed project, these changes are not significant enough to warrant a drop greater than 1 or 2 points.
.500(6)(c) Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 8	with: 4	**Without Project Condition:** Palustrine freshwater forested wetlands exist at the landward extent of the head of tide and above the saltwater-freshwater interface, which is defined as waters less than 0.5 ppt salinity. These wetlands include species such as Gum (Nyssa sp.) and Oak (Quercus sp.), Bald Cypress (Taxodium distichum), Tupelo, Red maple, Eastern red cedar, Atlantic white cedar, Wax myrtle, Sweet bay, Red bay, Pine, Magnolias, etc. A number of severly stunted black gums (Nyssa biflora) are widely scattered throughout the marsh interior. **With Project Condition:** Plants that are not adapted to tolerate higher salinities will generally succumb and be replaced by those with higher tolerances. Increases in salinity resulting from sea level rise or other factors has shown to cause vegetation stress, mortality, and retreat of tidal Palustrine freshwater forested wetland communities which are then replaced by freshwater or brackish marsh vegetation. The project will likely reduce the likelihood of invasives by increasing salt content. Since forest conversion to emergent marsh habitat is possible, the impacts to Palustrine freshwater forested wetlands are greater than those to marshes and this factor is applied to the with project score.

Score = sum of above scores/30 (if uplands, divide by 20)	current or w/o pres	with
	0.767	0.500

Delta = [with - current]
-0.267

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

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

For impact assessment areas	
FL=delta x acres=	-1.6347

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

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	USFS land acquisition

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
N/A	N/A	Mitigation	0.000 undisclosed

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.	Important Bird Area as designated by National Audubon Society. Nearby Cape Romain NWR is a Class I Air Quality Zone

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

Parcels are 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. The parcels are surrounded on multiple sides by conservation land, including privately protected properties and federally managed lands. The parcels have 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

The parcels have very complex mosaics of upland and wetland communities, with extensive northeast-southwest trending ecotones. Wetlands include both tidal and non-tidal palustrine examples. 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 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. 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 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 the parcels.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
Francis Marion Natural Forest, Cape Romain National Wildlife Refuge	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.

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).	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:

Some of the parcels are 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.

Assessment conducted by:	Assessment date(s):
Mark Messersmith (USACE), Jesse Helton (USACE), Patrick Moore (SCSPA)	4/30/2014

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	USFS acquisition parcels
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	Mark Messersmith, Jesse Helton, Patrick Moore	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: 6	with: 9	**Without Preservation:** The properties have consistently been managed for timber production, recreation, and historic ricefield 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 **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.
.500(6)(b) Water Environment (n/a for uplands)	w/o pres or current: 6	with: 9	**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. **With Preservation:** Preservation of any of these parcels will enhance water quality on site and downstream. 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:** The parcels 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 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. **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 normal and natural with higher presence of woody debris.

Score = sum of above scores/30 (if uplands, divide by 20)	current or w/o pres	with
	0.600	0.900

Delta = [with - current]
0.300

If preservation as mitigation,		*
Preservation adjustment factor* =	0.5	
Adjusted mitigation delta =	0.15	

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

For impact assessment areas
FL=delta x acres=

For mitigation assessment areas	
RFG=delta/(t-factor x risk)=	0.132

**This factor is reduced from 1.0 based on its gain of ecological value. Since the potential parcels have a high likelihood of preservation because of their value, and because the wetlands are partially out-of-kind since they're not entirely tidal. They are also in the 8-digit HUC but some parcels are in the Wando basin, not Cooper.*

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	0.131579				
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	-30.552		-30.552
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	-30.55200		0.132	=	-232.20
Cooper Forested	-28.62400		0.132	=	-217.54
Ashley Marsh	-2.94600		0.132	=	-22.39
Ashley Forested	-1.63467		0.132	=	-12.42
				Sum	**-484.550667**

Form 62-345.900(3), F.A.C. [effective date] ***TO BE COMPLETED DURING PED***

	Wetland Type	FL	<	FG (of one example parcel)	
Impact	emergent marsh	-33.49800			
	forested wetlands	-30.25867			
Mitigation	emergent marsh			0	FG = (RFG * acreage)
	forested wetlands			0	FG = (RFG * acreage)
Summation		**-63.7567**		**0**	