CLIMATE ACTION RESERVE

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# Forest Project Design Document[1]

# National Audubon Society

## Blue Source – Francis Beidler Improved Forest Management Project

## CAR Project 683

**PDD Version: 2/7/2013**

**Reporting Period: July 17, 2007 – October 31, 2012**

**Protocol Version 3.1**

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[1] Climate Action Reserve Forest Project Design Document (PDD) Template, (April 05, 2012). http://www.climateactionreserve.org/wp-content/uploads/2010/02/Forest-Project-Design-Document-Template-Final1.docx.

# Contents

# 1. Introduction

The Blue Source – Beidler Improved Forest Management Project is located on 5,548 acres of land owned by the National Audubon Society, Inc. ("Audubon") in the tidewater region of South Carolina.

The Project Area is dominated by naturally occurring native hardwood species (including red maple, sweet gum, water oak, bald cypress, tupelo gum) in uneven aged stands with a smaller component of stands of naturally generated native softwoods (loblolly, spruce, longleaf pine) and a small area of planted loblolly pine.

The Project Area includes previously private and commercial forestlands. The majority of these lands were actively managed for timber production and harvested prior to the acquisition by Audubon. The region still has active timber operations occurring today, and no regulations or restrictions would have prevented the Owner from continuing timber harvests as of the Start Date.

In the absence of the Project, these lands could have been managed according to one of the common practices in the region, whereby an individual or industrial timber operator buys land and harvests the most valuable wood (saw timber), some pulpwood, and leaves the stands to grow forward in a degraded state. The most common management by such an owner is to cut approximately 100% of growth.

Under such management, harvest rotations would vary based upon stands' post-harvest condition, from as short as 30-40 years in pulpwood stands or up to 60-80 years in quality saw-timber stands.

However, because the Owner conveyed a permanent conservation easement to the Natural Resources Conservation Service ("NRCS") on July 17, 2007, no active management of the Project Area will occur and the property will be permanently conserved as forest.

Under the terms of the easement, the following activities and uses are among those prohibited, unless authorized by the NRCS:[2]

- Altering of grassland, woodland, wildlife habitat or other natural features by burning, digging, plowing…or otherwise destroying vegetative cover
- Harvesting wood products
- Draining, dredging, channeling, filling, leveling, pumping, diking, impounding…as well as altering or tampering with water control devices
- Planting or harvesting any crop
- Development or conversion to non-forest uses

The Project therefore avoids the release of carbon emissions from biomass and soil stocks, and results in the ongoing sequestration of carbon in future biomass growth.

[2] This is described in Part IV Section B of the easement: "Allowance of Compatible Uses by the Landowner."

The Project offers additional environmental benefits by preserving continuous forest cover near private, state, and federally protected lands. In addition, Audubon is seeking permanent conservation protection on other nearby lands.

The forest offers habitat to many animals including 63 species of herpetofauna (9 salamanders; 16 frogs/toads, 9 turtles, 8 lizards, 20 snakes and 1 crocodilian); 56 species of neotropical migrant birds; scores of mammals including beaver, river otter, mink, bobcat, black wood rat, armadillo, numerous bat species and occasionally black bear; and vast array of invertebrates.

Special birds protected by the forest include: Prothonotarty, Swainson's and Kentucky Warbler; Acadian and Great-crested FlyCatcher; Wood and Hermit Thrush; and Swallow-tailed and Mississippi Kite.

Streams within and around the Project Area contain many species of fish including redbreast sunfish, blue-gill sunfish, red ear sunfish, warmouth, black crappie, long-nosed gar, bowfin, striped bass, large-mouth bass and 3 catfish species. These streams connect with streams and rivers in which 60 other species from the Atlantic Ocean and its estuaries spawn.

The property provides habitat that could support threatened species including Rafinesque's big eared bat, federally threatened frosted flatwoods salamander, bald eagle, federally endangered wood stork, red-cockaded woodpecker, shortnose sturgeon, pondberry, and chaffseed (though this potential does not in any way constrain baseline harvesting scenarios on the Project Area.)

The National Audubon Society, Inc. ("Audubon") owns the Project Area wholly and entirely, and any reference in this PDD to the "Project Owner," "Forest Owner," or "Owner" is to Audubon.

## 2. Project Eligibility

### a. Project Type

The Project involves management activities that will maintain or increase carbon stocks on forested land relative to baseline levels and meet all CAR criteria for Improved Forest Management Projects including:

- Project takes place on land that has greater than 10% canopy cover
- Project employs natural forest management practices
- Project does not employ broadcast fertilization
- Land is not part of any previously registered Forest Project

Planned management activities include only actions needed to enhance forest and habitat health and diversity, and no commercial timber harvesting is allowed by the terms of the conservation easement. No destruction of vegetative cover of any kind can occur without prior NRCS authorization, which can only be given if the activity enhances the natural values of the easement area.

## b. Project Location and Project Area

**Project Area Maps**

Maps detailing the following elements are provided in Appendix A:

- Public and private roads
- Towns (Note: there is only one town - Sandridge - in the immediate vicinity of the Project. Holy Hill, Harleyville, Dorchester, and Ridgeville are nearby, but not within the mapped area)
- Major watercourses ($4^{th}$ order or greater)
- Topography
- Latitude and longitude

**Other Project Area Attributes**

- **Existing land cover and land use:** With the exception of non-forested acreage (e.g. roads, lakes), the Project Area is currently used for habitat preservation and passive recreation (e.g. birding, hiking, canoeing).
- **Forest vegetation types:** Swamp and riverine hardwoods comprise the forested portion of the Project Area.
- **Site class:** The entire area is in a low CAR site productivity class (please see section 3e(v) for details).
- **Land pressures:** Intensive forestry and recreational, residential and commercial development, as occurring in adjacent areas.
- **Climate zone:** Humid Sub-Tropical

**Project Location**

Privately owned land in the United States (eligible without agency approval). See Appendix A for map.

**Project Area Definition**

Total area covered by conservation easement, less areas protected by pre-existing deed restrictions at the time as of the Start Date.

The entire Project Area falls into the Atlantic Coastal Plain & Flatwoods / Swamp Hardwood and Cypress Supersection / Assessment area per the Protocol.

**Table 1: Easement and Project Area Acreage**

| Easement vs. Project Area Acreage | | |
|---|---|---|
| | Easement Acreage | 6,127.0 |
| | Excluded Parcels | (578.9) |
| | **Project Area Acreage** | 5,548.1 |
| **Included Parcel #** | **Tract Name** | **Acres** |
| Parcel 1 | Original Tract | 3,415.0 |
| Parcel 2 | Georgia Pacific - 1988 | 821.0 |
| Parcel 3 | Georgia Pacific - 1987 | 514.4 |
| Parcel 4 | Georgia Pacific - 1986 | 283.7 |
| Parcel 5 | Georgia Pacific - 1986 | 149.8 |
| Parcel 6 | Jane Mims - 1988 | 127.2 |
| Parcel 7 | T. Mims - 1976 | 77.0 |
| Parcel 8 | TNC & Georgia Pacific | 74.3 |
| Parcel 9 | T. Mims - 1974 | 43.5 |
| Parcel 10 | Jane Mims - 1988 | 11 |
| Parcel 11 | Clay Mims - 2004 | 10.2 |
| Parcel 12 | Reeves - 1993 | 10.0 |
| Parcel 13 | Georgia Pacific - 1986 | 5.6 |
| Parcel 14 | T. Mims - 1974 | 5.6 |
| | **Project Area Acreage** | 5,548.1 |
| | Non-Forested | -46.3 |
| | **Forested Project Area** | 5,501.8 |

The total easement acreage is 6,127 acres, but when parcels with deed restrictions are excluded the total Project Area acreage is 5,548 acres. Forty-six acres of the 5,548 acres are non-forested, which makes the total forested acreage approximately 5,502 acres. The non-forested area includes buildings, power lines and ponds.

Please note that the above acreages have been rounded to the nearest 10$^{th}$ acre for the purpose of providing an overview. As a result, they do not sum to the totals shown (5,548.1 and 5,501.8), which were determined by summing the precise acreage associated with the legal description in each parcels' deed.

## c. Additionality – Legal Requirement Test

Planned management activities that will increase carbon stocks over baseline were not legally required by any federal, state, or local regulations at the time the easement was conveyed on the Start Date. There have not been any violations, environmental notices, non-compliance events, or any other legal requirements that would prevent the Project from meeting the eligibility criteria.

South Carolina foresters active in the surrounding area provided forest carbon inventory services, characterized baseline management practices, and confirmed the legality of both baseline and project management activities.

## d. Additionality – Performance Standard Test

Improved Forest Management projects automatically satisfy the Protocol's Performance Standard Test.

## e. Broadcast Fertilization

The Project will not utilize broadcast fertilization.

## f. Project Start Date

The Project Start Date was determined based on the recorded date of a forest conservation easement conveyed to the Natural Resources Conservation Service on July 17, 2007.[3]

Prior to acquisition by the Project Owner, previous owners commercially harvested timber on the property through the 1980s. While forest treatments were subsequently reduced, at the time the easement was conveyed, no legal restrictions prevented the Project Owner from pursuing common practice management of the Project Area.

Conveyance of the easement and initiation of the carbon project therefore marked the action that permanently and completely prevented common practice management of the Project Area and enabled perpetual maintenance in its natural state without timber revenues. This action thereby increased sequestration and/or decreased emissions relative to the baseline, consistent with the Protocol's definition of Start Date, as well as Protocol revisions that explicitly define easement conveyance as an action determining IFM project Start Date.

## g. Sustainable Harvesting Practices

N/A – No commercial timber harvesting or biomass destruction or removal is ongoing, planned, or allowed by the terms of the conservation easement.

## h. Natural Forest Management

The Project Area meets all CAR natural forest management criteria.

### i. Native Species

There are no known non-native tree species in the Project Area as seen in the Species Distribution table below. Any unknown species encountered during the inventory (which could potentially be individual

[3] The easement was signed on June 4, 2007, but was not recorded until July 17, 2007 when three separate copies of the easement were recorded in Dorchester, Berkeley, and Orangeburg counties.

exotic trees transported by wind or water) were recorded as "Other Hardwood Species" which account for <1% of the inventory volume.

**Table 2: Native Species Distribution**

| Species | Basal Area / acre (ft^2) | % Basal Area |
|---|---|---|
| ash species | 3.2 | 1.6% |
| baldcypress | 29.7 | 14.9% |
| birch species | 0.1 | 0.1% |
| blackgum, black tupelo | 70.1 | 35.2% |
| cherrybark oak | 0.3 | 0.2% |
| common persimmon | 0.3 | 0.1% |
| elm species | 5.9 | 2.9% |
| green ash | 1.6 | 0.8% |
| hickory species | 1.4 | 0.7% |
| laurel oak | 29.8 | 15.0% |
| loblolly pine | 4.4 | 2.2% |
| longleaf pine | 0.1 | 0.0% |
| other hardwood species | 1.5 | 0.8% |
| overcup oak | 1.5 | 0.8% |
| pond pine | 0.1 | 0.1% |
| red maple | 12.1 | 6.1% |
| southern red oak | 0.2 | 0.1% |
| spruce pine | 1.3 | 0.6% |
| swamp chestnut oak | 0.6 | 0.3% |
| sweetbay | 0.3 | 0.2% |
| sweetgum | 12.7 | 6.4% |
| sycamore | 0.0 | 0.0% |
| water oak | 20.4 | 10.2% |
| white oak | 1.1 | 0.5% |
| willow species | 0.0 | 0.0% |
| yellow-poplar | 0.5 | 0.2% |
| **Total** | **199.2** | **100.0%** |

Note: Values do not sum to totals due to rounding differences.

### ii. Composition of Native Species

No individual species accounts for more than 60% of the total basal area, the lowest Composition of Native Species percentage value established for this Assessment Area.

#### iii. Distribution of Age Classes / Sustainable Forest Management

Given that no timber harvest or even-aged management is planned, the concept of stand age does not apply. Over time, all stands are expected to maintain a smaller number of mature trees over 100 years old and a larger number of younger trees in the understory. Therefore, at no time is it anticipated that the Project Area will maintain more than 40% of forested acres in ages less than 20 years. (Note: The last commercial harvests on the Project Area occurred in the mid-1980s on <40% of the acreage.)

As no harvesting will occur on Project Area forestlands, the Protocol's sustainable forestry requirements are met.

#### iv. Structural Elements

Based on 2012 inventory data, in areas that were not subject to salvage harvest in the prior year (entire Project Area), standing deadwood accounts for 5.3 mt $CO_2e$ / acre or 2.6% (>1%) of the carbon in standing live trees. Because standing and lying dead carbon stocks are expected to remain stable over time at 5.3 mt CO2e per acre (as no standing or lying dead wood removal is allowed under the terms of the conservation easement), the start date and future standing dead wood stocks are also assumed to be 5.3 mt CO2e per acre.

### i. Ongoing Management Activities

No commercial timber harvesting is ongoing, planned, or allowed by the terms of the conservation easement. All planned and allowed activities are designed for the improvement of forest health and habitat. At the present time, Audubon plans to chemically control oak invasion on a long leaf regeneration tract (<15 acres total), burn the pine area when fuel loads allow, and possibly thin the long leaf pines to an open savannah density if required.

## 3. Inventory Methodology

### a. GHG Assessment Boundary

The following carbon pools are included in the Project's GHG Assessment Boundary:

1. Standing live carbon (carbon in all portions of living trees)
2. Standing dead carbon (carbon in all portions of dead trees)
3. Carbon in in-use forest products
4. Forest product carbon in landfills (when project harvesting is below baseline)
5. Biological emissions from site preparation activities
6. Biological emissions/ removals from changes in harvesting on forestland outside the Project Area (when project is below baseline)
7. Biological emissions from decomposition of forest products

## b. Inventory Design and Sampling Process

**Number of Sample Plots**

In May-June 2011, 45 forest inventory plots were sampled as part of a preliminary feasibility assessment of the Project. An additional 156 plots were sampled in January-April 2012 to further improve inventory confidence.

**Dimensions of Plots**

The inventory program is based upon a system of two nested fixed radius plots:

**Table 3: Inventory Plot Dimensions and Parameters**

| Plot | Plot Radius | Trees Included | Parameters Collected |
|---|---|---|---|
| 1/10th Acre | 37.2' | Standing live and dead >5" diameter at breast height ("DBH") | Species<br>DBH[4]<br>Total height<br>4" Top height (Balsam Fir, E. Hemlock, Green Ash)[5]<br>Strata confirmation<br>Dominant tree age / height) |
| 1/100th Acre | 11.8' | Standing live and dead 1.0-4.9" DBH | Species<br>DBH |

**Distribution of Phase I Plots (2011 Inventory Samples)**

Plot locations were generated for the 2011 inventory as follows:

A total sample size of 400 plots was generated as this was initially thought more than sufficient to provide a sampling error of +/- 5% at the 90% confidence level. Plots were mapped on pre-defined grids with a random starting point and fixed distance between points that varied by primary cover types.

Phase I focused on taking no less than 40 plots and no more than 60. Thus, 60 plots were randomly selected from the set of 400, and a total of 45 plots were sampled in Phase I.

**Distribution of Phase II Plots (2012 Inventory Samples)**

In 2012, based on preliminary sampling results, it was determined that only one-half of the original plot total (400) would be sufficient for the Project. Thus, Phase II plots were selected in a systematic manner such that every other plot (as well as plots sampled in Phase I) were skipped. A uniform distribution of plots was also a sought in the selection of additional plots to sample in Phase II (by visually looking at the plots gridded on the maps). Thus, 156 additional plots were sampled in Phase II.

[4] Please note that DBH was measured to the nearest inch for the phase I plots, and to nearest tenth of an inch for Phase II plots to improve accuracy.
[5] Added for Phase II and future sampling.

**Sampling Process**

Please see Section 3c for description of sampling process.

**Site Index Sampling**

Please see section 3e(v) for a description of the site index sampling process.

**Pre-Sampling Stratification**

Prior to sampling, the area was stratified based on assumed dominant species.

**Post-Sampling Stratification**

If during sampling, a forester found that stand species did not match the pre-assigned type, it was re-classified and records were later modified accordingly in data management and mapping. This did not affect the design of subsequent 2012 sampling, which was carried out by completing the full set of plot locations found in the previously generated grid without reference to strata.

For final inventory calculations, the Project Area was broken out into four strata based on differences in infrared aerial imagery reflecting differences in the water table (wetter sites have a slightly different spectral signature than the drier sites). Compartment 2 Stand 1 and Compartment 3 Stand 1 are in wetter areas of the property, whereas the other 2 strata are drier. The overall species mix is the same among the different stratum, with the exception of softwoods, which can only grow on the drier sites and a higher proportion of the most water tolerant species (bald cypress, blackgum) on the wetter sites.

The final four strata are:

- Compartment 2, Stand 1
- Compartment 2, Stands 2, 3 and 5
- Compartment 3, Stand 1
- Compartment 3, Stands 2, 3, 5, and 6

**Strata Acreage**

Total Project Area acreage was determined from the sum of the acreages (5,548 total acres / 5,502 forested acres[6]) stated in the deeds and based on physical historic surveys for each parcel. In contrast, Project Area maps were developed from GIS analysis, which digitized each deed's metes and bounds into GIS polygons. Due to the difference in these approaches, the deed acreages did not match GIS shape file acreages. Surveyed deed acreages were chosen to represent the Project acreage in carbon calculations as these acreages and documents correspond to legal ownership.

[6] Non-forested acreage was calculated from digitized polygons in GIS and subtracted from the total deed acreage

Because strata boundaries were determined via analysis of aerial imagery of GIS polygons, these GIS calculations (5,464 forested acres) diverged slightly from the Project Area acreage determined from deeds (5,502 forested acres). To determine the actual strata acreages corresponding to deed and Project Area acreage, each strata was scaled proportionally so that total strata acreage equals total Project Area based on deed acreage:

**Table 4: Strata Acreage Calculations**

| **Strata** | **GIS Strata Acreage (based on aerial imagery)** | **% of Total Acreage** | **Adjusted Strata Acreage (based on Deed Acreage)** | **% of Total Acreage** |
|---|---|---|---|---|
| Compartment 2, Stand 1 | 2,221 | 41% | 2,236 | 41% |
| Compartment 2, Stands 2, 3 and 5 | 314 | 6% | 316 | 6% |
| Compartment 3, Stand 1 | 1,120 | 20% | 1,128 | 20% |
| Compartment 3, Stands 2, 3, 5, and 6 | 1,809 | 33% | 1,821 | 33% |
| **Total** | **5,464** | **100%** | **5,502** | **100%** |

## c. Field Measurement and Plot Monumenting

**Selection Process for Inventory Point Locations**

Please see Section 3b for description of process used to select inventory plot locations.

**Tools Used to Monument Plots**

The center of each plot was marked by pushing flagging into the ground and placing PVC tubing at plot center. In addition, a metal bolt was placed in the ground adjacent to the PVC tubing.[7] All sample trees were painted with a line at ground level. Additional flagging was tied at eye level near each plot center and the first tree tallied was also be flagged. The plot number and cruiser's initials were marked on the flag at plot center.

**Sampling Method and Measurement Methodologies**

Field crews were provided a field instruction manual (provided separately to verifier) and all necessary equipment, including:

- Hand Held Data Recorder
- DME
- Loggers Tape (>75 foot recommended)
- Increment borer

[5] In Phase 1 sampling, metal pins were not used to monument plots and DBH was measured to nearest inch rather than 10th of inch.

- Compass
- Clinometer
- Pencils and permanent marker
- Flagging
- Cover type Maps and Aerial Photographs
- GPS units with point location data
- Paint tubes (for marking DBH measurement point and trees measured).
- Permanent plot stakes
- Paper tally sheets (for when handheld fails to work)
- Plot record form – records plot specific information (age, total height, stand conditions)
- Overview and point location maps.
- Point strata records (lists what strata the point should be representing)
- Point change forms (used to record when points need to be relocated, or a strata change indicated)
- Recommended: Metal detector to find stakes at previously sampled plots

Please see Table 7, for data parameters and measurement methodology.

**Sampling Intensity**

Please see Section 3b.

## d. Data Management System

Data was collected on hand held computers running Two Dog / Pocket Dog timber cruise software, with each plot saved as one file. Data was periodically collected from cruisers and transferred to computers, without editing, with multiple backups (hard drives, CD). For workup, data is transferred from Excel to Microsoft Access.

**Quality Control Procedures**

Database descriptions of raw data included a field description of calculations. Queries that modified or generated new data within the database were numbered sequentially so the original process could be recreated. Throughout, a record of the source and location of individual raw data files was maintained so that data roots could be traced back to field notes. If a point location was moved from its original mapped location, a description of that move can found in the database, shapefile, and raw data files.

Cruise specifications were followed using two man teams, meaning two sets of eyes were continuously onsite to ensure specifications were correctly followed. At the beginning of the cruise, members of the inventory design team accompanied all crews on initial plots to confirm the methodology was being correctly interpreted and implemented. Following sampling, plot/tree data was checked by a different team member for validation and reasonableness.

## e. Quantification Methodology

Carbon in live and dead trees was quantified based on Appendix A of FPP v3.1, as well as guidance provided on the Reserve's website: (http://www.climateactionreserve.org/how/protocols/forest/biomass-equations/.

### (i) Standing Live Biomass: Inventory

Biomass is computed using the component ratio method and Jenkins coefficients following the procedures and equations outlined in "The Forest Inventory and Analysis Database: Database Description and Users Manual Version 4.0 for Phase 2" and as specifically described in Appendix J Tables 1 thru 4. Gross cubic foot volume is calculated using equations developed by McClure and Cost (2010) and Hahn (1984), and Scott (1981), with appropriate coefficients by species and DBH (CAR, Cubic Foot Volume Equations for the United States outside of California, Washington, Oregon, Alaska, and Hawaii, 9/23/10). For unknown species, the "unknown or other live tree species" equation was used from CAR's "Cubic Foot Volume Equations for Southeastern United States." [8]

The only equation that used the Scott equation was green ash. Only one species in this supersection – American elm – uses the Hahn equation. For inventory calculations of "elm spp." the McClure and Cost, 2010 (equation 970) was used because the inventory methodology did not differentiate between different species of elm.

Sound cubic foot volume was determined from Forest Inventory and Analysis (FIA) data from 2007-2011 for Dorchester, Berkeley, and Orangeburg counties in South Carolina.

The ratio between total gross cubic volume and sound cubic volume for every FIA species group was used to determine the average percent defect in each Project species group. Sound cubic volume was calculated by multiplying the gross cubic volume by the percent defect for each species group. The following table shows the percent defect applied to each species:

[8] Climate Action Reserve. *Cubic Foot Volume Equations for the Southeastern United States*: 2010. <

**Table 5: Average Percent Defect by Species Group**[9]

| Species | % Defect |
|---|---|
| ash species | 5.66% |
| baldcypress | 1.32% |
| birch species | 3.97% |
| blackgum, black tupelo | 4.92% |
| cherrybark oak | 3.37% |
| common persimmon | 5.03% |
| elm species | 3.97% |
| green ash | 5.66% |
| hickory species | 5.10% |
| laurel oak | 3.37% |
| loblolly pine | 0.22% |
| longleaf pine | 0.18% |
| other hardwood species | 3.97% |
| overcup oak | 3.37% |
| pond pine | 0.81% |
| red maple | 7.02% |
| southern red oak | 3.37% |
| spruce pine | 0.81% |
| swamp chestnut oak | 3.37% |
| sweetbay | 5.03% |
| sweetgum | 1.79% |
| sycamore | 3.97% |
| water oak | 3.37% |
| white oak | 0.74% |
| willow species | 5.03% |
| yellow-poplar | 6.33% |
| **Total Weighted Average % Defect** | **3.55%** |

## (ii) Adjustments for Sampling and Start Dates

All inventory samples were assigned a date of March 30, 2012 - when inventory sampling was completed.

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[9] Source: *Forest Inventory Data Online (FIDO)*. Forest Inventory and Analysis (FIA), n.d. Web. 17 Sep 2012. <http://apps.fs.fed.us/fido/>.

To determine project and baseline stocks at the Start Date, the inventory was "grown-back" 5 years using the following steps in FVS and Excel:

1) Current inventory data was grown forward five years in FVS using the No Mortality keyword so that every tree was grown forward 5 years with no tree mortality.
2) Annual DBH and height growth was calculated by calculating the change in DBH and height between the inventory trees and the five year growth-trees.
3) The five-year DBH and height growth for every tree was subtracted from the inventory DBH and height to get the start date DBH and height.

No disturbances were modeled in the grow-back period as no significant disturbances were documented in this period. Any disturbances that did occur between 2007 and 2012 would lower the 2011-2012 inventory stocks, and this diminution would be reflected in the grown-back stocks.

After the current inventory data had been degrown to the Project Start Date, the initial carbon stocks were calculated using the carbon quantification methodology outlined in section 3e(i). The initial average aboveground live carbon stocks (weighted by strata) were 158.2 tonnes CO2e/acre. This result allowed us to determine whether the initial carbon stocks were above or below the common practice, per step 2 of section 6.2.1 of the FPP. The calculated common practice aboveground live CO2e for the Atlantic Coastal Plain & Flatwoods / Swamp Hardwood and Cypress Assessment area was 76.68 tonnes CO2e/acre, lower than our initial stocks (initial carbon stocks above baseline).

Please note that standing dead was assumed to be held constant at 5.3 mt CO2e/acre between 2007 and 2012.

### (iii) Estimation of 4" Top Height (2011 samples) and Merchantable Height (all samples)

Total height was measured in all samples and 4" top height of relevant species (Balsam Fir, E. Hemlock, Green Ash) was collected in 2012 sampling. In phase I sampling none of these species were found, so no adjustments were needed. As a result, a function for 4" top height based on DBH and total height was not needed because 4" top height was measured on these species.

Merchantable height was not measured in any samples. For projections of baseline wood products, merchantable wood was considered to be the CRM-adjusted bole.

### (iv) Standing Live Biomass – Projected Growth

The southeastern variant of the Forest Vegetation Simulator[10] was used to model forest growth, mortality and harvest over 100 years.

Plot data was entered into a database readable by FVS, with each plot entered as an individual stand and each tree record multiplied by the appropriate factor to determine trees per acre. Multiple

[10] Keyser, Chad. United States. Department of Agriculture Forest Service. *Southern (SN) Variant Overview Forest Vegetation Simulator*. Fort Collins: 2011.

databases needed to be created because FVS can only read 3000 tree records at a time and has limitations on the number of tree records that can be output into a tree list database. As a result, a separate database was created for each stratum.

After entry to FVS, the "forest" is grown 100 years and the resulting tree list used to calculate biomass. Simulations were conducted in 5-year increments with no harvests occurring in the project scenario.

The default settings for the Southern Variant are shown in the following table. These defaults are modified as described above (10 projection cycles, 5-year projection cycle). A location code for the Francis Marion forest was used.

**Table 6: FVS Southern Variant Default Parameters**

| Parameter or Attribute | Default Setting |
|---|---|
| Number of Projection Cycles | 1 (10 if using Suppose) |
| Projection Cycle Length | 5 years |
| Location Code (National Forest) | 80106 – NF in Alabama – Talledega Ranger District |
| Ecological Classification Code | 231Dd (Quartzite and Talladega Slate Ridge) |
| Slope | 5 percent |
| Aspect | 0 (no meaningful aspect) |
| Elevation (Default location) | 7 (700 feet) |
| Latitude (Default location) | 32.37 |
| Longitude (Default location) | 86.30 |
| Site Species | 63 (white oak) |
| Site Index | 70 (total age; 50 years) |
| Maximum Stand Density Index | Forest Cover Type specific |
| Maximum Basal Area | Forest Cover Type specific |
| Volume Equations | National Volume Estimator Library |
| Volume Specifications: | |
| Pulpwood Volume | Minimum DBH / Top Diameter Inside Bark |
| Softwoods Default | 4 / 4 |
| 7 – spruce pine (SR) | 6 / 4 |
| 13 – loblolly pine (LP) | 6 / 4 |
| Hardwoods - Default | 4 / 4 |
| 39 – loblolly-bay (LB) | 6 / 4 |
| 43 – black walnut (WN) | 6 / 4 |
| 44 – sweetgum (SU) | 6 / 4 |
| 52 – mulberry species (MB) | 6 / 4 |
| 53 – water tupelo (WT) | 6 / 4 |
| 55 – swamp tupelo(TS) | 6 / 4 |
| 63 – white oak (WO) | 6 / 4 |
| Stump Height | 1.0 foot |
| Sawtimber Volume | Minimum DBH / Top Diameter Inside Bark |
| Softwoods Default | 10 / 7 |
| 2 – redcedar species (JU) on Ozark & St. Francis NFs | 9 / 7 |
| Hardwoods - Default | 12 / 9 |
| Stump Height | 1.0 foot |
| Sampling Design: | |
| Large Trees (variable radius plot) | 40 BAF |
| Small Trees (fixed radius plot) | 1/300th Acre |
| Breakpoint DBH | 5.0 inches |

There were no species not included in the biomass equations required by CAR, so no substitutions needed to be made.

### (v) Site Index Determination

The goal of the site index sampling was to determine the site index values for each stratum. These values were used to determine Forest Service productivity classes and to calibrate the growth rates for the FVS modeling.

The site index values for each strata were based on an analysis of height and age samples of dominant and co-dominant sweetgums (liquidambar styraciflua) and blackgums (nyssa sylvatica var. biflora) sampled along transects across the Project area. Blackgum was selected as a site index species because it is the most common species across the property, and Sweetgum was also selected because it is a typical site index species in the southeast, and is often listed as a site species in the NRCS soils data for the surrounding counties.

In total, 58 dominant and co-dominant trees (37 blackgum, 21 sweetgum) were sampled. Site index curves from "Site Index Curves for Tree Species in the Eastern United States"[11] were used to determine the site index values (base age 50) for each tree.

Sweetgum values were converted to a common site index value (blackgum) based on a conversion factor developed in the analysis of productivity. The conversion factor solved for the blackgum site index that was equivalent to the sweetgum site index, based on the equivalent productivities.

The strata-level blackgum index averages were used to calibrate the growth model. The results of the site index analysis are as follows:

**Table 7: Site Indices by Strata**

| Strata | Average Site Index (blackgum) | Acreage | % |
|---|---|---|---|
| Compartment 2 Stand 1 | 60.5 | 2,236 | 41% |
| Compartment 2 Other Stands | 69.0 | 316 | 6% |
| Compartment 3 Stand 1 | 68.3 | 1,128 | 20% |
| Compartment 2 Other Stands | 68.0 | 1,821 | 33% |
| **Total / Weighted Average** | **65.1** | **5,502** | **100%** |

FVS was used to apply the above site indices to the other species; FVS automatically translates each species-specific site index to a corresponding site index for every other other species in the variant for which an individual site index was not entered.[12]

There was no need for additional model calibration, as defaults for the location code were used.

**Site Index Determination Issues and Resolutions**

An Associate Professor of biometrics at the Auburn University School of Forestry and Wildlife provided guidance on the following issues:

[11] Source: USFS. "Site Index Curves for Forest Tree Species in the Eastern United States" (1989).

[12] Dixon , Gary E. United States Department of Agriculture. Forest Service. *Essential FVS: A User's Guide to the Forest Vegetation Simulator*. Fort Collins: 2002.

1. Trees measured in the Beidler Forest were older than the upper end of the range presented on the site index curve. This was resolved by assuming that current tree height has been constant since the oldest age given on the curve.

2. While the Beidler Forest is mostly a bottomland hardwood forest, the site index equations didn't specifically indicate what type of sites were sampled for their development. This was determined not to be an issue because: 1) the blackgum curve (developed in the Georgia coastal plain) was most likely developed from similar sites, and 2) even though the sweetgum curve was likely developed on drier soils, sweetgum growing on wet sites would be expected to show lower site index values because such sites are in fact less productive for sweetgum. This is because sweetgum is under considerable stress on exceedingly wet sites.

3. Some sampled trees may have been suppressed in early years but became dominant after being released (natural or harvest disturbance). This was determined to not be an issue as: 1) blackgum are a shade tolerant species that often live in the understory and will become dominant following an opening in the canopy and, 2) no sweetgum trees sampled displayed signs of early suppression.

**Modeling of Project Harvest and Management Prescriptions**

Because no timber harvesting will occur in the Project Area, no management prescriptions were modeled in the Project Scenario.

**Modeling Natural Regeneration**

Because no timber harvesting will occur in the Project Area, no natural regeneration was modeled in the Project Scenario.

### (vi) - Standing Dead Wood

Standing dead trees' carbon stock was calculated using the same methods applied to the aboveground live biomass (see section 13.1). Total volume was calculated using the appropriate CAR volume equation, and deductions were made to account for missing/rotten portions of the tree. The measurements taken in the field were DBH, total height, total height as the tree originally stood, and percent missing in each third of the original tree height.

These measurements were then used to calculate % missing or rotten in the tree by assuming that the top third of the tree contains 5% of the volume, the middle third contains 25% of the volume, and the bottom third contains 70% of the volume. This assumption is based on the proportional volume of a cone. The percent defect was then used to convert from gross volume to sound volume, and then the component ratio method was used to calculate biomass, and carbon.

### (vii) – Belowground Live/Dead

The belowground portion of live and dead trees is calculated using the component ratio method ("CRM") described in Appendix J of the FIA documentation cited by the Reserve.

### f. Inventory Update Process

Each year, the forest biomass carbon inventory will be updated by:

1. Incorporating new forest inventory data sampled every 12 years (or 18 as allowed by FPP)
2. Modeling growth since the last inventory using FVS or another approved growth model
3. Updating for significant disturbances and harvests by estimating the acres affected, and the percent of onsite carbon lost as a result.

## 4. Baseline Carbon Stocks

### ii. Legal Constraints

Baseline carbon stocks were modeled using the FVS model and variant described below.

In South Carolina, forest management and timber harvesting, including drainage improvements and road building, are implemented using the guidelines published in "South Carolina's Best Management Practices for Forestry," a publication of the SC Forestry Commission.[13] The South Carolina Forestry Commission oversees compliance with these requirements, and publishes the results of their inspections annually.

Best Management Practices (BMPs) address only soil and water quality, but do not mandate specific forest management prescriptions, and are strictly voluntary outside of critical habitat areas. (In the Project Area, no acres are subject to this requirement.)

The only voluntary restriction on baseline harvesting in the Project Area is maintenance of a 40' primary Stream Management Zone ("SMZ") buffer (no secondary buffers under state BMPs) along a single "non-braided" stream.[14] The non-braided stream designation was based on "Best Management Practices for Braided Stream Systems: A Supplement to the 1994 BMP Manual".[15].

In the SMZ, no harvesting occurred so that this area would adequately shade and protect the stream from temperature fluctuations. This ensured that the SMZ always maintained the 50 $ft^2$ BA limit.

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[13] South Carolina Forestry Commission. *South Carolina Best Management Practices for Forestry*. 2011

[14] All BMPs are voluntary, even those relating to SMZs. However, loggers who do not follow regional timber buyers risk losing preferred supplier status with some regional timber buyers concerned with sustainable forestry.

[15] South Carolina Forestry Commission. *Best Management Practices for Braided Stream Systems: A Supplement to the 1994 BMP Manual*. Print. <http://www.state.sc.us/forest/braid.htm>.

### iii. Financial Constraints

Generally speaking, mature bottomland hardwood forests with 100 tons per acre are considered to be merchantable. This was determined by professional foresters in South Carolina based on general knowledge of similar harvesting operations in the area. Evidence on the viability of this assumptions can be found in "Economic Analysis of Bottomland Silviculture," which shows economically viable harvests of natural bottomland hardwood stands in the southeast with 95 tons per acre.[16] Swamp hardwood logging ("shovel logging") occurs on comparable forests in the area. While bottomland hardwood forests require special harvesting equipment and techniques, this expertise and equipment is available as evidenced by recent harvests that have occurred nearby.

Historic harvests that occurred in the Project Area offer further evidence of the viability of logging in this forest type.

There are also minimum (40 acres) and maximum (300 acres) harvest sizes modeled in any given year.

This minimum was incorporated into the model by overlaying a grid corresponding to 40 acre blocks, which were then joined based on size. Smaller blocks cut up by tract boundaries were joined, and those blocks lacking an inventory plot were joined with an adjacent block containing a plot.

The minimum acreage considered to be financially viable for a single crew to harvest in a given year was 40 acres. This number was derived from the tonnage a crew would need to harvest to defray the expense of transporting and setting up equipment, building roads, and site preparation.

A 40-acre site with 100 tons/acre (~3 loads) of sawtimber would generate 4,000 tons or 120 loads of sawtimber, plus pulpwood, which is financially viable (based on logging costs and revenues described below).

The smallest modeled harvest for a given year in the baseline scenario (184 acres) was significantly larger than the 40-acre minimum economic harvest.

The maximum harvest was set at ~300 acres/year, the approximate maximum one logging team can harvest in a year. This is a conservative assumption because several crews could be hired in a given year to harvest larger tracts.

The viability of the 40-acre minimum and 300-acre maximum harvests is evidenced by nearby recent harvests that were smaller than the minimum of 40 acres, and larger than the maximum 301 acres modeled in the baseline scenario.

(Please note: Harvests slightly over 300 acres [~301 acres] were allowed in the model because it was assumed that the excess acre could be harvested in the following year or working overtime. This is viable because no two harvest years had harvests over 300 acres in two consecutive years.)

For financial modeling, logging costs were assumed to be $18/ton, and road building costs were assumed to be $8/foot. This was determined by professional foresters in South Carolina based on

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[16] Busch, Tom. "Economic Analysis of Bottomland Silviculture." *Timberland Associates*. Timberland Associates, n.d. Web. <www.timberlandassociates.com/images/Economic_Anal.pdf>.

general knowledge of prevailing costs for similar harvesting operations in the area. Evidence on the viability of such assumptions can be found in "Economic Analysis of Bottomland Silviculture" and "Cost Estimation Guide for Road Construction."[17] The model utilized road building assumptions based on the proximity of stands to existing roads.

Prices for saw timber and pulp of different tree species were assumed to be the following:[18]

**Table 8: Sawtimber Prices:[19]**

| Species | Price/Ton[20] | Delivered[21] Price/tons |
|---|---|---|
| birch | $ 20.00 | $ 40.00 |
| black gum/tupelo | $ 20.00 | $ 40.00 |
| elm | $ 20.00 | $ 40.00 |
| hickory | $ 20.00 | $ 40.00 |
| sweetbay | $ 20.00 | $ 40.00 |
| other hardwood | $ 20.00 | $ 40.00 |
| over cup oak | $ 20.00 | $ 40.00 |
| pond pine | $ 20.00 | $ 40.00 |
| spruce pine | $ 20.00 | $ 40.00 |
| sweetgum | $ 20.00 | $ 40.00 |
| sycamore | $ 20.00 | $ 40.00 |
| laurel oak | $ 25.00 | $ 45.00 |
| water oak | $ 25.00 | $ 45.00 |
| white oak | $ 25.00 | $ 45.00 |
| yellow poplar | $ 25.00 | $ 45.00 |
| bald cypress | $ 30.00 | $ 50.00 |
| red maple | $ 30.00 | $ 50.00 |
| southern red oak | $ 30.00 | $ 50.00 |
| swamp chestnut oak | $ 30.00 | $ 50.00 |
| ash | $ 35.00 | $ 55.00 |
| cherrybark oak | $ 35.00 | $ 55.00 |
| green ash | $ 35.00 | $ 55.00 |
| persimmon | $ 35.00 | $ 55.00 |

[17] US Department of Agriculture. Forest Service. *Cost Estimating Guide for Road Construction*. 2012. Print. <www.fs.usda.gov/Internet/FSE.../stelprdb5279284.pdf>.

[18] Please see the South Carolina Timber Report for second quarter 2012, as well as the South Carolina Timber Mart South second quarter 2012, as evidence of feasibility of these prices.

[19] South Carolina professional foresters provided inputs to *Tables 8: Sawtimber Prices* and *Table 9: Pulp Prices* based on general knowledge of prevailing prices for different species and forest products in lower South Carolina.

[20] Price/ton refers to the price paid to the landowner for the trees (stumpage price)

[21] Delivered price/ton refers to the price that is paid at the mill or plant

**Table 9: Pulpwood Prices**

| Pulpwood | Price/Ton | Delivered Price/tons |
|---|---|---|
| Pine | $ 8.00 | $ 23.00 |
| Hardwood | $ 5.00 | $ 20.00 |

The baseline scenario was shown to be financially viable as it generates positive NPV (~$1,730/acre) over the life of the Project (while taking into account all legal, physical, and biological constraints) using a 6% discount rate. Therefore harvesting the Beidler property would be a financially viable option in the absence of the Project.

### iv. Estimate Baseline Onsite Carbon Stocks (Private Lands)

**Silvicultural Methods Modeled**

Clearcuts and thins were the silvicultural methods modeled in the baseline. As is noted in "Economic Analysis of Conservation Forestry Practices Applicable to the South Carolina Lowcountry" clearcutting is currently the most common form of harvesting bottomland hardwood in the region.[22] As described above, the maximum financially viable acreage to be harvested in a given year was conservatively determined to be approximately 300 acres, so groups of stands totaling approximately 300 acres or less were selected to be clearcut for each year. The northern-most groups of stands were harvested first, and each year more southern stands were harvested.

Rotation age was set at 60 years. This rotation length is economically feasible based on "Economic Analysis of Bottomland Hardwood Silviculture,"[23] which states 50 years is economically feasible for bottomland hardwood forests in the southeast.

To model these clearcuts in FVS, common harvest years were selected for each compartment and harvests were modeled to take place in those common years:

- Compartment 2: 2017 and 2077 for harvest periods 1 and 3
  - 2017 is the middle year for years 2013-2021
  - 2077 is the middle year for 2073-2081
- Compartment 3: 2027 and 2087 for harvest periods 2 and 4
  - 2027 is the middle year for years 2022-2031
  - 2087 is the middle year for 2082-2092

This approach was used for modeling efficiency as it allows modeling of just 4 harvests rather than 40. In addition, FVS models in 5-year increments, making it impossible to model annual harvests.

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[22] Straka, Thomas. "Economic Analysis of Conservation Forestry Practices Applicable to the South Carolina Lowcountry." June, 2012. <http://www.clemson.edu/psapublishing/pages/forestry/forlf36.pdf>.

[23] An economic analysis by the Timberland Associates (Busch 2009)

This approach is valid since it generates the same *average* baseline carbon stock over the harvest period, as would specifying the individual harvests for every year. This is because the *average* annual harvest and growth rates for a given period are the same regardless of whether all the acreage is harvested in a single year or in multiple harvest years.

The breakpoint DBH for sawtimber and pulpwood for all harvests was 13.5" for sawtimber, and 5" DBH for pulpwood. The minimum top diameter for sawtimber was assumed to be 10", and the minimum top diameter for pulpwood was assumed to be 2".

For the SMZ's (stands 822 and 823), no harvesting occurred. This met the 50 $ft^2$ BA limit for the SMZ's.

Stands 71, 72, 73, and 76 were only harvested once (in 2024, 2027, 2022, and 2032, respectively), and were harvested down to a DBH of 25 inches.

**Determination of Site Class Productivity**

The Beidler site productivity was determined from the site index values developed as described in Section 3e(v) above. NRCS data was used to develop relationships between site index and site productivity for sweetgum and blackgum trees in Orangeburg, Dorchester, and Berkeley counties. Specifically, the following relationships were developed from the data:

- Blackgum Site Index/Productivity Relationship: *Productivity = 2(SI) - 37*
- Sweetgum Site Index/Productivity Relationship: *Productivity = 2.87(SI) - 146.7*

This allowed for the classification of each stratum into the appropriate Forest Service productivity classes:

**Table 10: Site Productivity Classes**

| Site Productivity Classes (cu. ft./acre/year) | | | | | | |
|---|---|---|---|---|---|---|
| CAR High Site Class | | | CAR Low Site Class | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 225+ | 165-224 | 120-164 | 85-119 | 50-84 | 20-49 | 0-19 |

The productivity analysis yielded the following results:

**Table 11: Site Productivity Determination Results**

| Strata | Equivalent Blackgum Site Index | Average Productivity (cu. ft./ ac. /yr.) | Forest Service Productivity Class | CAR Site Class |
|---|---|---|---|---|
| Compartment 2 Stand 1 | 60.5 | 84.0 | 5 | Low |
| Compartment 2 Other Stands | 69.0 | 101.0 | 4 | Low |
| Compartment 3 Stand 1 | 68.3 | 99.6 | 4 | Low |
| Compartment 2 Other Stands | 68.0 | 99.4 | 4 | Low |

**Modeling Natural Regeneration**

Natural regeneration was modeled using the location code defaults generated from the southern variant of the Forest Vegetation Simulator (FVS). These defaults dictated which trees were sprouting species that would naturally regenerate after harvesting. For a description of the natural generation defaults for the Southern Variant of FVS, please see the "Southern Variant Overview" published by the U.S. forest service.

**Modeling Baseline Standing Dead**

The baseline modeling assumed that standing dead is equal to the proportion of inventory year standing live stocks. This meant that standing dead was assumed to be approximately 2.6% of standing live stocks over time. Such an assumption causes standing dead to decrease after harvests, and then subsequently increase over time in proportion to live tree growth. This assumption reflects density dependent mortality over time.

**Baseline Modeling Results**

The baseline scenario model resulted in an average weighted (by strata acreage) baseline aboveground live carbon stock of 76.95 mt $CO_2$e per acre over 100 years, above the average common practice stock of 76.68 mt $CO_2$e per acre. This result meets the requirement that the modeled 100-year average of the baseline stocks must not be below Common Practice.

Therefore, 76.95 mt $CO_2$e per acre was used as the baseline aboveground carbon stock.

**Figure 1: Graph of Baseline Carbon Stocks**

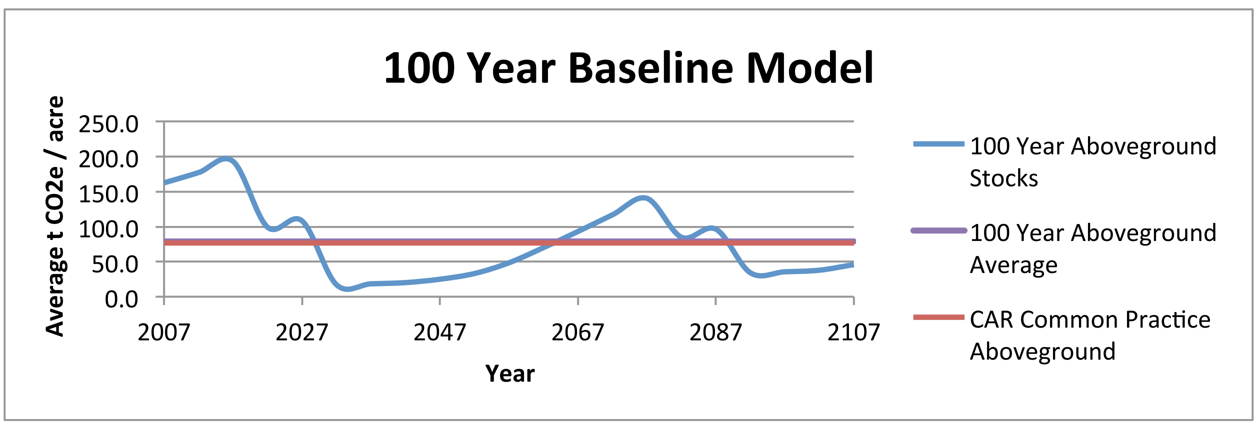



**Table 12: Baseline 100 Year Averages**

| 100 Year Average (mt CO2e / acre) | |
|---|---|
| Aboveground Live | 76.95 |
| Common Practice | 76.68 |

### v. Determination of Weighted Average Carbon Stocks (WCS)

N.A. under v3.1.

### vi. Estimating Baseline Carbon in Harvested Wood Products

**Process Description**

Wood products calculations were carried out using the CAR wood products calculation worksheet (dated July 18, 2012). Estimates of carbon in harvested trees were generated from the cut list outputs from FVS. The carbon in trees harvested was calculated using CAR's volume and biomass calculations summarized at the plot level.

To calculate the CO2e in trees harvested for wood products per year, total live tree carbon (above and belowground) was used. For the average carbon in trees delivered to the mills per year, only the CRM-adjusted CO2e in the bole was used. To determine the average cords of softwood and hardwood delivered to the mill, total cubic foot volume was converted to cords using a conversion factor of 128 cubic feet per cord.

For the percentage of hardwood and softwood products generated per year, average cords delivered to the mill was broken out into the various product classes found in CAR's Assessment Area data based on the following assumptions:

- The % softwood lumber and % hardwood lumber were used in the respective lumber categories
- The other product categories, besides miscellaneous, were used for both hardwood and softwood
    - For example, the 3% oriented strandboard was applied to both hardwoods and softwoods
- To make the total product classes sum to 100%, the percentage in the miscellaneous category was calculated using by assuming miscellaneous = 1 - (% in other product classes)
    - This method was chosen based on the CAR guidance in table 3 of the harvested wood products calculation worksheet: "If wood products class data is insufficient, categorize the unknown wood products as 'miscellaneous'."

Applying this distribution of product classes to the CAR harvested wood products calculation worksheet provided the estimates of carbon stored in long-lived wood products and landfills.

**Table 13: Harvested Wood Product Results**

| CO2e in Trees for Wood Products | | | | | | CO2e Delivered to Mills | | |
|---|---|---|---|---|---|---|---|---|
| Strata | Acres | % | Average Baseline CO2e in Trees Harvested for Wood Products / acre | Total Baseline CO2e in Trees Harvested for Wood Products | Baseline CO2e in Trees Harvested for Wood Products / year | Total CO2e Delivered to Mill / acre | Total CO2e Delivered to Mill | Average tonnes CO2e Delivered to Mill / year |
| **C2_S1** | **2,236** | **41%** | 446 | 997,832 | 9,978 | 280 | 625,950 | 6,259 |
| **C2_Other** | **316** | **6%** | 373 | 117,937 | 1,179 | 235 | 74,449 | 744 |
| **C3_S1** | **1,128** | **20%** | 413 | 465,768 | 4,658 | 261 | 294,451 | 2,945 |
| **C3_Other** | **1,821** | **33%** | 351 | 640,116 | 6,401 | 224 | 407,750 | 4,078 |
| **Total** | **5,502** | **100%** | **404** | **2,221,662** | **22,217** | **255** | **1,402,606** | **14,026** |

| Softwood Products Generated / year (cords) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Supersections** | **Lumber** | **Plywood** | **Oriented Strand Board** | **Non-structural Panels** | **Miscellaneous** | **Paper** | **Total** |
| Atlantic Coastal Plain & Flatwoods | 70% | 7% | 3% | 2% | 12.5% | 6% | 100% |
| Total Cords | 24.44 | 2.42 | 0.94 | 0.65 | 4.38 | 2.10 | 34.92 |

| Hardwood Products Generated / year (cords) | | | | | | |
|---|---|---|---|---|---|---|
| **Supersections** | **Lumber** | **Oriented Strand Board** | **Non-structural Panels** | **Miscellaneous** | **Paper** | **Total** |
| Atlantic Coastal Plain & Flatwoods | 8% | 3% | 2% | 81.5% | 6% | 100% |
| Total Cords | 29.36 | 9.90 | 6.83 | 299.74 | 22.13 | 367.96 |

The following average regional mill efficiencies (ME) and specific gravities (SG) were used for the calculation of carbon stored in wood products (from the CAR Harvested Wood Products Calculation Worksheet - dated July 18, 2012):

| **Region** | **Hardwoods** | | | **Softwoods** | | |
|---|---|---|---|---|---|---|
| | **SG** | **Saw Log ME** | **Pulp ME** | **SG** | **Saw Log ME** | **Pulp ME** |
| **Southeast(SE)** | 0.508 | 0.609 | 0.591 | 0.462 | 0.636 | 0.553 |

Over the Project's 100-year crediting period, carbon stored in long-lived wood products and landfills is estimated at 1,786 and 3,568 mt CO2e respectively.

# 5. Project Carbon Stocks

## i. Actual Onsite Carbon Stocks

**Inventory Results**

The following table shows the carbon stocks as of March 30, 2012. Thirty-six of the original 201 inventory plots sample fell in areas with deed restrictions that were subsequently removed from the Project Area, leaving 165 plots in the final inventory (please see Section 3b for a description of how the original 201 plots were generated and selected). The final data was degrown five years to the Project Start Date to determine initial onsite carbon stocks. Please see section 3e(ii) “Adjustments for Sampling and Start Dates” for details on the degrow process.

**Table 14: Inventory Results as of 3/30/12**

| 2012 Inventory Results (CO2e/acre) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Stand | No. of Plots (#) | Average Total Standing (CO2e/acre) | Std. Dev. (CO2e/acre) | Std. Error (CO2e/acre) | Acres | % | Total (CO2e) |
| Compartment 2 Stand 1 | 55 | 260.3 | 88.3 | 11.9 | 2,236 | 41% | 582,115 |
| Compartment 2 Other Stands | 12 | 194.9 | 75.0 | 21.7 | 316 | 6% | 61,692 |
| Compartment 3 Stand 1 | 30 | 216.9 | 116.3 | 21.2 | 1,128 | 20% | 244,585 |
| Compartment 2 Other Stands | 68 | 153.8 | 63.5 | 7.7 | 1,821 | 33% | 280,110 |
| **Total** | **165** | **212.4** | | | **5,502** | | **1,168,501** |

**Model Used**

Please see Section 3e for description of models and methods used to calculate current inventory and projected growth.

**Inventory Updates**

Please see Section 3f for description of inventory update process.

**Inventory Confidence Deduction**

**Table 15: Confidence Deduction**

| Total (CO2e) | n | Std. Error (CO2e) | Bound (CO2e) | Sampling Error (%)* | Confidence Deduction (%) |
|---|---|---|---|---|---|
| 1,168,501 | 165 | 39,064 | 64,260 | 5.5% | 0.4% |

*Sampling error with stratification

Based on this sampling error, the inventory confidence deduction is calculated as follows:

1) $39{,}064 * 1.65 = 64{,}260$
2) $\frac{64{,}2600}{1{,}168{,}501} * 100$ = 5.5%
3) 5.5% - 5.1% = 0.4% confidence deduction

### ii. Actual Carbon in Harvested Wood Products

There is no harvesting planned for the Project Area, so no harvested wood products are expected to be generated.

### iii. Quantifying Secondary Effects

Secondary effects are accounted for by applying the following equation:

SEy = min[0, (AChv, y - BChv, y) * 20%]

- *Where*, SEy = Estimated annual Secondary Effects
- AChv, y = Actual amount of onsite carbon harvested in year y (prior to delivery to a mill), expressed in CO2-equivalent tonnes
- BChv, y = Estimated average baseline amount of onsite carbon harvested in year y (prior to delivery to a mill), expressed in CO2-equivalent tonnes

## 6. Calculation of GHG Reductions and Removals

Actual onsite carbon stocks were calculated by weighting the average total CO2e stocks for each strata (weighting by acreage) and multiplying this value by the total acreage for each year. The confidence deduction applied to the actual onsite carbon stocks was 0.4%.

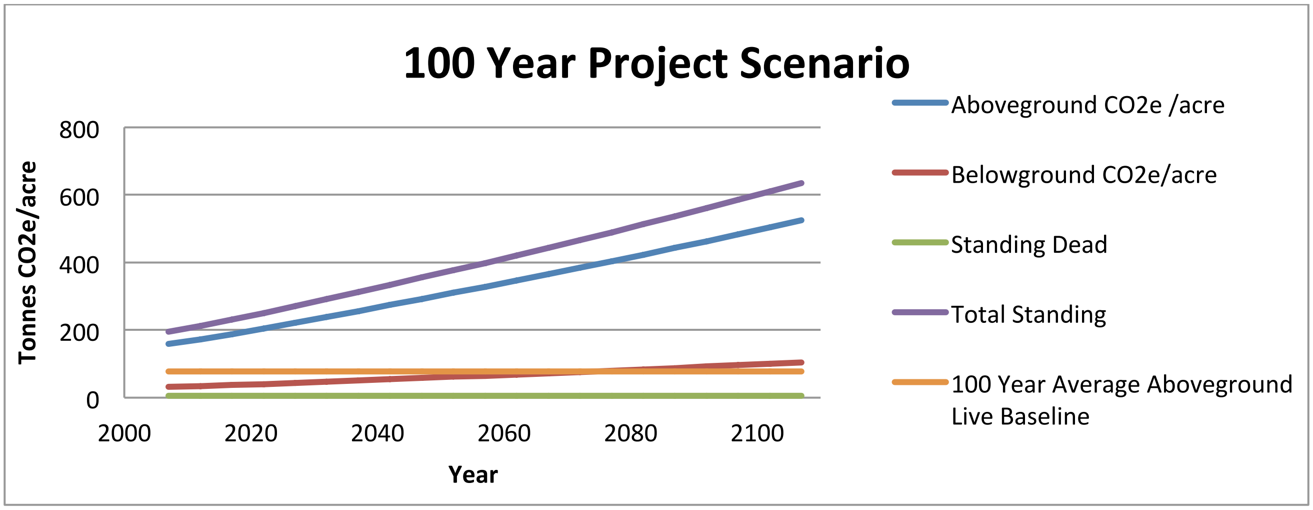
The 100 year averaged aboveground live baseline was 76.95 mt CO2e/acre.

Baseline harvested wood products are calculated with the CAR harvested wood products calculation worksheet (see section 4e).

The project-specific reversal risk rating was 20.9%

The Forest Project Calculation Worksheet (July 18, 2012) is used to calculate the annual CRTs issued to the account holder.

**Figure 2: GHG Reductions and Removals**




# 7. Reversal Risk Rating

## a. Reversal Risk Rating by Category

**Table 16: Reversal Risk**

| Risk Category | PIA Only |
|---|---|
| Financial Failure | 5% (Default Value) |
| Illegal Forest Biomass Removal | 0% (Default Value) |
| Conversion | 2% (Default Value) |
| Over-harvesting | 2% (Default Value) |
| Social | 2% (Default Value) |
| Wildfire | 4% (Default Valuefor Assessment Area based on CAR Assessment Area Data File) |
| Disease or Insect Outbreak | 3% (Default Value) |
| Other Catastrophic Events | 3% (Default Value) |

| | Subordination Clause Type 1[24] |
|---|---|
| PIA Subordination Type | 2% |

## b. Project Reversal Risk Rating

Reversal Risk Rating =

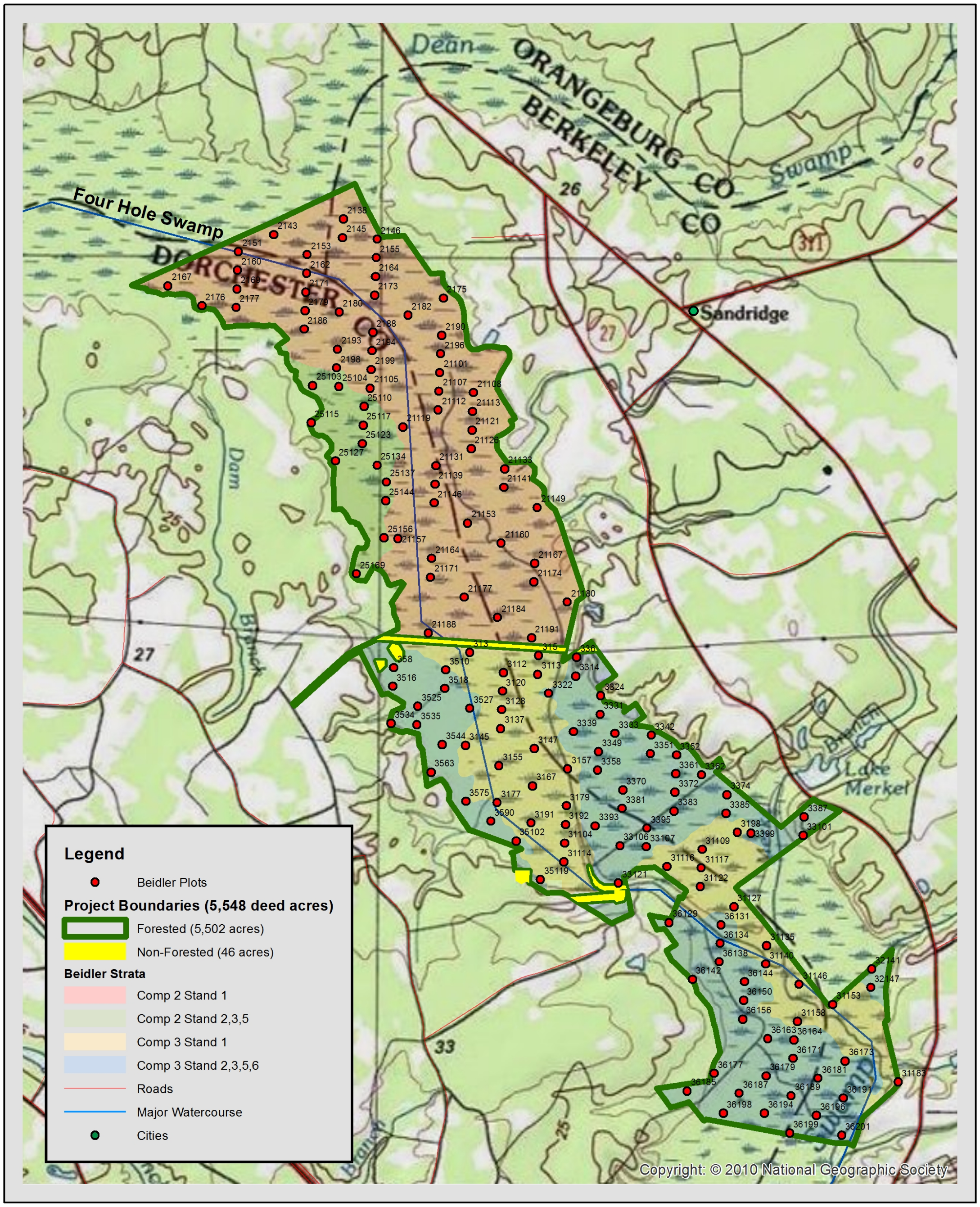
100% - (1-Financial Failure%) x (1-IllegalForestBiomassRemoval%) x (1-Conversion%) x (1-OverHarvesting%) x (1-SocialRisk%) x (1-Wildfire%) x (1-Disease/InsectOutbreak%) x (1-OtherCatastrophicEvents%) x (1-PIASubordination%) =

100% - ((100%-5%) x (100%) x (100% - 2%) x (100%- 2%) x (100%-2%) x (100%-4%) x (100%-3%) x (100%-3%) x (100% – 2%))

= 20.9%

[24] Any future mortgages placed on property will be subordinate to PIA unless higher buffer (for Subordination Clause Type 2) is applied.

# 8. Appendix A: Project Map




-80 23.817 W, 33 10.232 N

0 0.5 1 2 Miles

-80 17.205 W, 33 10.232 N

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