

APPENDIX G

MONITORING PLAN

The monitoring of the preservation, enhancement, creation and restoration at BHRMB will consist of both quantitative and qualitative monitoring. The quantitative vegetation and hydrologic monitoring will be conducted prior to any mitigation activities and will serve as the Baseline Monitoring data. Interim success and Long-Term monitoring will occur annually during the implementation of construction and enhancement activities, and will continue after final success criteria have been achieved. Reports will be submitted within 30 days of the associated monitoring event and / or with credit release requests associated with interim and final success attainment. Monitoring parameters consist of metrics that quantify hydrologic data and vegetation composition, cover and structure across all strata and include percent cover by species or grouping (i.e. wetland status, native status, etc.) in shrub and groundcover strata, and tree stand density of the canopy stratum. Qualitative monitoring information to be included in the annual reports will consist of:

- 1) an overall hydrologic assessment of the wetland
- 2) estimation of the percent cover and dominant species in each community
- 3) documentation of the presence and control (reduction/increase) of nuisance species
- 4) wildlife utilization
- 5) general biological integrity of each assessed community.

The monitoring data will be utilized in determining the success of the enhancement/restoration/preservation for each community type. Interim and Final Success Criteria are found in Appendix F.

Baseline Hydrologic Monitoring

As depicted on Figure 27 [Piezometer & Staff Gauge Location Map], five (5) gauges and four (4) piezometers (shallow monitoring wells) have been installed in appropriate locations throughout the BHRMB. The water levels in these locations are being monitored on a monthly basis through the summer rainy season of 2015. Baseline monitoring results will be provided to the IRT under separate cover.

Interim Success & Long-Term Hydrologic Monitoring

Following implementation of hydrologic enhancements to the Bank, additional staff gauges will be installed in created/enhanced/restored wetlands, as indicated on the planting plans for each wetland. All staff gauges and piezometers will be monitored on a monthly basis, until the final success criteria are achieved. Following release, staff gauges and piezometers will remain in place and monitored yearly.

Wetland Vegetation Quantitative Monitoring

Baseline, Interim Success and Long-Term vegetation monitoring will be conducted as described here. As depicted in Figures 24A-D, vegetation transects were established in the preservation, enhancement, creation and restoration areas on the Bank using a sub-meter Global Positioning System. Quantitative vegetation monitoring parameters consisted of:

- a) percent cover and composition of groundcover species
- b) percent cover and composition of shrub species
- c) composition of canopy and sub-canopy species
- d) stem counts of tree seedlings

Methods to be followed are according to Barry and Saha (2008). Each transect will be marked with rebar and PVC pipe at each terminus. A 50 m transect tape will be strung between the two transect endpoints at a taut/straight position for consistency. Canopy trees are defined as those woody plants with a diameter at breast height (dbh) greater than 10 centimeters (cm) (4 inches). The sub-canopy consists of tree species, excluding common woody shrubs such as wax-myrtle (*Myrica cerifera*), Carolina willow (*Salix caroliniana*), Brazilian-pepper (*Schinus terebinthifolius*), and saltbush (*Baccharis* sp.), with a dbh between 2.5 and 10 cm (1-3.9 inches). The shrub layer consists of trees with a dbh less than 2.5 cm (1 in) and any-sized shrub species. Ground cover consists of all plants not found in the other strata and consists primarily of herbaceous species.

Canopy and sub-canopy trees will be sampled along five meter wide belt transects (Mueller-Dombois and Ellenberg 1974). All canopy trees will be measured and the precise location along the transect recorded in order to facilitate re-sampling and to document mortality and recruitment. Sub-canopy trees will be counted by species to estimate density, but will not be tagged. Cabbage palms (*Sabal palmetto*) and other similar trees which tend to decrease in diameter with age will not be measured for dbh.

The composition and cover of shrub species, as defined above, will be quantified using the line-intercept method (Mueller-Dombois and Ellenberg 1974) along each transect. Intercept lengths included all overhanging or underlying shrub species. From these data, percent coverage will be estimated.

The composition of the groundcover, including bare ground, will be quantified using a one meter square quadrat placed at ten m intervals along the transect using modified Daubenmire (1959) cover classes. These seven cover classes are: <1%; 1-5%; 5-25%; 25-50%; 50-75%; 75-95%; and, 95-100%. All plant species whose stems originated from within the quadrat (including shrubs vines and tree roots) will be assigned cover class values. Shrub species will be assigned cover class values if any part of the plant overhung the quadrat regardless of where the stems originate. All plant nomenclature will follow Wunderlin (2003). Vegetation not identified to species level would be identified to the lowest taxonomic level possible and a specimen will be taken from outside of the transect as a voucher if possible.

Data Entry:

Data will be entered into a Microsoft Access database. A single table will be used for each study type: a) canopy data, b) sub-canopy data, c) shrub data, and d) quadrat data (groundcover).

Data Analyses:

Basic coverage statistics will be calculated and presented for each of the field methods including standard forestry parameters such as density and basal area for belt transect data, percent cover for shrub data, and percent cover in quadrats. Formulas for calculating these statistics are as follows:

$$\text{Stand Density} = \Sigma S_1 / \text{Area}$$

Where S_1 = the number of stems for a given species

$$\text{Shrub Percent Cover} = \Sigma S_1 / L_{\text{total}}$$

Where S_1 = the intercept length of a given species and L_{total} = the total length sampled.

$$\text{Groundcover Percent Cover} = \Sigma S_1 / S_{\text{total}}$$

Where S_1 = the percent cover of a given species and S_{total} equals the sum of all cover class values within a given quadrat or transect. Cover class values would be assigned as the median value of a cover class range and would be as follows: >1% = 0.5, 1-5% = 2.5, 5-25% = 15, 25-50% = 37.5, 50-75% = 62.5, 75-95% = 85, 95-100% = 97.5.

Upland Vegetation Monitoring Methods

Baseline, Interim Success and Long-Term vegetation monitoring will be conducted and analyzed as described above. The percent vegetation cover within the upland preservation and habitat improvement areas will be monitored as illustrated in Figures XX. One-meter square quadrats will be established along transects within each Assessment Area (AA) and placed at 10 meter (m) intervals for 100 m long transects and at five meter intervals for 50 m transects in order to representatively document the zoning and habitat. Each transect terminus will contain permanently established photographic documentation stations, where qualitative observations will be recorded in the cardinal directions. Transect termini were marked are marked using metal t-posts so they can withstand prescribed fire.

For all forested AAs, 10-meter square quadrats will be nested around the one-meter square quadrat stations, and will be used to collect quantitative data regarding shrub and tree metrics. The percent cover of shrubs will be visually estimated for each quadrat location. The number of stems within each quadrat will also be counted and grouped by species.

- **Permanent photographic Stations:** Photographs will be taken in cardinal directions at permanently established stations within each transect.
- **Monitoring Locations:** The proposed monitoring locations are illustrated in Figure XX. This figure depicts the approximate location of the vegetation transects and photo-stations, within each habitat area.

Data Entry: Data will be entered into a Microsoft Access database. A single table will be used for each study type: a) canopy data, b) shrub cover data; and, c) groundcover data.

Data Analyses: Basic coverage statistics will be calculated and presented for each of the field methods including standard forestry parameters such as density and basal area for canopy data, percent cover for shrub and groundcover data. Additionally, canopy cover will be estimated. Formulas for calculating these statistics are as follows:

Canopy

$$\text{Stand Density} = \Sigma S_1 / \text{Area}$$

Where S_1 = the number of stems for a given species

Percent Canopy Cover = estimated

Shrub

$$\text{Percent Cover} = \Sigma S_1 / S \text{ Total}$$

Where S_1 = the percent cover value of a given species and S Total equals the sum of all cover class values (including non-vegetated space) within a given quadrat.

Cover class values will be assigned as the median value of a cover class range on a modified Daubenmire cover class scale and are as follows: >1% = 0.5, 1-5% = 2.5, 5-25% = 15, 25-50% = 37.5, 50-75% = 62.5, 75-95% = 85, 95-100% = 97.5.

$$\text{Groundcover Percent Cover} = \Sigma S_1 / S \text{ Total}$$

Where S_1 = the percent cover value of a given species and S Total equals the sum of all cover class values (including bare ground and leaf litter) within a given quadrat. Cover class values are assigned as the median value of a cover class range on a modified Daubenmire cover class scale and were as follows: >1% = 0.5, 1-5% = 2.5, 5-25% = 15, 25-50% = 37.5, 50-75% = 62.5, 75-95% = 85, 95-100% = 97.5.

Qualitative Monitoring (All Assessment Areas):

Qualitative monitoring would occur within each assessment area. The condition of the vegetation, groundcover and trees, wildlife use observations, and general habitat health will be qualitatively evaluated. This evaluation consists of making observations throughout the enhanced uplands and wetlands, and at the established monitoring transects. Notes on general health and reproductive status of vegetation, estimates of cover and dominant species, notation of recruitment of new species, the presence or spread of nuisance/exotic species, will also be recorded on field data sheets. An evaluation would be made regarding how representative the monitoring areas are relative to the community being measured. Observations of wildlife will also be recorded. These observations consist of direct sightings, scat, tracks, or vocalizations.

Results and Discussion

A detailed discussion of the current community structure of each upland and wetland Assessment Area will be provided. Monitoring data will be utilized to request credit releases, as outlined in Appendix I.