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TECHNICAL MEMORANDUM NO. 25112.01

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SUBJECT: Technical memorandum of biological assessment results from the Hilton Head Plantation and Palmetto Hall recycled water projects, 2025.

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EXECUTIVE SUMMARY

Nutter & Associates, Inc. (NAI) conducted biological assessments of three recycled water discharge wetlands for the Hilton Head Public Service District (HHPSD) in spring 2025. This biennial report evaluates the Whooping Crane Conservancy and Cypress Conservancy wetlands in Hilton Head Plantation, and the wooded wetland at Palmetto Hall Golf Course. (Figure 1).

The sustainable water reuse program has been in operation since 1986 when HHPSD began discharging advanced-treated, dechlorinated influent into the Whooping Crane Conservancy and Cypress Conservancy wetlands at Hilton Head Plantation. Wetlands at Palmetto Hall first began receiving recycled water inputs in 1996. Inputs of recycled water into the receiving wetlands were established with three main goals (1) to provide additional uptake and filtration of water and nutrients; (2) eliminate discharges to other waters, such as tidal streams; and (3) enhance the natural hydrology and ecological conditions of the receiving wetlands.

Initial baseline assessments of these recycled water discharge wetlands were conducted by Ballentine Environmental Resources, Inc. (Ballentine) in 1998. Nutter & Associates NAI have conducted assessments in the Spring of 2019, 2023, and 2025. The biological assessments conducted by NAI included qualitative vegetation and quantitative macroinvertebrate biological assessments. The current evaluations of the three wetlands were carried out between June 16 and 18, 2025. The sampling period coincided with past springtime biological assessments conducted by NAI during the spring of 2019 and 2023.

Macroinvertebrate Health: Biological integrity indices remain consistent with historical data, averaging 7.55 in 2025 (compared to 7.73 in 2019 and 7.58 in 2023). The diverse macroinvertebrate assemblages indicate sustained hydro-periods, and support for higher food chain species.

Vegetation Communities: All three wetlands support mature Non-Riverine Swamp Forest communities typical of the Mid-Atlantic Coastal Plain, dominated by black gum, cypress, red maple, and pine species. The Whooping Crane and Cypress Conservancy wetlands exhibit diverse age-class distributions, indicating healthy regeneration and quality habitat.

Area of Concern: Canopy decline was observed in the Palmetto Hall wetland, with mature black gums showing broken crowns and reduced leaf density. The cause remains unknown but may involve pathogens, pests, nutritient availabilty, or hydroperiod.

Habitat Value: Lower vegetation strata demonstrate good native species diversity, vertical stratification, and hummocky topography indicating high hydrologic storage capacity. Thirty-six bird species were recorded during monitoring largely represented by breeding populations.

Conclusion: The 2025 assessment confirms that HHPSD's recycled water discharge wetlands continue to function as valuable ecological systems. Continued monitoring of canopy conditions at Palmetto Hall is recommended.

1.0 INTRODUCTION

The following technical memorandum details the results of supplemental biological assessments conducted between June 16 and 18, 2025 at three recycled water discharge wetlands on Hilton Head Island, South Carolina. The Hilton Head Public Service District (HHPSD) discharges advanced treated, dechlorinated recycled water to the wetlands as part of a sustainable water reuse program during low recycled water demand periods. The PSD water reuse program discharges to receiving wetlands under the National Pollution Discharge Elimination System (NPDES) permit Number SC0046191, administered by the S.C. Department of Environmental Services (SCDES). The recycled water discharge wetlands include Whooping Crane Conservancy wetland and the Cypress Conservancy wetland in the Hilton Head Plantation neighborhood and the wooded wetland within the Palmetto Hall Golf Course (Figure 1). The following details the methods and results of the 2025 biological assessment.

2.0 METHODS

The goal of monitoring the discharge wetlands was to evaluate the influence of the water reuse program on the discharge wetlands. Field data collection consisted of quantitative assessments of benthic macroinvertebrates at one discrete station per wetland and quantitative and qualitative vegetative data at monitoring stations established along transects within each of the receiving wetlands in the Hilton Head Plantation and the Palmetto Hall Golf Course. In addition, bird surveys were conducted at each of the three wetlands, and the results are included in Appendix A. Biological monitoring was conducted during June 2025 during comparable conditions observed during previous monitoring events. Tables 1 and 2 detail the specific vegetation monitoring locations, effort, and monitoring elements conducted during the 2025 monitoring event. Figure 2 provides a schematic of the plot design and protocol conducted by NAI during the monitoring event.

Table 1. Location of the two Recycled Water Project sites and associated monitoring requirements.

Recycled Water Project (RWP) Site / Wetland Areas	Benthic Macroinvertebrates	Vegetative Community	Hydrology and Wildlife (qualitative)
Palmetto Hall RWP			
Wooded Wetland	1 representative station	4 Transects / 1 station per transect	Throughout Site
Hilton Head Plantation RWP			
Cypress Conservancy	1 representative station	3 Transects / 1 station per transect	Throughout Site
Whooping Crane Conservancy	1 representative station	3 Transects / 1 station per transect	Throughout Site

Table 2. Monitoring parameters and data collection methods.

Monitoring parameter / Metric	Sample Method
Hydrology	
Water depth	One (1) discrete manual measurement per station
Climatic inputs	Digital acquisition
Reclaimed water discharge	Hilton Head PSD provided
Vegetation	
Canopy and Shrub	One (1) 1/10th acre plot per station
Groundcover	One (1) 1/100th acre plot per transect
Benthic Macroinvertebrates	
Macroinvertebrates	Two (2) multihabitat grab samples per Wetland Area
Bird Surveys	
Birds	Visual and audible observation

2.1 Vegetation Assessment Methods

At each monitoring station, one 1/10-acre and one 1/100-acre circular plot were established. Within the 1/10-acre plot all canopy and sapling/shrub species were identified and canopy coverage was estimated for canopy and shrub strata. In the middle of the 1/10-acre plot, a 1/100-acre sub-plot was established to document herbaceous vegetation and cover. All monitoring plots were marked with a waypoint so that they could be re-located during future monitoring events.

For herbaceous ground cover plots mean coverage was calculated as the total coverage divided by the number of stations in each wetland. Because invasive species were not prevalent in the canopy of any of the receiving wetlands, total cover of native plant species was calculated for the shrub and herbaceous layers only so as to not skew the results of total native cover. Importance values (IVI) for ground cover plots was calculated as the sum from the relative frequency and the relative dominance of each species divided by two. Importance values for shrub and herbaceous cover can range between 0 (absent) and 100 (highly frequent with high density). The results of the vegetative plot data are included in Appendix B.

Vegetation within the receiving wetlands was evaluated qualitatively using version 3.0 of the U.S. Environmental Protection Agency's (USEPA) Ecological Integrity Assessment (VIA) of wetland ecosystem condition (Faber-Langendoen et al., 2012). A summary of the rating scale for each metric is included in Table 3. The qualitative assessment included evaluations of:

- Vegetation structure
- Vegetation composition
- Native plant species cover
- Woody regeneration
- Coarse woody debris

Evaluation of vegetation structure involved an assessment of the overall structural complexity of the vegetation layers and growth forms, including the presence of multiple strata, age and structural complexity of the canopy layer, evidence of the effects of disease or mortality on structure, overall canopy cover, the frequency of canopy gaps with regeneration, and the number of different age/size patches represented. Vegetation structure is an important reflection of vegetation dynamics and for creating heterogeneity within the community. Plants strongly influence the quantity, quality, and spatial distribution of water and sediment within wetlands.

An assessment of vegetation composition evaluated the overall species composition and diversity by individual vertical strata. There are no available freshwater reference wetlands on Hilton Head Island, so vegetation composition was compared to suites of species known to occur in wetland systems within the Coastal Plain of South Carolina. Vegetation composition and the presence or absence of both indicator species and ruderal species provide important indications about the temporal stability of wetland systems.

Estimates of native plant species cover involved a measure of the percent cover of all plant species in shrub and herbaceous layers at each sampling point within the receiving wetlands that are native to the region. Although Chinese tallowtree (*Triadica sebifera*) was present in all three wetlands, it was not prevalent within the canopy layer. Because of this, coverage of the canopy layer was not included so as to not skew the results of total native cover. The metric was calculated by estimating the total absolute cover of all vegetation, subtracting total exotic species cover, and expressing the total native species cover as a percentage of the total vegetative cover.

Woody Regeneration evaluated the tree regeneration layer (tree seedlings less than 1.3 m tall and saplings greater than 1.3 m tall and up to 10 cm dbh), as well as the shrub regeneration layer. The metric was recorded through visual evaluation of the abundance of tree seedlings and saplings and younger shrub growth.

Ratings for coarse and fine woody debris were strictly qualitative. At the end of the vegetation survey at each station, the observer paid special attention to the amount of coarse and fine woody debris and selected the narrative description from Table 3 that best characterized the amount of woody debris at each sampling point.

Table 3. Summary of Ratings for Field-Based Metrics used to Assess Wetland Vegetation Integrity.

Metric	Metric Rating Criteria			
	Excellent (A), Value = 5	**Good (B), Value = 4**	**Fair (C), Value = 3**	**Poor (D), Value = 1**
Vegetation Structure	Canopy a mosaic of small patches of different ages or sizes, including old trees and canopy gaps containing regeneration. Overall density moderate and average tree cover generally greater than 25%.	Canopy largely heterogeneous in age or size, but with some gaps containing regeneration or some variation in tree sizes AND overall density moderate and greater than 25% tree cover.	Canopy somewhat homogeneous in density and age, AND extremely dense or very open. Canopy cover may be very high or very low (>90%, <25%).	Canopy extremely homogeneous, sparse or absent (<10% cover)
Vegetation Composition	Vegetation is at or near reference standard condition in species present and their proportions. Lower strata composed of appropriate species, and regeneration good. Sensitive native species are present, functional groups indicative of anthropogenic disturbance are absent to minor, and full range of diagnostic/indicator species are present.	Vegetation is close to reference standard condition in species present and their proportions. Upper or lower strata may be composed of some native species reflective of past anthropogenic degradation (ruderal or "weedy" species). Some indicator/diagnostic species may be absent.	Vegetation is different from reference standard condition in species diversity or proportions, but still largely composed of native species characteristic of the type. This may include ruderal ("weedy") species. Regeneration of expected native trees may be sparse. Many indicator/diagnostic species may be absent.	Vegetation severely altered from reference standard in composition. Expected strata are absent or dominated by ruderal species, or comprised of planted stands of non-characteristic species, or unnaturally dominated by a single species. Regeneration of expected native trees minimal or absent. Most or all indicator/diagnostic species are absent.
Relative Total Cover of Native Plant Species	>99% relative cover of native plant species	97–99% relative cover of native plant species	90–96% relative cover of native plant species	D: 50–89% relative cover of native plant species
Woody Regeneration	All age classes of native woody species present. Native tree saplings /seedlings and shrubs common to the type present in expected amounts and diversity. Regeneration is obvious.	Age classes of native woody species restricted to mature individuals and young sprouts. Middle age groups appear to be absent or there is some other indication that regeneration is moderately impacted.	Native woody species comprised of mainly mature individuals OR mainly evenly aged young sprouts that choke out other vegetation. Regeneration is obviously impacted.	Native woody species predominantly consist of decadent or dying individuals OR are absent from an area that should be wooded.
Coarse and Fine Woody Debris	Metric scored as A/B (Value = 4.5). Site characterized by moderate amount of coarse and fine woody debris, relative to expected conditions. There is a wide size-class diversity of standing snags and downed logs in various stages of decay. For riverine wetlands, debris is sufficient to trap sediment, but does not inhibit stream flow. For non-riverine wetlands, woody debris provides structural complexity, but does not overwhelm the site.		Site characterized by small amounts of woody debris OR debris is somewhat excessive. For riverine wetlands, lack of debris may affect stream temperatures and reduce available habitat.	Site lacks woody debris, even though inputs are available.

2.2 Benthic Macroinvertebrate Assessment Methods

Macroinvertebrate sampling was adapted using protocols outlined in the SCDHEC Standard Operating and Quality Control Procedures (SOP) for Macroinvertebrate Sampling (SCDHEC, 2017). However, the SCDHEC SOP was specifically written for stream sampling, so adaptations were required to accommodate wetland sampling. At each wetland, multiple habitats were targeted for sampling using a D-frame dip net sampler. Targeted habitats included undercut banks and root wads, aquatic vegetation, and submerged logs. Submerged logs were rinsed within the D-frame dip net. Samples were collected at one location in each wetland and stored in a 70% ethanol solution for delivery to the taxonomic laboratory. Identification and enumeration of macroinvertebrates was performed by Pennington and Associates, Inc., Cookeville, TN.

Wetland macroinvertebrate biotic integrity was evaluated using the Hilsenhoff Biotic Index (HBI) and commonly used diversity metrics, including taxa richness. The HBI is a pollution sensitivity measure that assigns each macroinvertebrate taxon a tolerance value ranging from 0 (highly sensitive to pollution) to 10 (highly tolerant of pollution). The index is calculated by weighting these tolerance values against the relative abundance of each taxon in the sample, following protocols from the USEPA's Rapid Bioassessment Protocols (RBP; Barbour et al., 1999). Lower HBI scores (closer to 0) indicate a highly intolerant community and better water quality, while higher scores (approaching 10) suggest a more tolerant community and can indicate poorer water quality or habitat conditions. It should be noted that no wetland-specific indices of biotic integrity have been developed for coastal areas of South Carolina, and the RBP was originally designed to assess the biological integrity of streams and wadeable rivers rather than wetlands. Therefore, high HBI scores in wetland systems are often a reflection of habitat conditions (e.g. low dissolved oxygen, homogeneous habitat availability, low or zero flow, etc.) rather than water quality conditions.

3.0 VEGETATION MONITORING RESULTS

The Cypress Conservancy, Whooping Crane Conservancy, and the Palmetto Hall wooded wetlands continue to support mature stands of swamp tupelo (*Nyssa biflora*), and this species continues to be the dominant species present in all three wetlands. Shrub and groundcover diversity was highest in the Cypress Conservancy and Whooping Crane Conservancy. Both sites represented the most mature forest cover. Herbaceous diversity was similar across all sites but was highest in the Palmetto Hall Wooded wetland. Overall, the diversity of shrub cover and herbaceous groundcover within the discharge wetlands was limited by several factors. Based

upon field assessments, the most important factors affecting herbaceous cover were available sunlight and the presence of standing water, with deeper waters precluding substantial herbaceous growth. Several large canopy gaps occur within the Palmetto Hall wooded wetland which likely encourage increased herbaceous growth and density. Individual plot data for each wetland is included in Appendix B.

Qualitative assessments of vegetation suggest that the current conditions in the receiving wetlands are largely consistent with previous monitoring events. The wetlands support a vegetation community that is typical of the Non-Riverine Swamp Forest community types found in the Mid-Atlantic Coastal Plain. All three wetlands have mature forest canopies with swamp tupelo, cypress (*Taxodium* spp.), and red maple (*Acer rubrum*) being the most important canopy associates. The diameter class distribution of trees within the wetlands is uneven, representing a diverse range of age classes. This uneven age structure within the forested wetlands is indicative of good quality habitat and consistent regeneration of canopy species. The 2025 monitoring event represented a late spring season monitoring effort in regard to vegetation. Much of the herbaceous layer was more developed as compared to past early-growing season monitoring events. However, the composition of vegetation communities was similar to conditions observed in past monitoring events. Past monitoring events have highlighted the presence of Chinese tallowtree. Chinese tallowtree was present in all three wetlands but does not appear to have increased in distribution or frequency of occurrence. It continues to persist as seedlings and small saplings in low densities and has not invaded the forest canopy. The results of the 2025 monitoring effort showed that assemblages across all vegetative strata remain largely composed of native species.

A discussion of the vegetative communities observed at the three sampled wetlands are provided below.

3.1 Whooping Crane Conservancy

The Whooping Crane conservancy contains a mature canopy of swamp tupelo, with pines and red maple serving as important canopy associates. The shrub stratum within the Whooping Crane Conservancy was dominated by wax myrtle (*Morella cerifera*), fetterbush (*Lyonia lucida*), Carolina willow (*Salix caroliniana*), shinyleaf (*Lyonia lucida*), and red bay (*Persea borbonia*). Swamp loosestrife (*Decodon verticillatus*) continues to persist within the shrub stratum but was only observed outside of individual sampling stations.

Herbaceous composition in Whooping Crane was dominated by pennyworts (*Hydrocotyle* spp.), cinnamon fern (*Osmundastrum cinnamonea*), and small-spike false nettle (*Boehmeria*

cylindrica). Important secondary species were, lizard's tail (*Saururus cernuus*), creeping primrose (*Ludwigia palustris*), flatsedges (*Cyperus* spp.), Virginia chain fern (Woodwardia virginica), and cone-cup spikerush (*Eleocharis tuberculosa*). One rare herbaceous species, golden canna (*Canna flaccida*), was observed while traversing the wetland. However, the species was not recorded in any of the monitoring stations. Although the golden canna is considered rare in South Carolina, it has no state or federal listing status.

Water depth varied from 2-inches to 1.5-feet in depth across the wetland. Open water habitats were largely dominated by duckweed (*Lemna* sp.). Where water depths were shallower and where hummocks occurred, the herbaceous community was dominated by clepennywort, cinnamon fern, lizard's tail, creeping primrose, cinnamon fern, and smartweed.

The results of the VIA indicate that Whooping Crane Conservancy continues to support overall a vegetative community with good integrity (Table 4). The 2005 VIA rating was 4.3, slightly higher as compared to the 4.1 rating in 2023. VIA sub-ratings increased for Vegetation Composition and Native Plant Species Coverage due to the presence of rare species and a slightly higher percentage of native cover across monitoring stations. The wetland continues to support a mature canopy with good age class distribution and evidence of persistent tree regeneration. The community is largely native in all three vegetative strata, and there are substantial contributions of coarse and fine woody debris.

The same factors that impacted the integrity score for Whooping Crane Conservancy during 2023 monitoring were observed in 2025, but they did not appear to increase. These included a high proportion of duckweed (a ruderal species) present within the herbaceous layer in open water habitats and the presence of non-native species, including swamp loosestrife and Chinese tallowtree. Duckweed is a native species and is common in wetlands throughout the coastal plain. Dense populations of duckweed are an important food source for aquatic waterfowl and fish. Where hummocks and coarse woody debris occur, Whooping Crane Conservancy supports a suite of herbaceous species that are typical of a Non-Riverine Swamp Forest community type. Although some non-native, invasive species occur in the shrub and herbaceous layers, the overall non-native and invasive species coverage is low. The non-native and invasive species encountered in the Whooping Crane Conservancy are also common in wetlands throughout the coastal plain.

Table 4. Vegetation Integrity Rating Calculation for Whooping Crane Conservancy, June 16, 2025.

Metric	Rating	Description
Vegetation Structure	4.5	Continues to support uneven-age-class distribution, gaps present, cover >25%
Vegetation Composition	4.0	Largely native in all strata, tree regeneration present
Native Plant Species Cover	4.0	Shrub and herb layer contained 97%-99% native cover. Rare species present (*Canna flaccida*), some invasive and ruderal species but mostly along the perimeter of the wetland
Woody Regeneration	4.5	Obvious regeneration with good age class distribution of native species
Coarse Woody Debris	4.5	Large contributions of fine and coarse debris
Vegetation (Biota) Rating	**4.3**	Whooping Crane Conservancy continues to support overall good integrity within the vegetative community

3.2 Cypress Conservancy

The Cypress Conservancy canopy is dominated by stands of large swamp tupelo with bald cypress (*Taxodium distichum*). The forest canopy supports several other canopy associates including loblolly pine (*Pinus taeda*), sweetgum (*Liquidambar styraciflua*), and red maple. The presence of bald cypress is of particular note. Although bald cypress is a regionally common species in wetlands of the Coastal Plain, Cypress Conservancy is the only wetland on Hilton Head Island where the species persists.

Shrub cover within the Cypress Conservancy was dominated by dwarf palmetto (*Sabal minor*), red bay, and wax myrtle. Chinese tallowtree was also present in lower woody strata but does not appear to have increased in distribution or density compared to previous monitoring events. Previous monitoring reports do indicate that Chinese tallowtree was present in all prior monitoring years.

Overall herbaceous species composition was similar to Whooping Crane Conservancy monitoring stations. Species composition in the Cypress Conservancy was dominated by lizard's tail and swamp smartweed (*Persicaria hydropiperoides*), with sub-dominates composed of pennywort, flatsedges, Virginia chain fern, cinnamon fern, and slender woodoats (*Chasmanthium laxum*).

The results of the 2025 VIA indicate that Cypress Conservancy continues to support good vegetative community integrity (Table 5). The results of the VIA increased slightly from 4.2 to 4.3 in 2025 as compared to 2023. This increase was due to fewer non-native species being recorded within individual monitoring stations. The wetland contains a mature canopy and supports the only known mature stands of bald cypress on Hilton Head Island. There is evidence of persistent tree regeneration in canopy gaps and within the forest understory. The community is largely native in all three vegetative strata, and there are substantial contributions of coarse and fine woody debris. Factors that impacted the integrity score for Cypress Conservancy were the same factors that impact integrity within Whooping Crane Conservancy. This includes a high proportion of duckweed present within the herbaceous layer in open water habitats and the presence of Chinese tallowtree in the shrub and herbaceous layers. Although some non-native invasive species occur in the shrub and herbaceous layers, the overall non-native species coverage is low and the species encountered are common in wetlands throughout the coastal plain.

Table 5. Vegetation Integrity Rating Calculation for Cypress Conservancy, June 17, 2025.

Measure	Rating	Description
Vegetation Structure	5.0	Supports an uneven-age-class distribution, with a mix of natural regeneration and the only mature stand of *Taxodium* on the island, gaps present, cover >25%.
Vegetation Composition	3.5	Largely native, with some ruderal species particularly along the margins of the wetland complex, tree regeneration present and persistent
Native Plant Species Cover	3.5	Shrub and herb layer contained >95% native cover
Woody Regeneration	5.0	Good age class distribution of native species
Coarse Woody Debris	4.5	Large contributions of fine and coarse debris
Vegetation (Biota) Rating	**4.3**	Cypress Conservancy continues to support a diverse and mature vegetative community.

3.3 Palmetto Hall Wooded Wetland

The results of the 2025 monitoring event indicate that Palmetto Hall wooded wetland supports similar conditions to those observed in 2023. The canopy is dominated almost exclusively by swamp tupelo, with red maple and sweet gum occurring occasionally. Canopy trees are less mature as compared to the Whooping Crane Conservancy and Cypress Conservancy wetlands and there were signs of past disturbance with some large trees that had fallen down or suffered from mid-stem failure where the tops of trees were destroyed, and the trunks were retained as

snags. Regenerating tree species included young cohorts of those species found in the forest canopy as well as Chinese tallowtree. Important species within the shrub layer included wax myrtle, dwarf palmetto, and red bay. Palmetto Hall Wooded Wetlands contained the highest amount of herbaceous cover amongst the three wetlands and was dominated by duckweed in open water habitats. Where water depths were shallow or exposed soil existed, lizard's tail, swamp smartweed, and flatsedges were common species.

Palmetto Hall Wooded Wetland again scored the lowest VIA score of the receiving wetlands, and the 2025 assessment scores were slightly lower than in 2023 (3.4 as compared to 3.7). The results indicate that the wetland continues to support fair to good vegetative community integrity (Table 6). Factors that affected the VIA score for the Palmetto Hall wooded wetland as compared to the other receiving wetlands include an overall younger canopy with less diversity in age structure and the presence of invasive species in the understory and herbaceous layers.

The Palmetto Hall Wooded Wetland scored lower for Vegetation Structure, Vegetation Composition, and Woody Regeneration in 2025 as compared to 2023. These results are due to a decline in swamp tupelo canopy cover. Past monitoring reports conducted by Ballentine and NAI have noted canopy decline within the wetland, and this decline was attributed to potential wind shear from coastal storms, particularly Hurricane Matthew which occurred in 2016. However, the health of the remaining canopy appears to have not recovered and the continuing decline in canopy coverage may be due to additional environmental stressors. Potential environmental stressors may include pathogens, pests, nutrient availabilty, and hydroperiod.

In addition to and in conjunction with canopy decline and large canopy gaps, the growing presence of Chinese tallowtree poses the greatest threat to the integrity of the community. Open native canopy conditions can allow Chinese tallowtree to become established, and the distribution of the species should continue to be monitored in the future.

Table 6. Vegetation Integrity Rating Calculation for Wooded Wetland, June 17, 2025.

Measure	Rating	Description
Vegetation Structure	3.0	Some uneven-age-class distribution, but less mature than other receiving wetlands, some large gaps absent of canopy cover
Vegetation Composition	3.5	Largely native but with a high proportion of ruderal species, tree regeneration present in gaps
Native Plant Species Cover	3.0	Shrub and herb layer contained 95% native cover
Woody Regeneration	3.0	Forest continuing to mature after past disturbance, likely from Hurricane Matthew. Age class restricted to younger cohorts
Coarse Woody Debris	4.5	Large contributions of fine and coarse debris
Vegetation (Biota) Rating	**3.4**	Wooded Wetland represents the youngest forest of the three receiving wetlands, overall condition is between good and fair.

4.0 MACROINVERTEBRATE ASSESSMENT RESULTS

The macroinvertebrate communities in the discharge wetlands are typical of many freshwater wetland systems in the coastal plain (Table 7). The soft sediments and naturally low dissolved oxygen concentrations in these wetlands are conducive to a community dominated by midge larvae in the family Chironomidae, as well as other short-lived, low dissolved oxygen tolerant species such as isopods, copepods, and annelids. Generally, wetlands will sustain a more tolerant suite of macroinvertebrate taxa compared with freshwater streams. For instance, the Whooping Crane wetlands were dominated by a single species of fairly tolerant amphipods, *Hyalella azteca*, which are typically indicative of abundant aquatic vegetative growth. In contrast, the receiving wetlands at Cypress Conservancy and Palmetto Hall supported several species with low- to mid-tolerance values including the mayfly *Ameletus* sp., predatory diving beetles *Neoporus* sp., and midge larvae including *Cladopelma* sp., *Corynoneura* sp., and *Polypedilum flavum*. Additionally, long-lived species that require sustained hydrologic duration, such as Coleopterans, were collected, especially from the Cypress Conservancy wetlands, indicating sustained hydroperiods in these wetlands. Differences in communities between wetlands are often indicative of overall habitat availability, aquatic vegetative growth, canopy coverage, and sunlight penetration. However, some differences may be due to fluctuating re-use water discharges and nutrient inputs to these wetlands.

There was a reduction in abundance of individuals enumerated in 2025 at all stations as compared to 2019 and 2023. These reductions could be due to the overabundance of duckweed encountered at all wetland sites, making sampling conditions very difficult in 2025.

Despite reductions in abundance, taxa richness between 2023 and 2025 was similar for Cypress Conservancy (15 and 16 taxa, respectively) and Palmetto Hall Wooded Wetland (19 and 14 taxa, respectively). Due to the abundance of amphipods collected at Whooping Crane Conservancy, richness dropped from 11 taxa in 2023, to 5 taxa in 2025.

A discussion of the macroinvertebrate communities observed at the three sampled wetlands are provided below.

4.1 Whooping Crane Conservancy

Taxa richness was lowest in the Whooping Crane Conservancy with a total of 5 taxa collected. Low taxa richness in Whooping Crane is likely due to sampling inefficiencies related to abundant floating duckweed which limits the ability to target diverse habitat types but may also be due to laboratory sub-sampling procedures that can potentially bias invertebrate enumerations. A layer of duckweed several inches thick dominated the water column throughout the Whooping Crane Conservancy. The wetland was dominated by the short-lived amphipods from the *Hyalella azteca* species complex. These amphipods feed on diatoms and algae and can become locally abundant where aquatic vegetative growth is also abundant. They are fairly tolerant to temperature and salinity changes and can thrive in coastal wetland areas with abundant vegetative growth. Where they become overly abundant, it can be difficult to find other taxa. The biotic index (HBI) reported for the Whooping Crane Conservancy was 7.68, which is indicative of a fairly tolerant invertebrate community typical of stagnant water wetland conditions.

4.2 Cypress Conservancy

The Cypress Conservancy had the highest taxa richness with a total of 16 taxa collected, although the abundance of individuals collected was considerably lower in 2025 compared with 2019 and 2023. Like Whooping Crane Conservancy, duckweed density was very high at the sampling location in 2025, likely affecting collection efficiency. The Cypress Conservancy had the highest abundance of midge larvae taxa in the Chironomid family, some of which have fairly low pollution tolerance values and can indicate the presence of good quality water. Notably, pollution-sensitive Chironomid taxa included *Cladopelma* sp. (tolerance value 4.09) and *Polypedilum flavum* (tolerance value 5.7). The biotic index score was 7.50, which is lower than the biotic index score of 8.35 in 2023, but is still indicative of a fairly tolerant community.

4.3 Palmetto Hall Wooded Wetland

The Palmetto Hall Wooded Wetland macroinvertebrate taxa richness was also high, with a total of 14 taxa collected. Amphipods from the *Hyalella azteca* species complex made up the largest portion of the community with other crustaceans and leeches (Annelid-Hirundinea) also making up a significant proportion of the assemblage. Interestingly, one mayfly (*Ameletus* sp.) was captured, likely from flowing water areas in the northern portion of the site. The presence of this pollution-sensitive mayfly (tolerance value 2.40) suggests localized areas of more favorable water quality conditions where dissolved oxygen levels are likely higher due to mechanical mixing. The biotic index score was 7.48, which was higher than 2023 when the biotic index was 6.63, though both scores indicate a fairly tolerant community.

Table 7. Macroinvertebrate assemblages collected from the Hilton Head Island PSD recycled water discharge wetlands on June 16, 2025.

Phylum	Class	Order	Family	Taxon	T.V.[1]	F.F.G.[2]	Whooping Crane Conservancy	Cypress Conservancy	Palmetto Hall Wooded Wetland
PLATYHELMINTHES	Turbellaria	Tricladida	Dugesiidae	Girardia tigrina	7.10	P	-	-	5
ANNELIDA	Oligochaeta	Lumbriculida	Lumbriculidae	Lumbriculidae (LPIL)	7.03	CG	**2**	-	-
	Hirundinea	Arhynchobdellida	Erpobdellidae	Erpobdellidae (LPIL)	-	P	**1**	-	-
		Rhynchobdellida	Glossiphoniidae	*Helobdella stagnalis*	8.60	P	-	-	1
				Helobdella triserialis	9.30	P	-	-	8
ARTHROPODA	Crustacea	Cylclopoida	Cylclopoida	Cylclopoida (LPIL)	-	-	-	-	1
		Isopoda	Asellidae	*Caecidotea sp.*	8.40	CG	-	8	5
		Amphipoda	Crangonyctidae	*Crangonyx sp.*	7.20	CG	-	1	-
			Hyalellidae	*Hyalella azteca*	7.80	CG	100	3	14
	Insecta	Ephemeroptera	Ameletidae	*Ameletus*	2.40	CG	-	-	1
		Odonata	Coenagrionidae	Coenagrionidae (LPIL)	9.00	P	1	-	2
		Hemiptera	Belostomatidae	Belostomatidae (LPIL)	-	-	-	1	-
				Belostoma sp.	9.50	P	-	-	1
		Coleoptera	Curculionidae	Curculionidae (LPIL)	-	-	2	-	-
			Dytiscidae	*Neoporus sp.*	5.00	P	-	1	-
			Hydraenidae	*Helius sp.*	-	P	-	1	-
			Hydrophilidae	*Enochrus sp.*	8.50	CG	-	1	-
			Sciritidae	*Scirtes sp.*	-	SC	-	-	1
		Diptera	Ceratopogonidae	Ceratopogonidae (LPIL)	-	P	-	2	-

Table 7. Macroinvertebrate assemblages collected from the Hilton Head Island PSD recycled water discharge wetlands on June 16, 2025. (Continued)

Phylum	Class	Order	Family	Taxon	T.V.[1]	F.F.G.[2]	Whooping Crane Conservancy	Cypress Conservancy	Palmetto Hall Wooded Wetland
ARTHROPODA	Insecta	Diptera	Chironomidae	*Chironomus sp.*	9.3	**CG**	-	1	-
				Cladopelma sp.	4.09	**CG**	-	-	3
				Corynoneura sp.	*5.7*	**CG**	-	2	-
				Dicrotendipes sp.	7.2	**CG**	-	1	-
				Dicrotendipes simpsoni	9.8	**CG**	-	-	2
				Diplocladius cultriger	8	**CG**	-	1	-
				Monopelopia sp.	-	-	-	2	-
				Nanocladius sp.	7.4	**CG**	-	-	2
				Polypedilum flavum	5.7	**SH**	-	4	-
				Polypedilum illinoense gp.	8.7	**SH**	-	5	-
				Tanypodinae	-	-	-	-	1
			Stratiomyidae	*Myxosargus sp.*	-	-	-	1	9
				TOTAL NO. OF ORGANISMS			**106**	**35**	**51**
				TOTAL NO. OF TAXA (Richness)			**5**	**16**	**14**
				EPT INDEX[3]			**0**	**0**	**1**
				BIOTIC INDEX Assigned Values			**7.68**	**7.50**	**7.48**

Notes:
[1] T.V. = Tolerance Value; derived from U.S. Environmental Protection Agency Rapid Bioassessment Protocol
[2] F.F.G. = Functional Feeding Guild: CG = collector-gatherer, FC = filterer-collector, OM = omnivore, P = predator, SC = scraper, SH = shredder, UN = unknown
[3] EPT = Ephemeroptera, Plecoptera, Trichoptera

5.0 BIRD SURVEYS

Because they are relatively undisturbed as compared to the surrounding landscape, the receiving wetlands provide critical wildlife habitat for a wide variety of bird species on Hilton Head Island. They provide excellent bird habitat because they support diverse vertical stratification of vegetative layers, abundant water resources, and high productivity. These wetlands feature a mosaic of standing water, saturated soils, and hummock-and-hollow microtopography that create a variety of niches for ground dwelling species. Mature canopies and the forest understory offer shade, nesting sites, and protection for tree dwelling species. The combination of standing dead trees, fallen logs, and shallow pools provides excellent foraging and breeding habitat as well as migratory habitat throughout the year.

A bird survey was conducted in each of the three wetlands through auditory and visual observation during the 20025 HHPSD monitoring event. In total, 37 bird species were observed during the spring 2025 HHPSD wetland monitoring trip. Due to the timing of the monitoring event in late spring, the majority of these species are considered to be nesting on site. Two exceptions are yellow-rumped warbler (*Setophaga coronata*) and hermit thrush (*Catharus guttatus*) which are typical late season migrants which breed further to the north. A record of bird observations for the 2025 monitoring season is provided in Appendix A. Diversity and bird assemblages were similar among all three wetlands. It is likely that several other species occur, but were not observed during the monitoring event.

6.0 CONCLUSIONS

Based on the 2025 biological assessment conducted in the Hilton Head Island reuse water discharge wetlands, the wetlands continue to support diverse biological communities. These wetlands are critical natural resources on an island otherwise experiencing substantial development pressures and serve as important vegetative and wildlife habitat on the Island.

The wetlands continue to support critical ecological function within the developed landscape, acting as important urban filtration systems and providing interior coastal plain habitats for a myriad array of freshwater wetland and coastal aquatic and terrestrial species. The macroinvertebrate assemblage observed during the 2025 monitoring event indicate long-term hydrology conditions conducive for higher level food chain species, such as fish and amphibians, and good water quality conditions conducive for supporting a diverse assemblage of aquatic invertebrates. The results of the 2025 VIA assessment indicate that the vegetative communities within the wetlands have persisted as largely intact vegetative communities that support a

majority of native species. Future monitoring events should continue to focus on these community assemblages and the distribution and density of those non-native species that are discussed in this report. Finally, the health and condition of swamp tupelo within the canopy of the Palmetto Hall wooded wetland should continue to be monitored.

7.0 LITERATURE CITED

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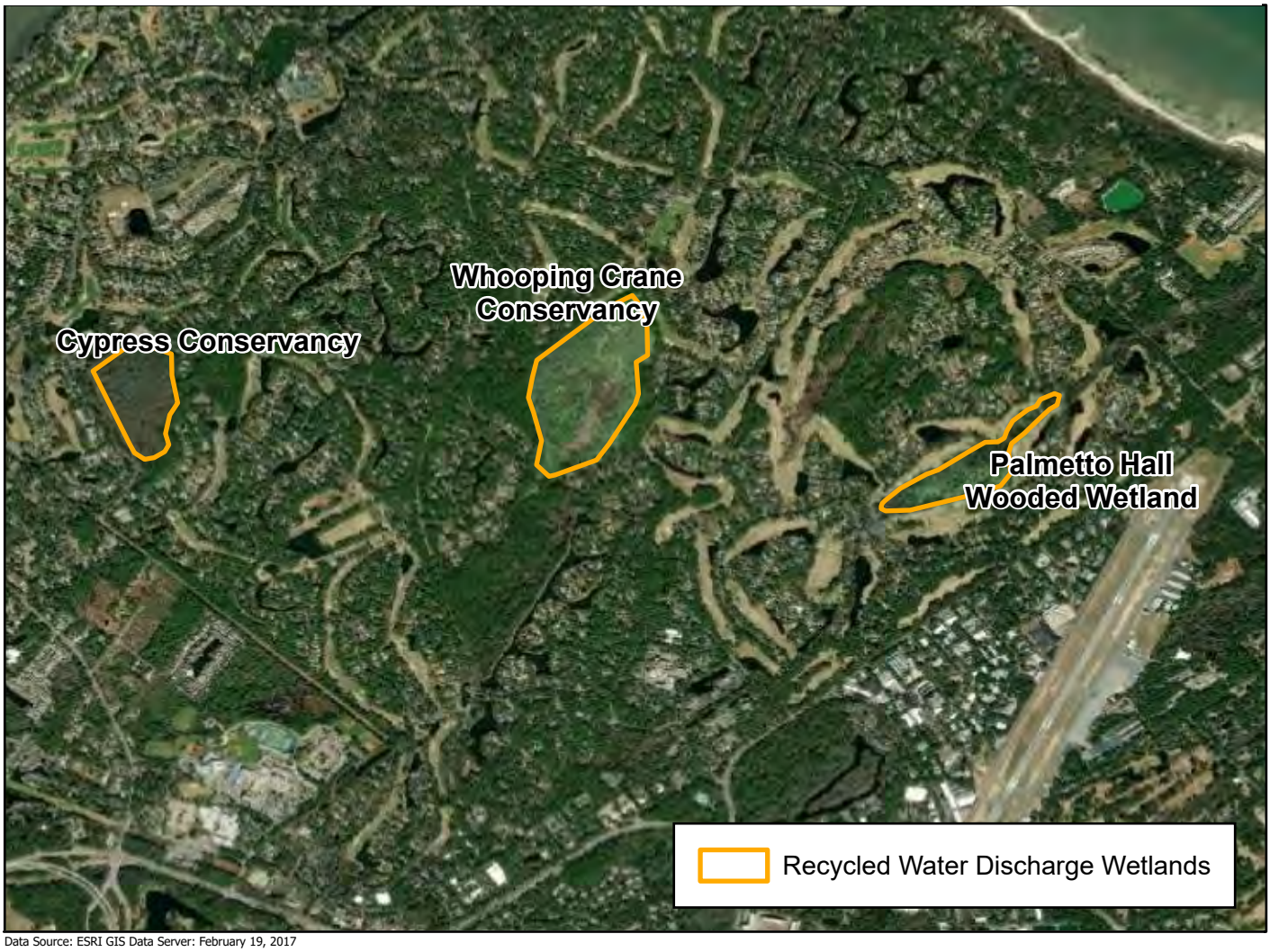
South Carolina Department of Health and Environmental Control. 2017. Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling. Technical Report No. 0914-17. Bureau of Water. Columbia, South Carolina.

FIGURES



Data Source: ESRI GIS Data Server: February 19, 2017

Figure 1. Vicinity map for the Hilton Head Island PSD Recycled Water Discharge Wetlands.

0 0.25 0.5 1 Miles

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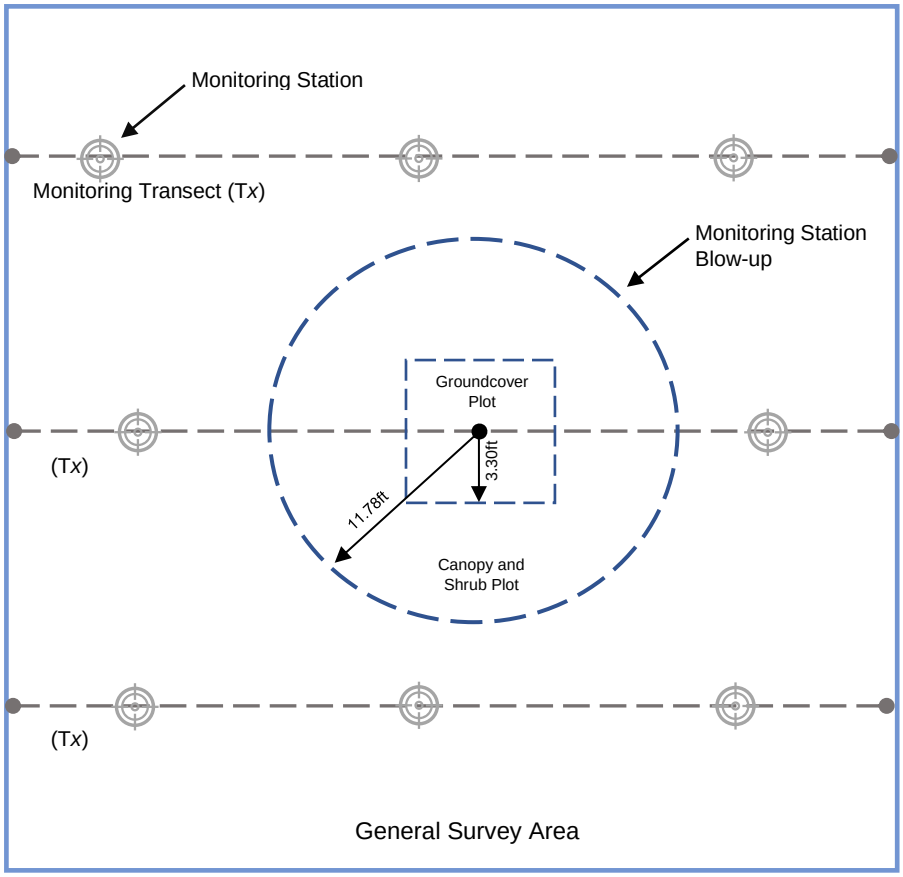
Figure 2. Biological monitoring plot schematic as conducted by NAI during 2025 monitoring.



APPENDIX A

Bird species observed within each HHPSD assessment wetland during 2025 spring monitoring

Bird species observed within each HHPSD assessment wetland during 2025 spring monitoring.

Common Name	Scientific Name	Cypress Conservancy	Whooping Crane Conservancy	Palmetto Hall Wooded Wetland
American crow	*Corvus brachyrhynchos*	X	X	X
American robin	*Turdus migratorius*	X	X	
Blue-grey gnatcatcher	*Polioptila caerulea*	X	X	X
Blue jay	*Cyanocitta cristata*	X	X	X
Barred owl	*Strix varia*	X		
Black-bellied whistling duck	*Dendrocygna autumnalis*		X	
Brown-headed nuthatch	*Sitta pusilla*	X	X	X
Carolina chickadee	*Poecile carolinensis*	X	X	X
Carolina wren	*Thryothorus ludovicianus*	X	X	X
Chipping sparrow	*Spizella passerina*	X	X	
Common yellowthroat	*Geothlypis trichas*		X	X
Coopers hawk	*Astur cooperii*	X		X
Downy woodpecker	*Picoides pubescens*	X	X	X
Eastern bluebird	*Sialia sialis*		X	X
Eastern phoebe	*Sayornis phoebe*		X	X
European starling	*Sturnus vulgaris*			X
Great-crested flycatcher	*Myiarchus crinitus*	X		
Great egret	*Ardea alba*		X	
Green heron	*Butorides virescens*		X	X
Grey catbird	*Dumetella carolinensis*		X	X
Hermit thrush	*Catharus guttatus*		X	
Mourning dove	*Zenaida macroura*	X		X
Northern cardinal	*Cardinalis cardinalis*	X	X	X
Northern parula	*Setophaga americana*	X	X	X
Pileated woodpecker	*Dryocopus pileatus*	X	X	
Pine warbler	*Dendroica pinus*	X	X	
Red-bellied woodpecker	*Melanerpes carolinus*	X	X	X
Red-shouldered hawk	*Buteo lineatus*	X	X	
Red-winged blackbird	*Agelaius phoeniceus*			X
Ruby-crowned kinglet	*Regulus calendula*	X	X	X
Tufted titmouse	*Baeolophus bicolor*	X	X	X

Bird species observed within each HHPSD assessment wetland during 2025 spring monitoring (continued).

Common Name	Scientific Name	Cypress Conservancy	Whooping Crane Conservancy	Palmetto Hall Wooded Wetland
Turkey vulture	*Cathartes aura*		X	X
White ibis	*Eudocimus albus*		X	X
White-eyed vireo	*Vireo griseus*	X	X	X
Wood duck	*Aix sponsa*	X		X
Yellow-rumped warbler	*Setophaga coronata*	X	X	X
Yellow-throated warbler	*Setophaga dominica*	X		
Total Taxa		**25**	**29**	**26**

"x" denotes that the listed species was observed.

APPENDIX B

Vegetation data for each HHPSD assessment wetland during 2025 spring monitoring

Groundcover Plot Data By Individual Wetland

Whooping Crane Conservancy					
Species	**Common Name**	**Mean Cover**	**Relative Dominance**	**Relative Frequency**	**IVI**
Lemna sp.	Duckweed	69.5%	72.5%	26.3%	49.39
Hydrocotyle sp.	Pennywort	9.5%	9.9%	21.1%	15.48
Osmundastrum cinnamomeum	Cinnamon Fern	6.5%	6.8%	7.9%	7.34
Boehmeria cylindrica	Small-Spike False Nettle	1.6%	1.7%	10.5%	6.10
Saururus cernuus	Lizard's-Tail	2%	2.1%	7.9%	4.99
Eleocharis tuberculosa	Cone-Cup Spike-Rush	1.3%	1.4%	7.9%	4.63
Woodwardia virginica	Virginia Chain Fern	2.0%	2.1%	5.3%	3.67
Ludwigia palustris	Marsh Primrose	1.0%	1.0%	5.3%	3.15
Persicaria sp.	Smartweed	0.3%	0.3%	2.6%	1.47
Decodon verticillatus	Swamp-Loosestrife	0.2%	0.2%	2.6%	1.42
Cyperus sp.	Flatsedge	0.2%	0.2%	2.6%	1.42
				Species Richness	**11**
				Average Depth of Water in Inches	**13.5”**

Cypress Conservancy					
Species	**Common Name**	**Mean Cover**	**Relative Dominance**	**Relative Frequency**	**IVI**
Saururus cernuus	Lizard's-Tail	47.9%	56.1%	27.3%	41.7
Lemna sp.	Duckweed	19.4%	22.8%	18.2%	20.5
Persicaria hydropiperoides	Swamp Smartweed	5.4%	6.4%	12.1%	9.3
Limnobium spongia	American Spongeplant	5.0%	5.9%	9.1%	7.5
Hydrocotyle sp.	Pennywort	1.8%	2.1%	12.1%	7.1
Chasmanthium laxum	Slender Wood-Oats	2.4%	2.9%	6.1%	4.5
Woodwardia virginica	Virginia Chain Fern	1.1%	1.3%	3.0%	2.2
Triadica sebifera	Chineese Tallowtree	1.1%	1.3%	3.0%	2.2
Cyperus sp.	Flatsedge	0.6%	0.7%	3.0%	1.8
Carex stipata	Stalk-Grain Sedge	0.3%	0.4%	3.0%	1.7
Eclipta prostrata	False Daisy	0.2%	0.3%	3.0%	1.6
				Species Richness	**11**
				Average Depth of Water in Inches	**1.5”**

Groundcover Plot Data By Individual Wetland (Continued)

Palmetto Hall Wooded Wetland					
Species	**Common Name**	**Mean Cover**	**Relative Dominance**	**Relative Frequency**	**IVI**
Lemna sp.	Duckweed	39.4%	45.1%	23.1%	34.1
Saururus cernuus	Lizard's-Tail	25.6%	29.3%	26.9%	28.1
Alternanthera philoxeroides	Alligator-Weed	11.3%	12.9%	7.7%	10.3
Mikania scandens	Climbing Hempvine	1.5%	1.7%	7.7%	4.7
Hydrocotyle sp.	Pennywort	3.8%	4.3%	3.8%	4.1
Decodon verticillatus	Swamp-Loosestrife	1.9%	2.1%	3.8%	3.0
Boehmeria cylindrica	Small-Spike False Nettle	1.3%	1.4%	3.8%	2.6
Typha latifolia	Broad-Leaf Cat-Tail	1.3%	1.4%	3.8%	2.6
Bidens laevis	Smooth Beggarticks	0.6%	0.7%	3.8%	2.3
Persicaria sp.	Smartweed	0.4%	0.4%	3.8%	2.1
Cyperus sp.	Flatsedge	0.1%	0.1%	3.8%	2.0
Triadica sebifera	Chineese Tallowtree	0.4%	0.4%	7.7%	4.1
				Species Richness	**12**
				Average Depth of Water in Inches	**13.3”**

Mean Shrub Cover By Individual Wetland

Whooping Crane Conservancy		
Species	**Common Name**	**Mean Cover**
Morella cerifera	Southern Bayberry	27.5%
Salix caroliniana	Carolina Willow	11.3%
Persea borbonia	Red Bay	4.3%
Lyonia lucida	Shinyleaf	1.8%
	Total	**44.9**%

Cypress Conservancy		
Species	**Common Name**	**Mean Cover**
Sabal minor	Dwarf Palmetto	15.0%
Morella cerifera	Southern Bayberry	12.3%
Triadica sebifera	Chineese Tallowtree	8.3%
Magnolia virginiana	Sweet-Bay	1.7%
	Total	**37.3**%

Mean Shrub Cover By Individual Wetland (Continued)

Palmetto Hall Wooded Wetland		
Species	**Common Name**	**Mean Cover**
Morella cerifera	Southern Bayberry	31.3%
Persea borbonia	Red Bay	5.0%
Sabal minor	Dwarf Palmetto	2.5%
Lyonia lucida	Shinyleaf	0.5%
	Total	**39.3**%

Mean Tree Cover By Individual Wetland

Whooping Crane Conservancy		
Species	**Common Name**	**Mean Cover**
Nyssa biflora	Swamp Tupelo	32.5%
Pinus elliotii	Slash Pine	20.0%
Acer rubrum	Red Maple	0.5%
	Total	**53.0**%

Cypress Conservancy		
Species	**Common Name**	**Mean Cover**
Nyssa biflora	Swamp Tupelo	36.7%
Taxodium distichum	Bald Cypress	26.7%
Pinus taeda	Loblolly Pine	1.7%
Liquidambar styraciflua	Sweetgum	1.7%
Acer rubrum	Red Maple	1.0%
	Total	**67.7**%

Palmetto Hall Wooded Wetland		
Species	**Common Name**	**Mean Cover**
Nyssa biflora	Swamp Tupelo	28.8%
Liquidambar styraciflua	Sweetgum	2.5%
Acer rubrum	Red Maple	0.5%
	Total	**31.8**%