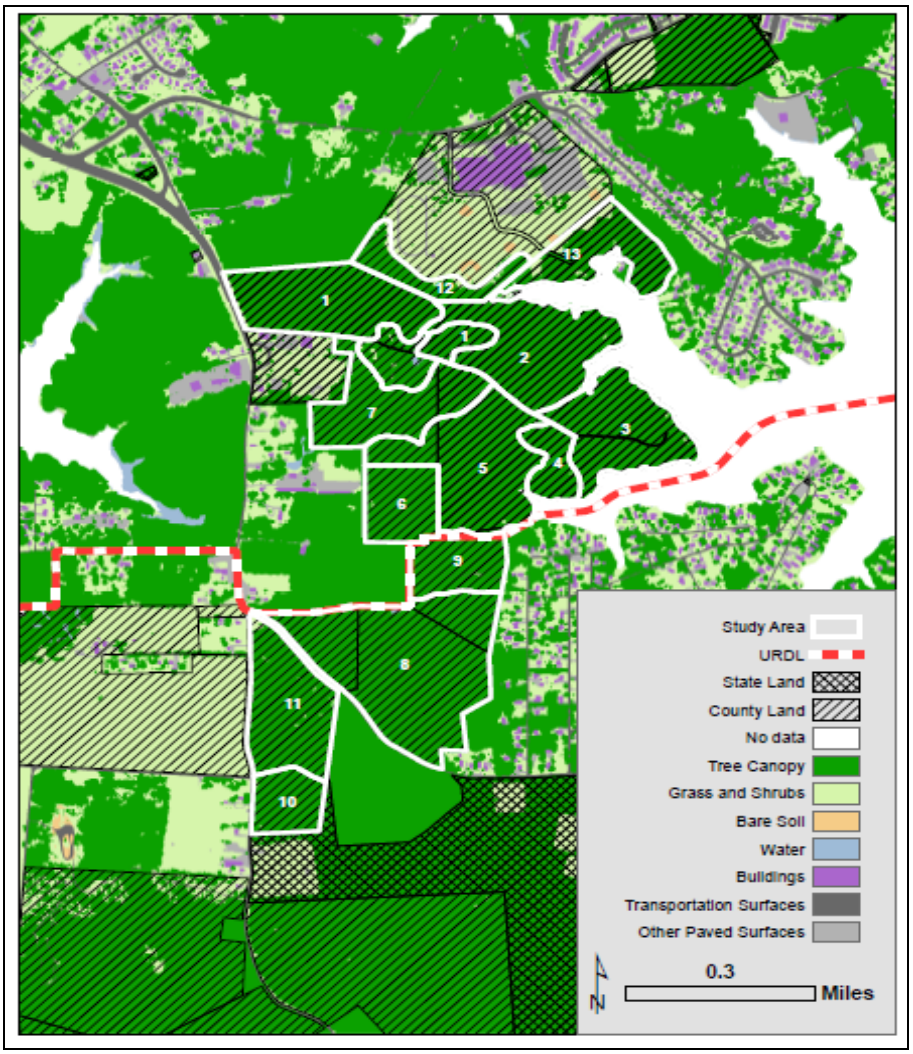
FOREST HEALTH ASSESSMENT AND FOREST MANAGEMENT PLAN

for

POTTERY FARM PARK



Baltimore County, MD
Department of Environmental Protection & Sustainability
Towson, MD 21204

Mar-Len Environmental, Inc., Forestry Consultants

February 2011

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY 1

2.0 FORESTS OF POTTERY FARM PARK
2.1 Introduction 8
2.2 Pottery Farm Park 8
2.3 Ecological Importance of Forests 16

3.0 FOREST HEALTH ASSESSMENT
3.1. Introduction and Assessment Objective 18
3.2. Forest Stand and Sampling Plot Delineation Procedures 18
3.3. Sampling Procedures in Overstory and Understory 21
3.4. NED Model 22
3.5. Summary Descriptions Across Forest Stands 23
3.6. Management Questions and Answers 39
3.7 Habitat Characteristics for Wildlife 41
3.8 Major Findings of the Forest Assessment 52

4.0 FOREST MANAGEMENT PLAN
4.1 Purpose and Goals of the Forest Management Plan 53
4.2 Desired Future Condition 53
4.3 Management Objectives and Recommendations 54
4.4 Silvicultural Methods for Regeneration 56
4.5 Environmental Concerns 56
4.6 Timber Stand Improvement 57
4.7 Management Recommendations for Wildlife 57
4.8 Best Management Practices for Maintaining Forest Health 60

5.0 LITERATURE CITED, REFERENCES, AND GLOSSARY
5.1. Literature Cited 86
5.2. References 87
5.3. Glossary of Forestry Terms 88

6.0 APPENDICES (Volume II)
6.1. Description of the NED Stand Assessment Report Tables and Narratives 2
6.2. Forest Stand Data 7
6.3. Sampling Plot Data 398

1.0 EXECUTIVE SUMMARY

A FOREST HEALTH ASSESSMENT AND FOREST MANAGEMENT PLAN FOR POTTERY FARM PARK

This document includes a Forest Health Assessment and Forest Management Plan for 227.4 acres of forest land owned by Baltimore County in Pottery Farm Park (PFP). The purpose of this Plan is to provide decision support for implementing sustainable management practices for the PFP forest. This was accomplished by assessing current forest health conditions and recommending forestry prescriptions necessary for achieving the desired future condition of the forest ecosystem.

The goals of the Forest Management Plan are to restore and maintain a healthy forest ecosystem, including to:

- Restore, to the greatest extent possible, the historic composition of the oak dominated hardwood forest ecosystems and forested wetlands native to the mid-Atlantic region, including multiple forest layers, to promote hydrologic benefits and nutrient management for healthy, sustainable forests and watershed functions.
- Manage the forests to promote their use for Forest Interior Dwelling Species.
- Restore the capacity for natural regeneration of desirable forest vegetation through techniques such as controlling invasive species, monitoring deer populations to assure low levels of browsing, and thinning selectively to reduce the canopy stocking density as necessary to allow natural oak regeneration.
- Manage the forests to eliminate harmful human actions, such as the use of ATV's that disturb soil, create erosion, and disrupt surface hydrology.
- Manage forest lands to promote compatible human activities such as passive recreation and wildlife observation.

THE FORESTS OF POTTERY FARM PARK

Pottery Farm Park is an environmentally sensitive area, containing swales, natural drainage areas, and wetlands. The park is situated between Turkey Point and Holly Neck Roads in the Back River Peninsula, and surrounded on three sides by Sue Creek (Figure 1.1). The 227.4-acre PFP forest is within close proximity to the Muddy Gut wildlife habitat area, just west of Back River Neck Road, and north of protected state forests and wetlands which connect PFP to the ecologically significant Lower Back River Peninsula Habitat Protection Area, under Baltimore County stewardship.

Together, this block of nearly 2,200 acres of state and county lands is home to some of the largest contiguous forested tracts in the County. The PFP forest, although small, benefits greatly from its proximity to these other protected forests and forested wetlands that together contribute to the protection of water quality in the Chesapeake Bay Ecosystem, the largest and most biologically productive estuary in the world and a national treasure and resource. This important ecosystem also provides crucial habitat for forest interior dwelling bird species (FIDS), a group that includes neo-tropical migratory bird species, as well as species of forest-dependent reptiles, amphibians, and mammals. The quality of this habitat system and the Bay is strongly dependent on the health and sustainability of the forests and forested wetlands.

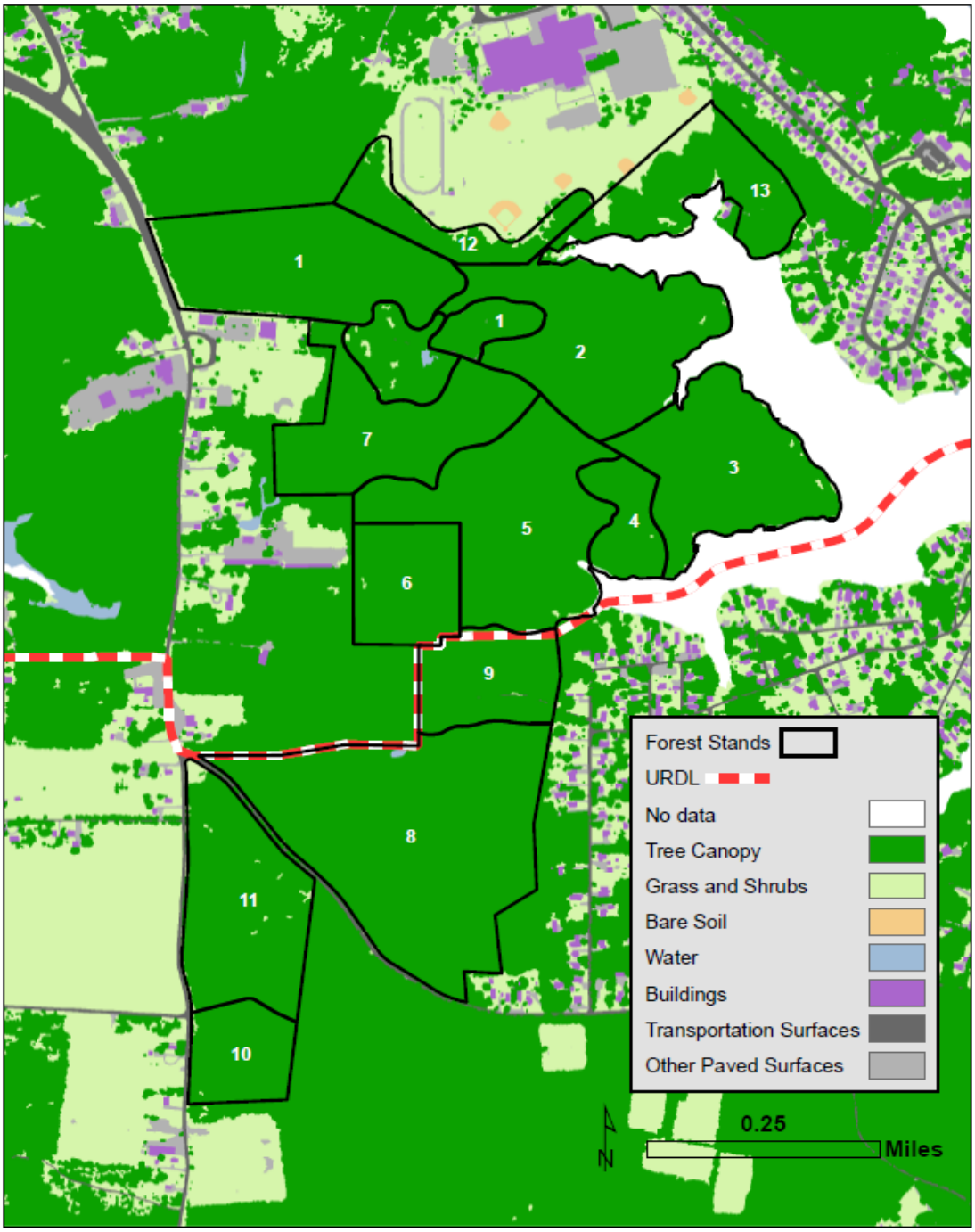
FOREST HEALTH ASSESSMENT

The objective of the forest assessment was to determine the condition and health of the forest ecosystem in Pottery Farm Park. This included assessing the present condition of the forest, identifying major stressors that could threaten the forest's long-term sustainability, and addressing management questions based upon assessment data and observations. Forest characteristics assessed included forest cover types by delineated stands, overstory biology, structural characteristics and health, understory biotic and abiotic characteristics, and habitat characteristics. Descriptive information collected for each forest stand included dominant species for each canopy layer, size class distribution, canopy condition, invasive plants, regeneration, and deer pressure.

A field inventory was conducted from February 2 to March 31st, by Mar-Len Environmental, Inc., professional foresters licensed in the State of Maryland. Field data were input into the USDA Forest Service NED model, which provides valuable information to natural resource managers concerning forest health for present and future management activities.

Thirteen forest stands greater than 5 acres each were delineated based upon field visits to the site and a qualitative assessment of forest types, size classes of the dominant trees (overstory), age, stand conditions, and relative position within the landscape. The location of the thirteen forest stands is presented in Figure 1.1. Within the stands, transects were laid out in the office against topographic gradients, to capture the greatest degree of diversity. Sampling plots were spaced equidistant from each other in a grid pattern. Throughout the entire study area, 68 sampling points were set with numbered flags in the field.

Figure 1.1: Location of Forest Stands Assessed



MAJOR FINDINGS OF THE FOREST ASSESSMENT

The following are major findings about the health of the 227.4-acre forest ecosystem owned by Baltimore County in Pottery Farm Park:

FIDS Habitat Sustainability: The composition of the once oak-dominated forest, described in both the 1910 Plant Life of Maryland and the 1987 DEPRM Habitat Assessment Study, has undergone severe changes (Figure 1.2). Oak dominance or co-dominance has been lost to dominance by Sweetgum and Red maple. This is a major finding because of the critical importance of oaks in the life cycles of the forest interior dwelling bird species (FIDS) of the PFP forest. Their documented breeding activities in the 1983-87 Breeding Bird Atlas Survey was a major factor in dedicating the forest as a Habitat Protection Area in 1987.

In the deciduous forests of the eastern U.S., there is a critical interdependence between oak trees, the hatchlings of songbirds, including FIDS, and the caterpillars of forest moths. Oak foliage is the preferred food of the caterpillars of more moths (534 species) than any other tree species in the forest, and the caterpillars are the most abundant and easily collected food source for the hatchlings. The birds time their nesting and egg-laying activities to coincide with the highest populations of feeding caterpillars in the spring of each year. The interrelationships are so strong that oaks are identified as “keystone species.” Whatever affects the survival of the oaks also directly affects the reproductive success of its dependent animal communities.

Without management to maintain and enhance oak dominance, the relative proportions of size classes and forest types within the forest ecosystem will continue to change, reducing the quality of habitats that have supported a FIDS community in the past.

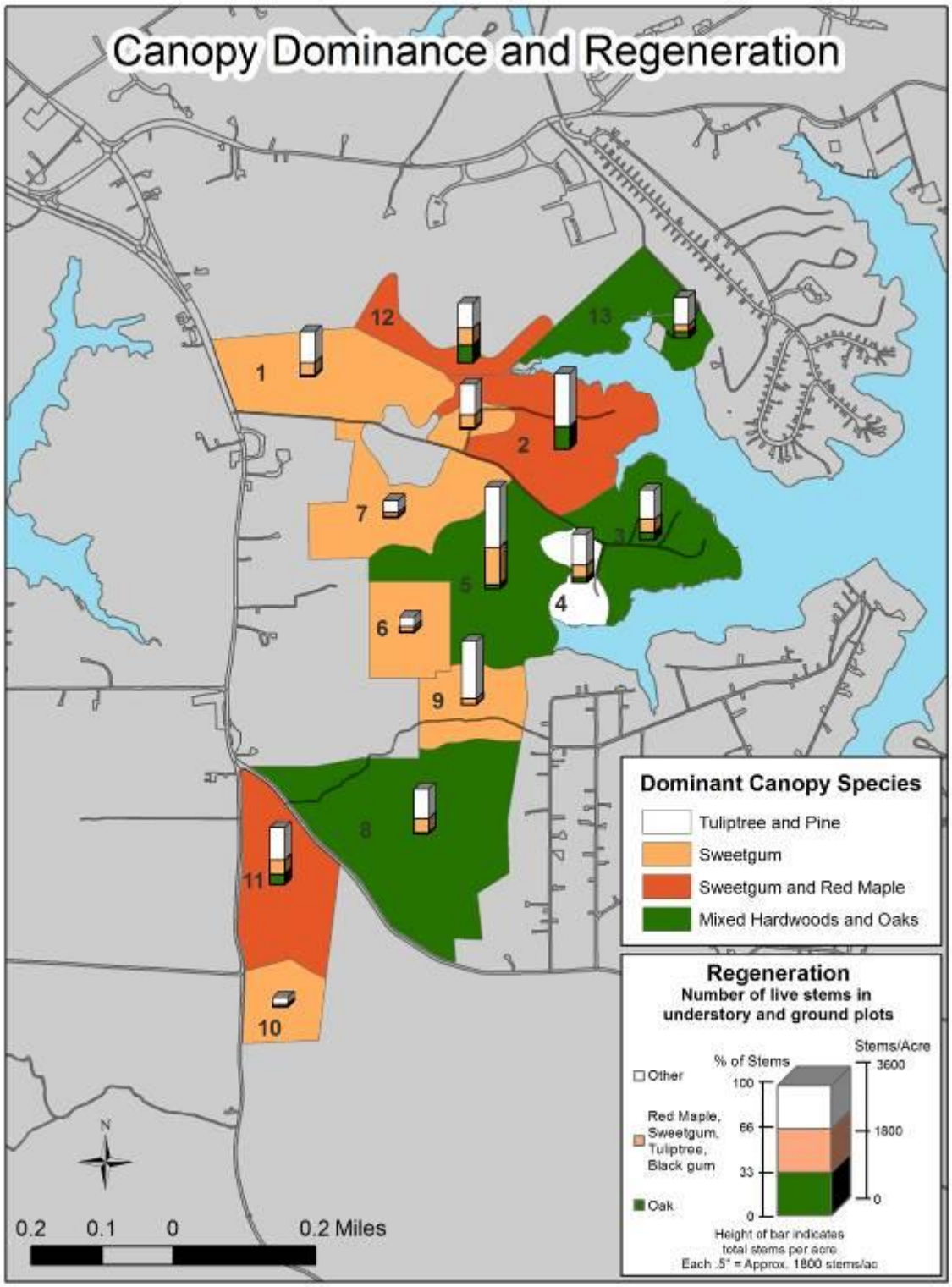
Forest Sustainability: The distribution of size classes is not balanced, meaning that some size classes are under-represented or over-represented. In the majority of the stands, approximately 90% of the trees range in diameter from 11.5” to 23.5. This condition does not allow for sustainable tree growth in the full range of size class categories.

Tree Condition: Half of the forest stands have a significant percentage of unhealthy trees, called “Undesirable Growing Stock” (UGS) by foresters. These are trees with growth deformities or other qualities of form, damage, or disease that will prevent the trees from reaching optimal height, age, and ecological functional capacity. Stands 2, 3, 6, 7, 8, 10, and 12, totaling nearly 130 acres, consist of more than 50% of undesirable trees.

Measures of Stocking (tree crowding): The basal area of all trees (square feet of trees per acre) ranges from 118 to 192.9, with a weighted average of 133.7 sq. ft. per acre. With 13 stands with a BA of $\geq$110, the overall forest system is over-stocked. Relative density is another measure of tree crowding that accounts both for the size of each tree and the amount of space typically occupied by a tree of that size and species. The relative density of stands in this forest system ranges from 62% to 133% with a weighted average of 87.6% relative density. Eight stands are overcrowded with a relative density of >85%.

Regeneration: Regeneration was present for 17 species with an average of 1,383 seedlings/saplings per acre across stands. While all oak species combined comprise only 13.3% of all regeneration, Black cherry, Red maple, Black gum, and Sweetgum – not desirable as canopy dominants – represent 59.9% of all regeneration. Overall, regeneration is not over abundant due to several factors including: a mostly closed canopy, which blocks light for the seedlings of shade-intolerant tree species, deer browsing pressure, and the distribution of exotic, invasive plant species that compete for habitat space and nutrients.

Figure 1.2: Distribution of Dominant Canopy and Regeneration Layer Species by Stand



MANAGEMENT RECOMMENDATIONS

General Stand Management Recommendations

The management recommendations prioritize actions for improving and maintaining forest health and ecological conditions. Management recommendations include silvicultural practices to improve forest health with an emphasis on natural regeneration and sustainability. The eradication of invasive plants and the reduction of deer population are also prioritized.
All silvicultural recommendations are for the purpose of reducing stocking to allow healthy trees room to grow by removing undesirable trees (TSI-Timber Stand Improvement) or to establish natural regeneration.

In addition to the stand-specific recommendations presented below, vines in crowns and dense invasive plant communities should be controlled throughout the PFP forest. While deer are not a significant problem at this time for the overall forest system, their populations should be monitored. If deer populations increase, then forest management practices that increase regeneration may be compromised. In that case, deer must be controlled prior to any type of activities to increase regeneration in ALL stands, as well as removal and control of undesirable vegetation that hinders the development of the desired natural regeneration. A study by Hix et al. (1991) found repeated browsing on oaks gives competing vegetation such as Red maple, Black gum, American beech and exotic species a greater advantage of occupying the forest. A recommended deer population is 15-20 deer per square mile.

Stand-Specific Management Recommendations

Stand-specific existing conditions, management objectives, and recommended actions are presented in the following table.

Stand	Acres	Relative Density	Basal Area	Existing Stand Condition	Stand Management Objectives	Recommended Actions	Year
PFP1	24.9	133.9	192	48% undesirable trees	Reduce stress from overstocking	T.S.I, reduce B.A. to 80, control invasives after thinning	1
PFP2	23.1	100.0	124	60% undesirable trees	Improve regeneration	T.S.I, reduce B.A. to 70, control invasives after thinning	2
PFP3	18.9	76.0	118	54% undesirable trees	Manage for Old Growth; improve regeneration	T.S.I, reduce B.A. to 75, control invasives after thinning	2
PFP4	5.7	71.0	133	45% undesirable trees	Favor Tuliptree, reduce stocking	T.S.I. reduce B.A. TO 80, control invasives after thinning	3
PFP5	25.0	75.0	122	37% undesirable trees	Manage for Old Growth; improve regeneration,	T.S.I, reduce B.A. to 80, Stand too sensitive for management after thinning	6
PFP6	9.9	62.0	118	59% undesirable trees	Release mast trees; improve regeneration, favor oaks	Control invasives, reduce B.A. to 60 with a T.S.I.	4
PFP7	21.6	86.0	131	55% undesirable trees	Reduce stress from overstocking	T.S.I., reduce B.A. to 75, control invasives after thinning	4
PFP8	41.5	89.0	132	50% undesirable trees	Stand too sensitive for management; allow Old Growth elements to develop	Cut vines and treat invasives near acceptable regeneration	1
PFP9	9.9	89.0	140	50% undesirable trees	Reduce stocking, improve crown health	Remove vines in crowns, deuce B.A.to 80, control invasives	1
PFP10	7.5	86.0	132	64% undesirable trees	Stand too sensitive for management; allow Old Growth elements to develop	Cut vines and treat invasives near acceptable regeneration	5
PFP11	18.5	105.0	144	57% undesirable trees	Stand too sensitive for management; allow Old Grow elements to develop	Cut vines and treat invasives near acceptable regeneration. Stabilize ATV trails in wetlands	3
PFP12	7.4.	76.0	116	71% undesirable trees	Stand too sensitive for management	Invasive plant control.	7
PFP13	13.4	92.0	133	45% undesirable trees	Encourage multiple layered canopies	Manage for Old Growth	7

Notes: All forested wetlands must be flagged, buffered, and avoided during all silvicutural improvements.
-Vines are a common problem in many stands; vines should be removed from acceptable growing stock.
- Establish well defined stable hiking trails, close and restore ATV access roads throughout.
-Invasives plants are common throughout and must be controlled after thinning

2.0 THE FORESTS OF POTTERY FARM PARK

2.1 INTRODUCTION

As background for the Forest Health Assessment (Chapter 3) and the Forest Management Plan (Chapter 4), this Chapter provides an overview of the study area, including geography, hydrology, soils, and historic land cover. Current information about long-term changes that might be expected as a result of sea level rise is also presented. This Chapter includes a description of the ecological importance of the forests of Pottery Farm Park.

2.2 POTTERY FARM PARK

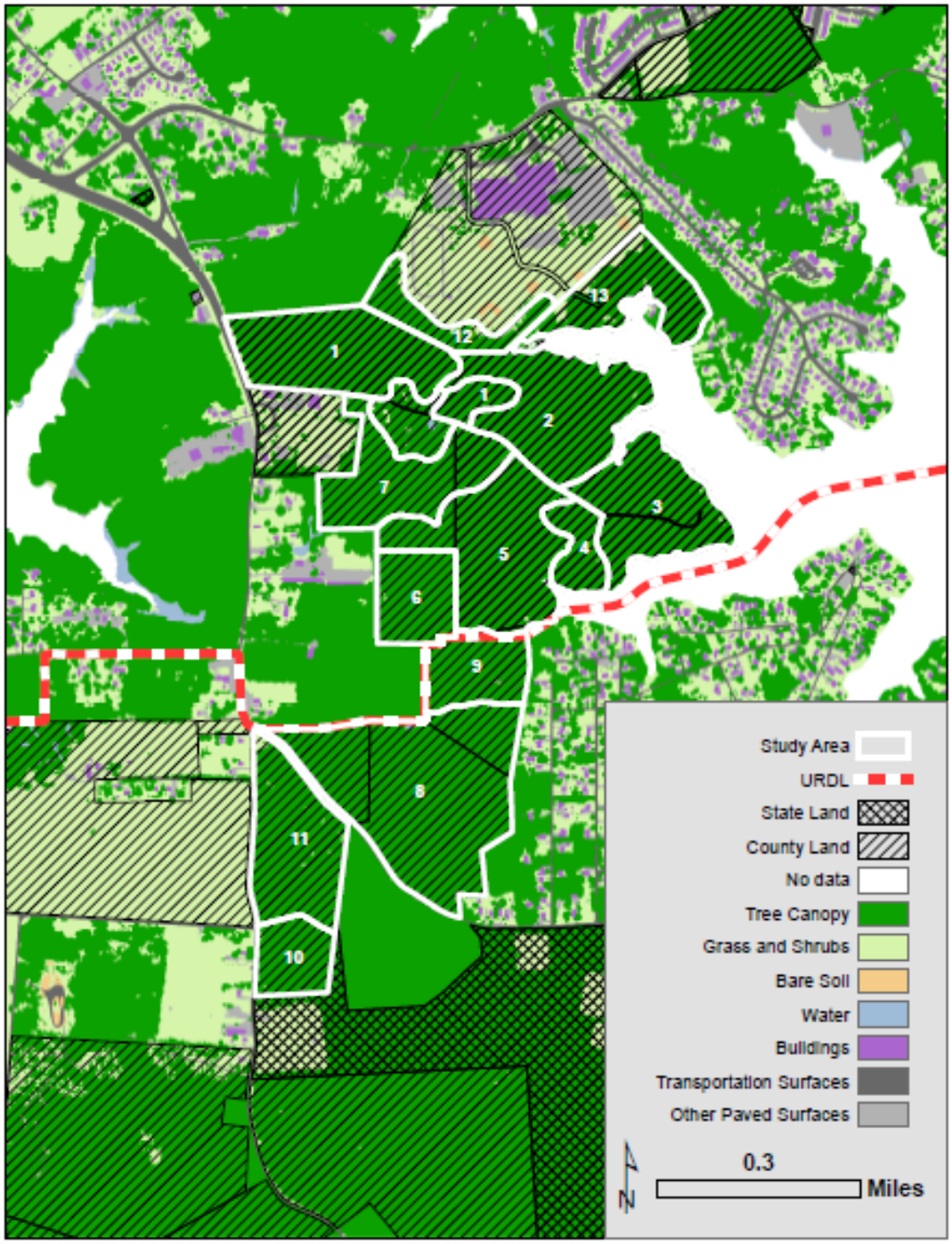
Pottery Farm Park is an environmentally sensitive area, containing swales, natural drainage areas, and wetlands. The park is situated between Turkey Point and Holly Neck Roads in the Back River Peninsula, and surrounded on three sides by Sue Creek (Figure 2.1). The 227.4-acre PFP forest is within close proximity to the Muddy Gut wildlife habitat area, just west of Back River Neck Road, and north of protected state forests and wetlands which connect PFP to the ecologically significant Lower Back River Peninsula Habitat Protection Area, under Baltimore County stewardship.

Together, this block of nearly 2,200 acres of state and county lands is home to some of the largest contiguous forested tracts in the County. The PFP forest, although small, benefits greatly from its proximity to these other protected forests and forested wetlands that together contribute to the protection of water quality in the Chesapeake Bay ecosystem, the largest and most biologically productive estuary in the world and a national treasure and resource. This important ecosystem also provides crucial habitat for forest interior dwelling bird species (FIDS), a group that includes neo-tropical migratory bird species, as well as species of forest-dependent reptiles, amphibians, and mammals. The quality of this habitat system and the Bay is strongly dependent on the health and sustainability of the forests and forested wetlands.

Forest Assessment Study Area

The assessment for this project examined 227.4 acres (over 94% of the forest) in the Pottery Farm Park property. A previous assessment by Mar-Len Environmental , Inc. in 2009 evaluated 870 acres or 39.4% of the total tree canopy in the LBRP. (The remaining un-assessed forest is in either State or private ownership.)

Figure 2.1: Forest Assessment Vicinity Map



Hydrology

Six distinct drainage patterns exist on site, draining east toward Sue Creek and dominated by alluvial land, which consists of mostly sandy soils. Generally these drainage areas are poorly drained and saturated. Based on existing state (2007 Tidal Wetlands) and federal (National Wetland Inventory) mapped wetland information (not field delineated), one large pond system drains east toward Sue Creek between stands 2 and 12, joining another first order stream originating in stand 12 to form a second order stream system. These large drainage areas/wetlands consist of palustrine, forested broad leaf, deciduous, seasonally-flooded wetlands classified as PFO1C (Cowardin system).

The distribution of mapped wetlands in Pottery Farm Park is presented in Figure 2.2. Overall, as is presented in Table 2.1, mapped wetlands total 30.52 acres in Pottery Farm Park. About half of the total wetlands, 15.3 acres, are located in Stand 8 and comprise 37% of that stand.

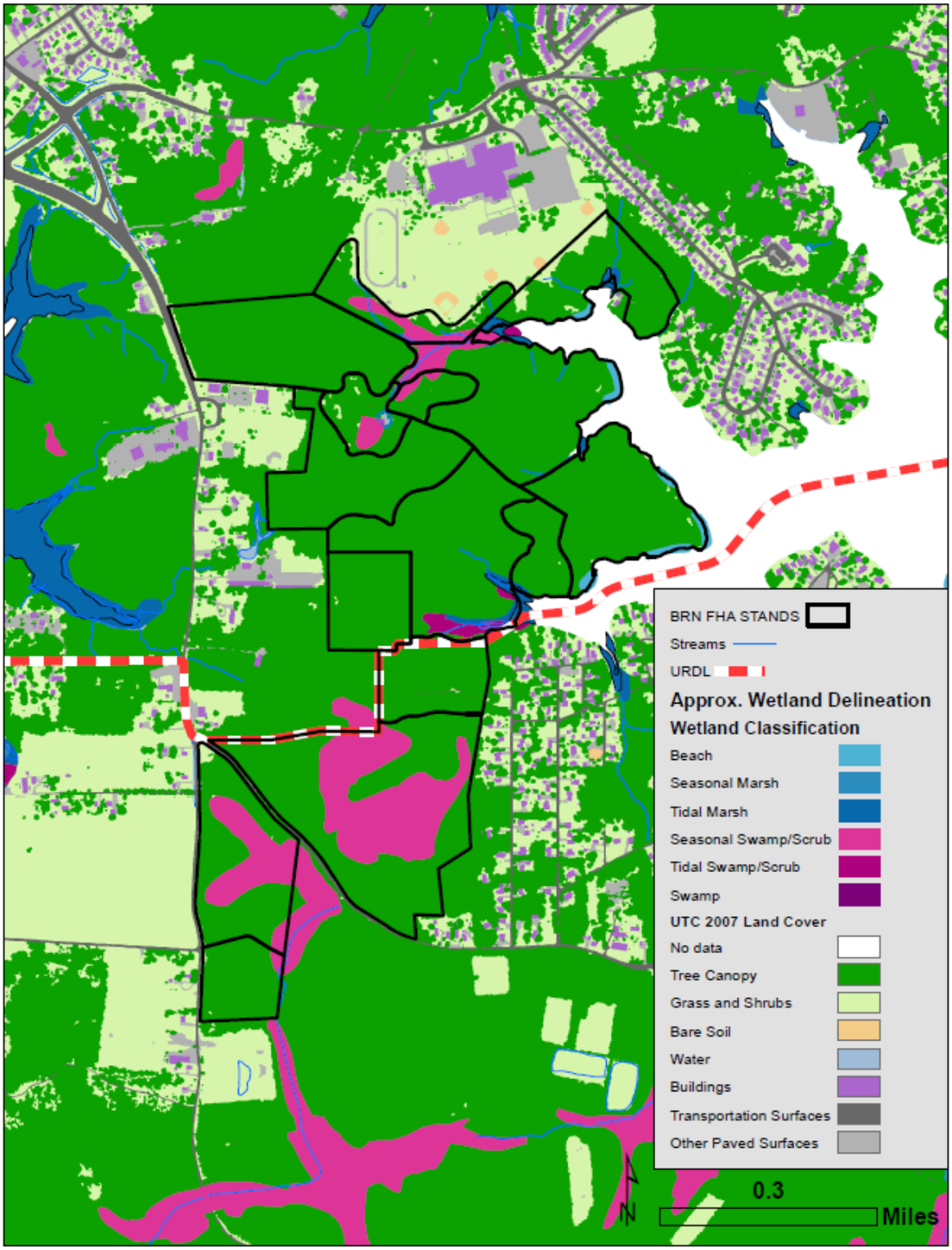
Table 2.1 Acreage of Mapped Wetlands at Pottery Farm Park, by Stand

Stand	Wetland Acres
PFP1	0.55
PFP2	2.28
PFP3	0.87
PFP4	0.13
PFP5	2.44
PFP8	15.33
PFP9	0.00
PFP10	0.29
PFP11	6.23
PFP12	1.75
PFP13	0.65
Total	30.52

Forested wetlands are complex ecosystems that perform a variety of functions of vital importance to the environment. Wetlands regulate water flow by detaining storm flows for short periods, therefore reducing flood peaks. Wetlands improve water quality by retaining or chemically transforming excess nutrients, and by trapping sediment and heavy metals. Wetlands provide many wildlife habitat components such as breeding grounds, nesting sites, and other critical habitat for a variety of wildlife species as well as the unique habitat requirements for possible endangered plants and animals.

While many wetland functions are unaffected by land management activities, some functions can be either compromised or enhanced by them. For example, deforestation can reduce or eliminate the ability of a wetland to reduce flood peaks. Retaining forest vegetation on a wetland can help retain the ability of the soil to absorb runoff, thus reducing peak flood flows. In addition, management of the forest can actually improve the quality of wildlife habitat and tree growth.

Figure 2.2: Mapped Wetlands of the Pottery Farm Park



The Influence of Soil Composition and Structure in Forest Development

Over vast spans of time, soils are formed by the slow weathering and disintegration of the bedrocks from which they are derived. The characteristics of the bedrock parent material determine the soil structure, which includes soil porosity and permeability, hardness, and chemical reactivity. Sandy soils consist of hard spherical particles of silica that make the soils highly permeable to the passage of water, air, and dissolved organic matter, but chemically un-reactive. Clay soils have flattened lens-like particles that compress easily, resist the passage of air and water between the particles, and typically react chemically with organic matter. The degree of sands and clays in soils, along with the topographic position of the soils – from ridges to slopes and bottomlands – supply appropriate habitat conditions for a range of forest types from upland forests to bottomland forested wetlands.

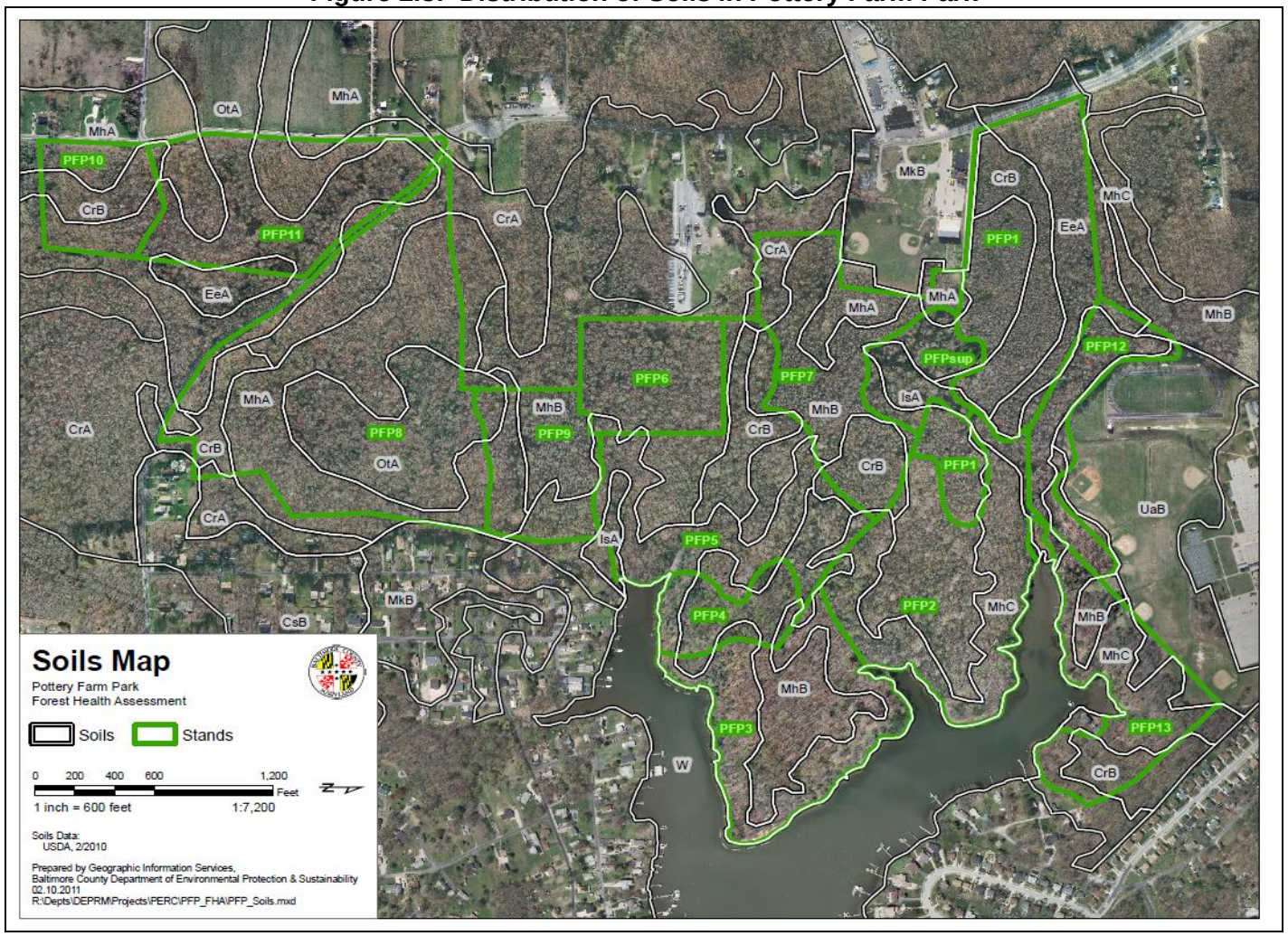
As presented in Table 2.1, the soil properties of the Pottery Farm Park forest range from poorly drained to moderately well drained, with generally good productivity for tree growth. The distribution of these soils is presented in Figures 2.4A & B.

	Soil Classification	Drainage	Productivity for Growth	Common Species	Site Index*
OtA	Othello	Poor to moderately drained	Good	Mixed oaks	70-80
MhA-B	Mattapex	Well to moderately drained	Good	Mixed oaks	70-80
The pond site araEeA	Elkton	Poorly drained	Excellent	Mixed oaks	75-85
CrB-A	Cumberstone	Somewhat poorly drained	Good**	Sweetgum and Red maple	** 70-80

Table 2.2: Site Index, Productivity, and Soil Characteristics for Soil Types in Pottery Farm Park

*Site index is the height of a tree at age 50. This table displays average site indices for common species.
** From the data collection.

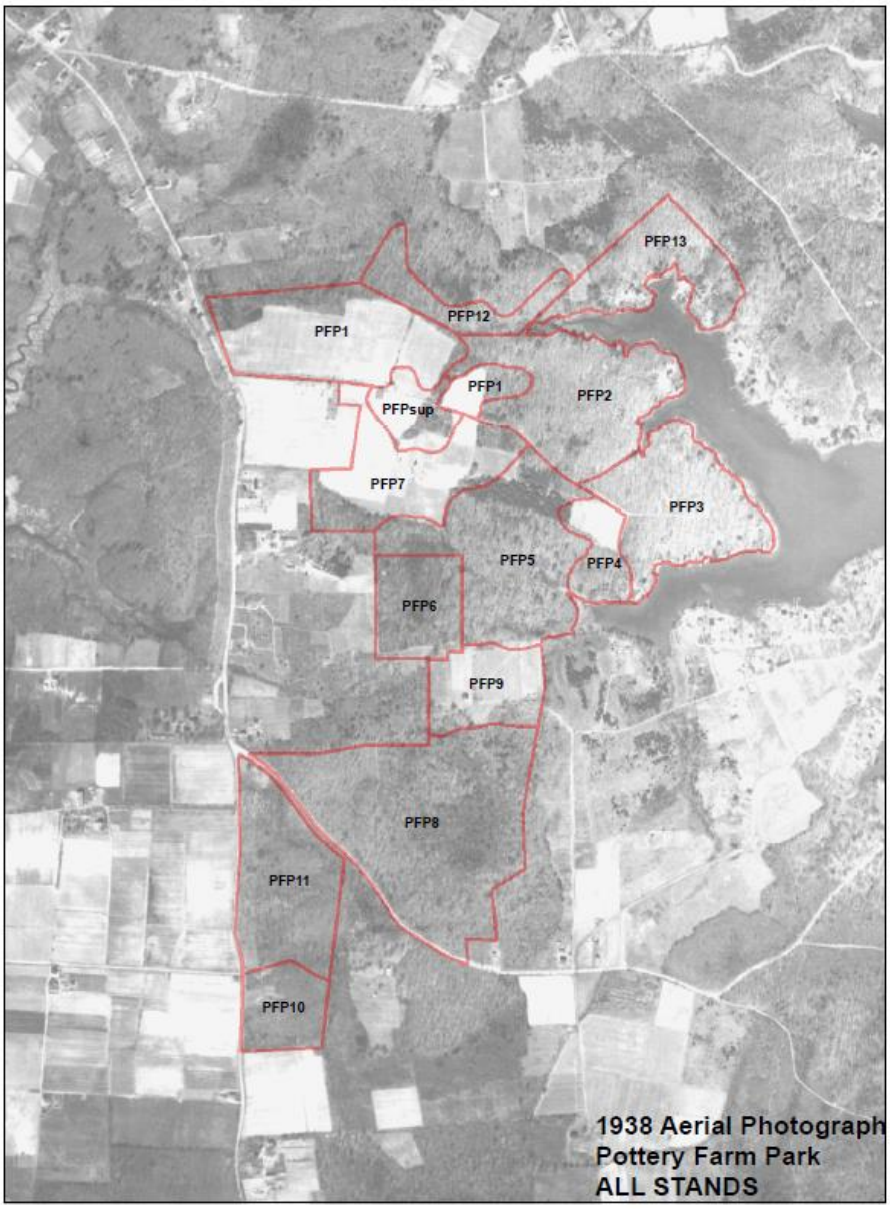
Figure 2.3: Distribution of Soils in Pottery Farm Park



Historical LandUse/Land Cover

The PFP forest assessment includes large areas that were not forested within the past century. A 1938 U.S. Dept. of Agriculture Soil Conservation Service aerial photo (Figure 2.3) shows all or portions f Stands 1, 7, 4, and the 5.6 acres in and around the pond site open at one time. The pond site area once housed the farm buildings.

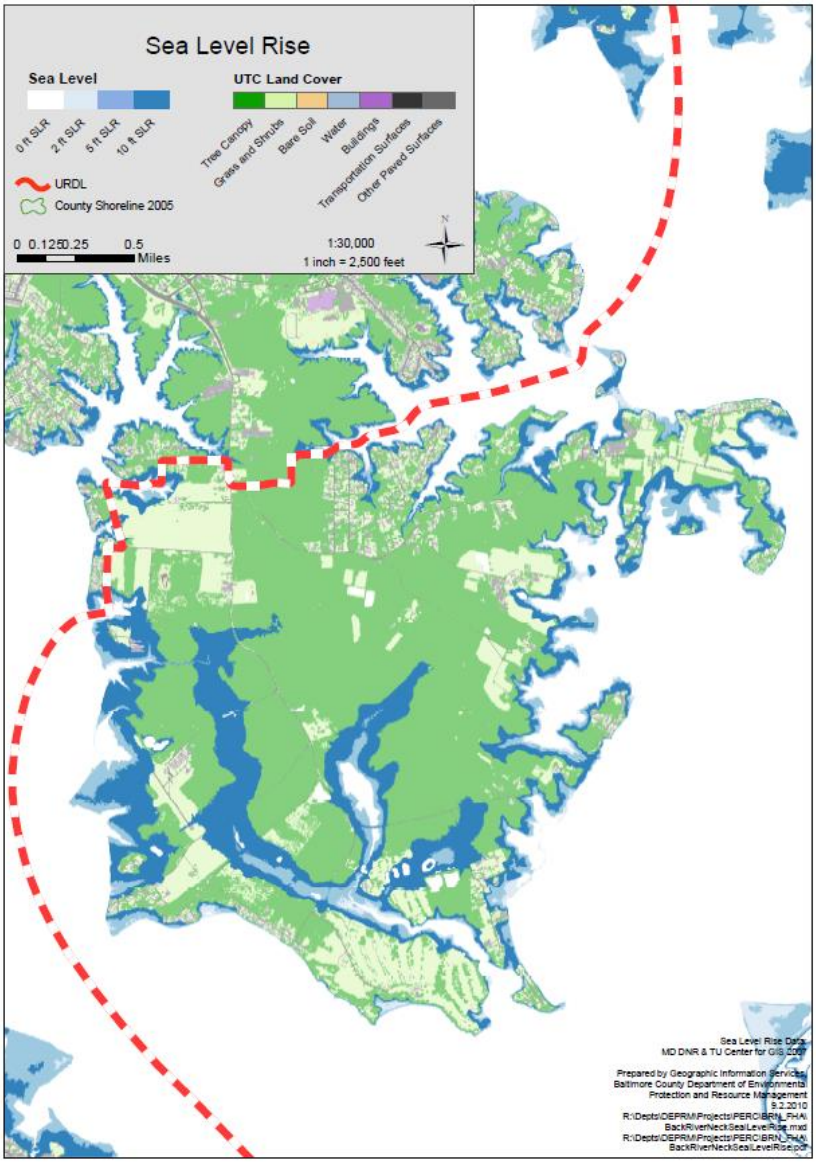
Figure 2.4: 1938 Aerial Photograph of the Pottery Farm Forest Soils



Sea Level Rise

The Pottery Farm Park area and its forest system are dynamic landscapes that have changed over the centuries and which will continue to change. In recent years, the prospect for significant changes in coastal areas due to relative sea level rise has been recognized. These changes include land subsidence as well as potential effects of climate change. The relative sea level rise at Baltimore, for example, has been documented at greater than 1 foot over the past century. The rate of sea level rise is projected to accelerate over the coming century and, as a result, it is expected that some existing coastal areas in eastern Baltimore County will become inundated. In Figure 2.6, the current expected level of sea level rise is presented, based on data from the State of Maryland in 2007. The data include areas of inundation under several different levels of sea level rise up to 10 feet.

Figure 2.5: Projected Sea Level Rise for Pottery Farm Park



2.3 ECOLOGICAL IMPORTANCE OF FORESTS

The forests of Pottery Farm Park provide an important buffer between the densely-urbanized Upper Peninsula communities near Essex and the Chesapeake Bay. Although a formal trail system and advertised passive recreational uses do not currently exist, this forest provides a quiet environment for experiencing its aesthetic beauty and numerous opportunities to observe some of the animals that depend upon this complex ecosystem for their survival, especially forest interior dwelling birds. That said there are forest health and sustainability issues, revealed through the forest assessment that need to be addressed if the potential recreational values of the forest are to be realized and the wildlife communities sustained. In addition to the value of forests for potential passive recreation and wildlife, the forest is critical for managing the movement of water and nutrients through the watershed. Moreover, the forest itself creates many of the ecological conditions required for its own perpetuation, long-term health, and biodiversity.

Forests play a major role in maintaining or improving the water quality of wetlands, streams, and the Chesapeake Bay by slowing the movement of soil particles and nutrients from the land to waterways. This hydrologic process is presented in Figure 2.6. The complex of root systems holds forest soils in place, while canopy and mid-story tree and shrub foliage dissipate the force of raindrops on the forest floor. In the warmer months, forest shade keeps soils cool and moist, providing microclimates suitable for the maintenance of microbial communities that process and recycle nutrients for forest growth and regeneration. Shade cast from forest trees also reduces stream water temperatures, slowing down some chemical processes that can lead to an increased release of nutrients associated with water quality degradation and the production of by-products that degrade water and habitat values. In the winter, the annual fall deposits of spent leaves and woody debris blanket the forest floor. This mat of detritus warms the soils, allowing the infiltration of melt water, and providing shelter for small animals and microbes that act as decomposing agents during the growing season. These forest functions conserve soil and recycle nutrients in the ecosystem.

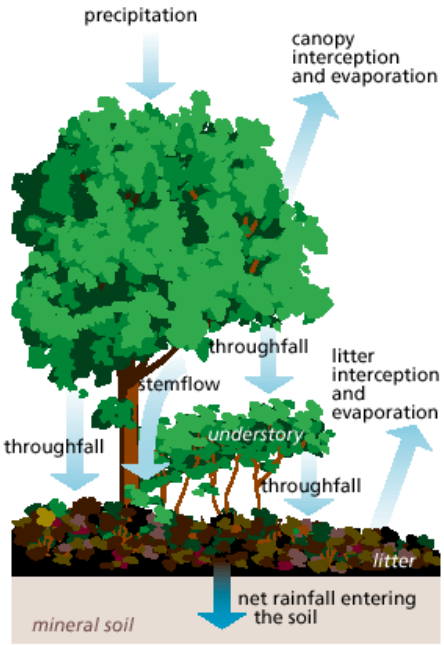


Fig. 2.6: The Forest Hydrologic Cycle (MD DNR 2003)

Numerous studies of watersheds have provided evidence of the link between healthy forest ecosystems and good water quality (Carlton 1990, Dunne and Leopold 1978). Rainfall interception accounts for a reduction of 2-6% of flood-producing rainfall and 5% of the 40-45 inches of annual precipitation common in the eastern United States. Thick mats of annually renewed organic detritus, which can hold many times its weight in moisture, increase the water-holding capacity of the soils. Soil moisture is further conserved by the high shade of the canopy, which reduces transpiration rates in the lower vegetation during the growing season (18 inches of the 40-45 inches of annual precipitation common in the eastern U.S.). Forests also intercept a variety of elements and materials that would otherwise be carried via runoff to water

bodies. These forest systems provide a line of defense against atmospheric deposition of heavy metals and acids and intercept groundwater pollutants, rendering them harmless through physical processes and chemical transformations.

All ecosystem components contribute to a forest's diversity and functional value, especially the quality and movement of surface and groundwater through watersheds. These components include native trees, shrubs, other woody and herbaceous plants, animals, fungi, and beneficial microorganisms, as well as the non-living elements in the landscape. The maintenance of biological and structural diversity reduces a forest's vulnerability to serious damage from major disturbances such as ice and wind storms, insect infestations, and disease outbreaks, as well as from more frequent but minor disturbances such as animal activities. Diversity also enhances the forest's resiliency in recovering from disturbance events. Forest diversity and vigor provide an efficient and effective means of protecting water quality and watershed function.

Nitrogen Cycling and Water Quality

With respect to forest composition, the forest ecosystem of Pottery Farm Park was historically dominated by oak species during pre-Settlement times. Oaks are especially valuable for maintaining good water quality. Although the efficiency of nitrogen cycling in forests is dependent upon many factors including geography, climate, soil types, and forest stand ages (Goodale et al. 2002), oak-dominated forests throughout the eastern U.S. typically have tighter control on nitrogen cycling than do beech/maple forests, releasing lower levels of nitrates from organic forest floor litter to adjacent waters (Lovett, et.al. 2004). Oak forests maintain a higher ratio of carbon to nitrogen in forest floor litter than other deciduous forest types because of high lignin content, which slows the decomposition rate of downed debris, and the movement of soluble nitrogen compounds through the landscape (Finzi et.al. 1998). Lignins also boost forest soils' capacity for storing and releasing water and cycling nutrients by adding very long-lived (hundreds to thousands of years), degradation-resistant biomass to the soil humus component, which supports myriad microorganisms and chemical processes that bring resource cycling efficiency and stability to the forest ecosystem (Fisher and Binkley 2000). In these ways, oak forests are critical for the maintenance of good water quality and productive aquatic habitats in both upland and bottomland forests.

Wildlife Habitat

From a habitat perspective, the Pottery Farm Park forest provides a diverse spectrum of habitat types for forest-dependent plant and animal communities. Detailed information about the structure and quality of the PFP forest for wildlife habitat is presented in Chapter 3.

3.0 FOREST HEALTH ASSESSMENT

3.1 INTRODUCTION AND ASSESSMENT OBJECTIVE

This chapter describes the Forest Health Assessment conducted for Pottery Farm Park for forested properties owned by Baltimore County. The major findings and summary data from that assessment are also presented. Detailed data for each of the forest stands inventoried are presented in the Appendices. This chapter is organized as follows:

3.1 INTRODUCTION AND OBJECTIVE
3.2 FOREST STAND AND SAMPLING PLOT DELINEATION PROCEDURES
3.3 SAMPLING PROCEDURES IN OVERSTORY AND UNDERSTORY
3.4 NED MODEL
3.5 SUMMARY DESCRIPTION ACROSS FOREST STANDS
3.6 MANAGEMENT QUESTIONS AND ANSWERS
3.7 HABITAT CHARACTERISTICS FOR WILDLIFE
3.8 MAJOR FINDINGS OF THE FOREST ASSESSMENT

The objective of the forest assessment was to determine the condition and health of the forest ecosystem in Pottery Farm Park. This included assessing the present condition of the forest, identifying major stressors that could threaten the forest's long-term sustainability, and addressing management questions based upon assessment data and observations. Five major characteristics assessed included forest cover types by delineated stands, overstory biology, structural characteristics and health, understory biotic and abiotic characteristics, and habitat characteristics. Descriptive information collected for each forest stand included dominant species for each canopy layer, size class distribution, canopy condition, invasive plants, regeneration, and deer pressure.

The assessment provided the data for the development of a recommended management plan for the County-owned forestland. A field inventory was conducted from February 2 to March 31, 2010, by Mar-Len Environmental, Inc., professional foresters licensed in the State of Maryland. Field data were input into the USDA Forest Service NED model, which provides valuable information to natural resource managers concerning forest health for present and future management activities.

3.2 FOREST STAND AND SAMPLING PLOT DELINEATION PROCEDURES

Thirteen forest stands were delineated based upon field visits to the site and a qualitative assessment of forest types, size classes of the dominant trees (overstory), age, stand conditions, and relative position within the landscape. The location of the 13 forest stands is presented in Figure 3.2.1. Within the stands, transects were laid out in the office against topographic gradients, to capture the greatest degree of diversity. Sampling plots were spaced equidistant from each other in a grid pattern.

Throughout the entire study area, 68 field plots were field located by GPS points and each was flagged with a center stake. The number of trees per acre was calculated using a 1/20th-acre plot. Stand acreage and the number of sampling plots are presented in Table 3.2.1.

Figure 3.2.1: Location of Forest Stands

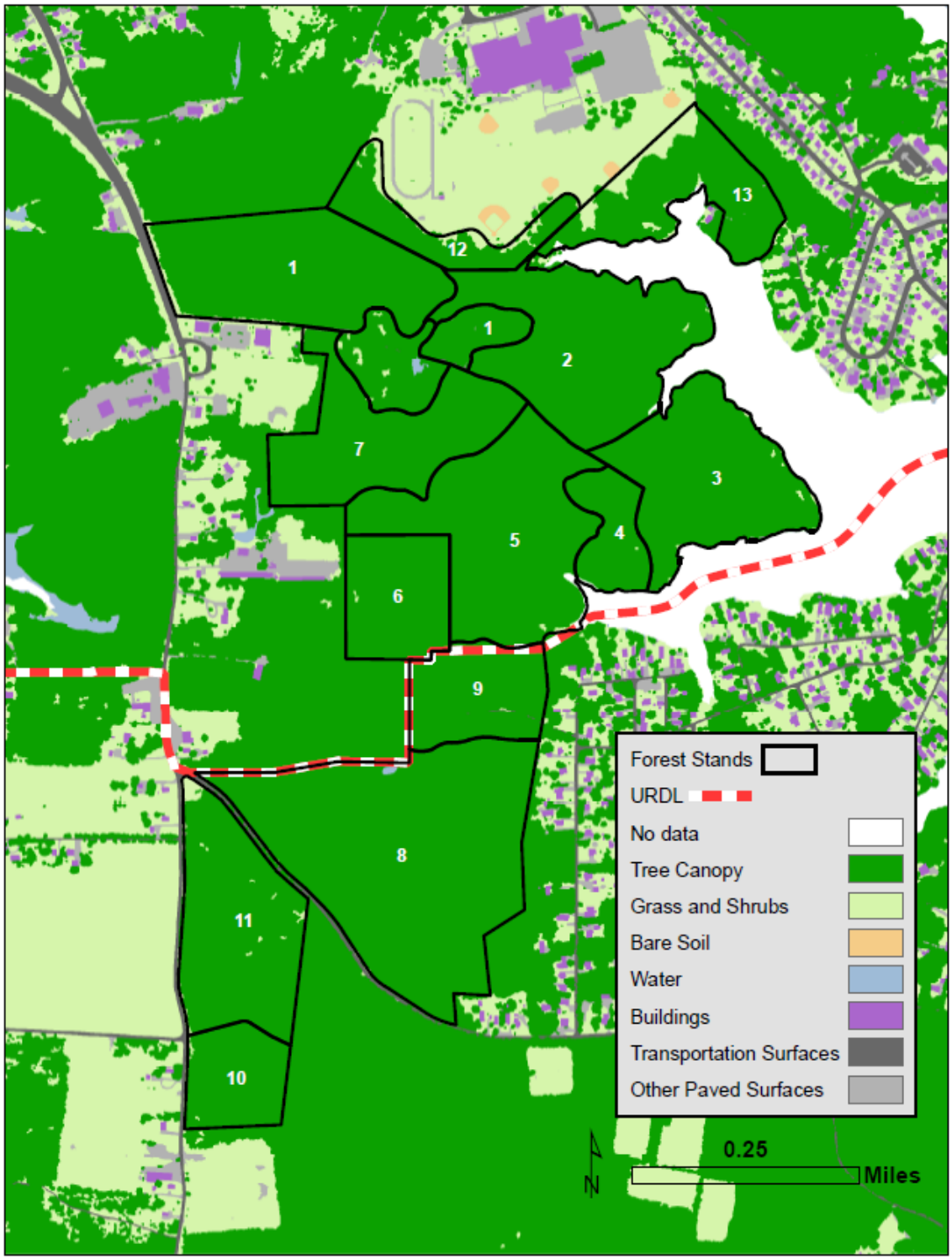


Table 3.2.1: Stand Area and Number of Plots

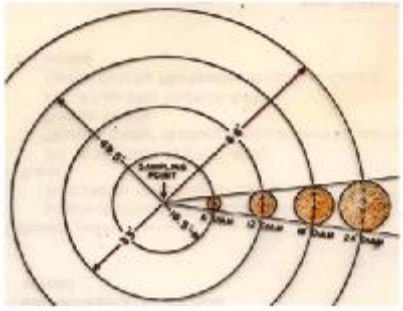
Stand	Stand Area (acres)	# of Plots	One plot per per/acres
PFP1	24.90	7	3.50
PFP2	23.10	7	3.30
PFP3	18.90	5	3.70
PFP4	5.70	3	1.90
PFP5	25.0	7	3.50
PFP6	9.90	5	1.90
PFP7	21.60	6	3.60
PFP8	41.50	10	4.10
PFP9	9.90	3	3.30
PFP10	7.50	4	1.80
PFP11	18.50	5	3.70
PFP12	7.40	3	2.40
PFP13	13.40	3	4.40

Note: stand acreages are rounded to nearest tenth of an acre.

3.3 SAMPLING PROCEDURES IN OVERSTORY AND UNDERSTORY

Data sheets developed by the USDA Forest Service were used to collect most of the information needed for analysis using the Northeast Decision Model (NED), described below. Each stand was sampled using line-transect and plot sampling methods. Point sampling with a Basal Area Factor 10-factor prism (10 BAF) was used to identify trees within the sampling plots. The prism method increases sampling efficiency, reducing the cost required to collect quality data. As a tree increases in size, it accounts for a larger fraction of the forest canopy and overstory basal area. Recognizing this fact, the prism method scales the probability of sampling a tree to the size of the tree. This reduces the number of trees that must be measured, while ensuring that the resultant sample is representative of the forest canopy and the overstory basal area. The following is a description of the 10-factor prism and its use to measure basal area.

The 10-Factor Wedge Prism



Every 6" of diameter equals 16.5' of limiting distance

"A prism is a small, wedge-shaped piece of glass used to determine which trees should be included in your inventory. When sampling with a prism, the plot size is variable, rather than fixed. Whether or not you sample a tree and take its measurements depends only on its size (diameter) and its distance from the plot center. Small diameter trees must be close to the plot center to be tallied, while larger diameter trees can be relatively far from the plot center and still be tallied. To determine whether a tree is tallied (referred to as "in") or not ("out"), stand at the plot center and look at each tree through the prism at a height of 4.5 feet. If the displaced image overlaps with what you see just above or below, the tree is "in," and the diameter is recorded…. For images right on the borderline, count every other tree (or record half the diameter).

The prism is useful in calculating forest metrics (such as basal area per acre – the sum of all the individual tree cross sections at 4.5 feet off the ground) because it projects an angle of just over one degree, which is an angle equivalent to a ratio of 33:1. When looking through a 10-factor prism, light is deflected in such a way that an angle is created in which every 33 units of distance is displaced one unit horizontally. Small trees must be close to you in order to fit between this angle, whereas larger trees can be further away and still fit.

In the woods, each tree has a limiting distance from the plot center that it must be within to be counted. The distance is based on the 33:1 ratio. A tree 1 foot in diameter must be 33 feet (or less) from the plot center or it won't be tallied."

Source: excerpted from the University of Vermont: http://www.uvm.edu/envnr/forestry/plot/

At each sampling plot, trees that fell within the prism's range were tallied for species, diameter, count, quality, product (sawtimber or pulpwood), product height, and crown classification. Additional data at each plot included a subplot equaling 1/100th of an acre for a mid-story count, shrubs, and natural regeneration count. The overstory sampling evaluated the percent cover of the mid-story (10-30 feet height) and the overstory (>30 feet height). Canopy closure was determined at each plot location. Other data collected for the overstory plots included:

individual tree species and diameter at breast height, insects/disease, and living or dead, quality, crown class, and crown condition. Overstory and midstory trees 2" or greater were midstory trees 2" or greater were counted, utilizing a variable point sampling method to determine basal area. Using the BAF 10 factor prism accounts for both the diameter of a tree and its distance from the center of the plot. In Figure 3.3.1, trees with a larger diameter have a larger radius. Larger trees can be further away and still have the radius overlap the sample location allowing them to be counted. For every inch of diameter a tree can be 2.75 feet away from the sampling point center and still be counted, therefore a 36-inch diameter tree can be 99 feet (2.75 X 36) away and still be counted in the plot.

Each understory sample included ground and herbaceous cover (0-3 feet height) within a 1/100 acre plot as well as shrub cover (3-10 feet). The data collected in these understory samples included shrub cover, percent regeneration, fern cover, grass and sedge cover, riparian location, deciduous shrubs, ericaceous shrubs, wetland shrubs, wetland ground vegetation, ground and shrub species observed, and the percent cover of each species. The number of trees per acre, ranging from 2" in diameter or greater and natural regeneration were collected on a 1/100 acre plot.

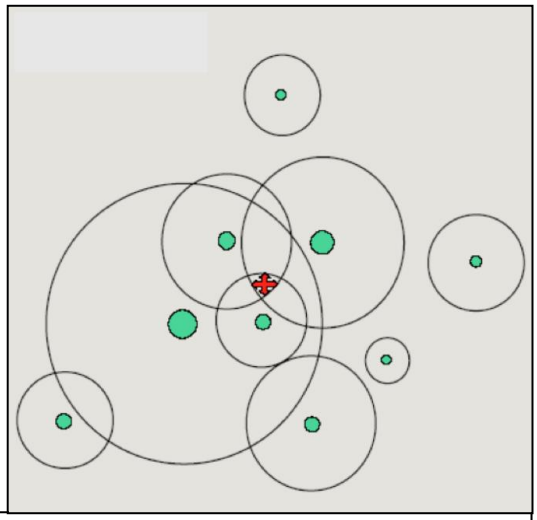


Figure 3.3.1: Plot with sampling points. Mueller-Dombois and Ellenberg (1974). Aims and Methods of Vegetation Ecology. New York: Wiley & Sons. Pp 101-106.

Data collected at each supplemental plot included dominant understory and overstory species, dominant size class distribution, canopy closure, canopy condition, invasive plants and deer pressure.

3.4 NED MODEL

It was determined that the use of NED-2, an enhanced version of NED, was best suited for this study area. NED is a collection of software tools created to help resource managers develop goals, assess current and future conditions, and produce sustainable management plans for forests in the eastern United States. The NED tools are being developed by the USDA Forest Service, Northeastern Forest Experiment Station (unit NE-4454 in Burlington, VT), in cooperation with state and educational institutions and other research units in the Northeastern, North Central, and Southern Research Stations. As the geographical scope of the project expanded, the software originally known as the Northeast Decision Model lost the regional reference in its name and has become simply NED.

NED-2 emphasizes the analysis of inventory data for various forest resources on a management area up to several thousand hectares (1 ha = 2.47 acres). The resources it addresses include visual quality, ecology, forest health, timber, water, and wildlife. NED-2 evaluates how a forest study area as a whole, or an individual stand, may provide conditions required for specific goals.

NED-2 users may select a variety of reports including tabular summaries, general narratives, and goal specific analyses. An extensive hypertext system provides the user with information about the goals, the desired conditions that support those goals, and related data used to analyze the condition of the forest, in addition to detailed information about the program itself and the rules and formulas used in the analyses.

3.5 SUMMARY DESCRIPTION ACROSS FOREST STANDS

This section provides summary data "across" stands. This allows a comparison of the conditions for the entire study area. In addition to summary tables of data, maps are provided for selected characteristics.

As presented in Chapter 1, some of the existing forest stand areas were not forest in 1938.

Summary information across delineated stands includes:

- **3.5.1 Overall Stand Characteristics**
- **3.5.2 Species List**
- **3.5.3 Overstory Dominance and Forest Type**
- **3.5.4 Overstory Vegetation Summary**
- **3.5.5 Regeneration**
- **3.5.6 Midstory Cover**
- **3.5.7 Ground Cover Attributes**
- **3.5.8 Timber Assessment**

3.5.1 Overall Stand Characteristics

The Pottery Farm Park study area includes 13 stands of existing forest, comprised of five forest types and three forest size classes, as presented in Table 3.5.1.

Table 3.5.1: Forest Types and Acreage

Forest Type	Acres	% of Total
bottomland hardwoods	63.8	28.0
oak bottomland hardwoods	122.9	55.0
mesic mixed pine /hardwoods	5.7	2.0
oak-poplar bottomland hardwoods	25.0	11.0
sweetgum	9.9	4.0
Total	227.3	100.0

Size Classes: Approximately 90% range in diameter from 11.5" to 23.5".

Small sawtimber-sized trees (11.5" – 17.5" dbh)
Large sawtimber-sized trees (>23.5" dbh)
Pole-sized trees (5.5" – 11.5" dbh)

3.5.2 Species List

A list of the species identified in the overstory, understory, and ground layers is presented in Table 3.5.2. Twenty three tree species were identified in the overstory, and 31 species of trees and shrubs were identified in the understory shrub layer. Overall, eight species of oaks were identified in the overstory. Five species of invasive, non-native plants were also identified, most occurring in the ground layer.

Table 3.5.2: Plant Species List

Species	Overstory	Understory	Ground
Counts	22	29	33
Elderberry *(Sambucus nigra ssp. canadensis)*		X	
Winterberry *(Ilex verticillata)*		X	X
Spindletree *(Euonymus)*		X	X
Grape *(Vitis)*		X	X
Serviceberry *(Amelanchier)*			X
Spicebush *(Lindera benzoin)*		X	X
Sassafras *(Sassafras albidum)*		X	X
Blackberry *(Rubus)*	X	X	X
Privet *(Ligustrum)*		X	X
Persimmon *(Diospyros virginiana)*		X	X
Black oak *(Quercus velutina)*	X	X	
Chestnut oak *(Quercus prinus)*	X		X
Northern red oak *(Quercus rubra)*	X	X	
Pin oak *(Quercus palustris)*	X		
Scarlet oak *(Quercus coccinea)*	X		X
Southern red oak *(Quercus falcata)*	X		
White oak *(Quercus alba)*	X	X	X
Willow oak *(Quercus phellos)*	X	X	X
Red maple *(Acer rubrum)*	X	X	X
Tuliptree *(Liriodendron tulipifera)*	X	X	X
Hickory *(Carya)*	X	X	X
Blackgum *(Nyssa sylvatica)*	X	X	X
Sweetgum *(Liquidambar styraciflua)*	X	X	X
Flowering dogwood *(Cornus florida)*	X	X	X
American beech *(Fagus grandifolia)*		X	X
Ash *(Fraxinus)*	X	X	X
Black cherry *(Prunus serotina)*	X		
American holly *(Ilex opaca)*	X	X	X
Asian bittersweet *(Celastrus orbiculatus)*	X	X	X
Sweet pepperbush *(Clethra alnifolia)*			X
Japanese honeysuckle *(Lonicera japonica)*		X	X
Multiflora rose *(Rosa multiflora)*		X	X
Greenbrier *(Smilax)*			X
Black haw *(Viburnum prunifolium)*		X	X
Black locust *(Robinia pseudoacacia)*	X		
Virginia pine *(Pinus virginiana)*	X		
Eastern poison ivy *(Toxicodendron radicans)*			X
Cottonwood *(Populus)*	X		
Devil's walking stick *(Aralia spinosa)*		X	X

Species	Overstory	Understory	Ground
Southern arrowwood *(Viburnum dentatum)*		X	X
Highbush blueberry *(Vaccinium corymbosum)*		X	X
Wine Raspberry *(Rubus phoenicolasius)*			X

* denotes invasive/non-native species

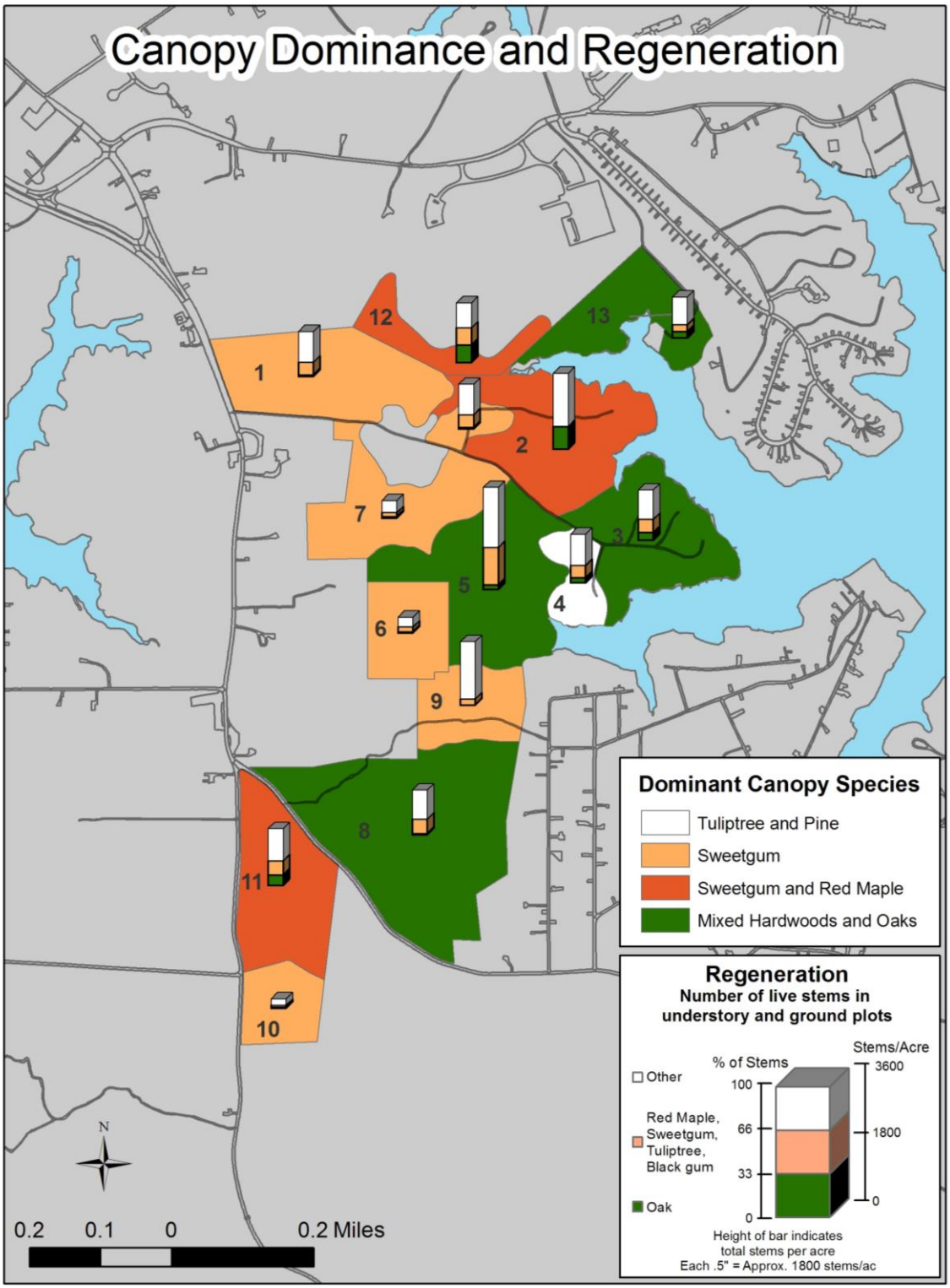
3.5.3 Overstory Dominance and Forest Types

Dominant tree species and general forest type are presented for each stand in Table 3.5.3. Overall, the canopy for the PFP forest is comprised primarily of oaks, Sweetgum, Red maple, and Tuliptree. The distribution of dominant canopy species and the primary composition of these species in regeneration layers (understory and ground layer) are presented in Figure 3.5.3.

Table 3.5.3: Overstory Dominance and Forest Type

Stand	# of Species	Dominant Species	Forest Type
PFP1	4	sweetgum	bottomland hardwoods
PFP2	14	sweetgum, red maple	oak bottomland hardwoods
PFP3	11	sweetgum, chestnut oak	oak bottomland hardwoods
PFP4	4	tuliptree, virginia pine	mesic mixed pine-hardwoods
PFP5	14	tuliptree, mixed oak	oak/poplar bottomland hardwoods
PFP6	9	sweetgum, red maple	bottomland hardwoods
PFP7	10	sweetgum	bottomland hardwoods
PFP8	13	red maple, sweetgum, white oak	oak bottomland hardwoods
PFP9	3	sweetgum	sweetgum, pure
PFP10	7	red maple, sweetgum	oak bottomland hardwoods
PFP11	11	sweetgum, red maple	oak bottomland hardwoods
PFP12	7	sweetgum, red maple	bottomland hardwoods
PFP13	8	sweetgum, white oak	oak bottomland hardwoods

Figure 3.5.3: Distribution of Dominant Canopy and Regeneration Layer Species by Stand



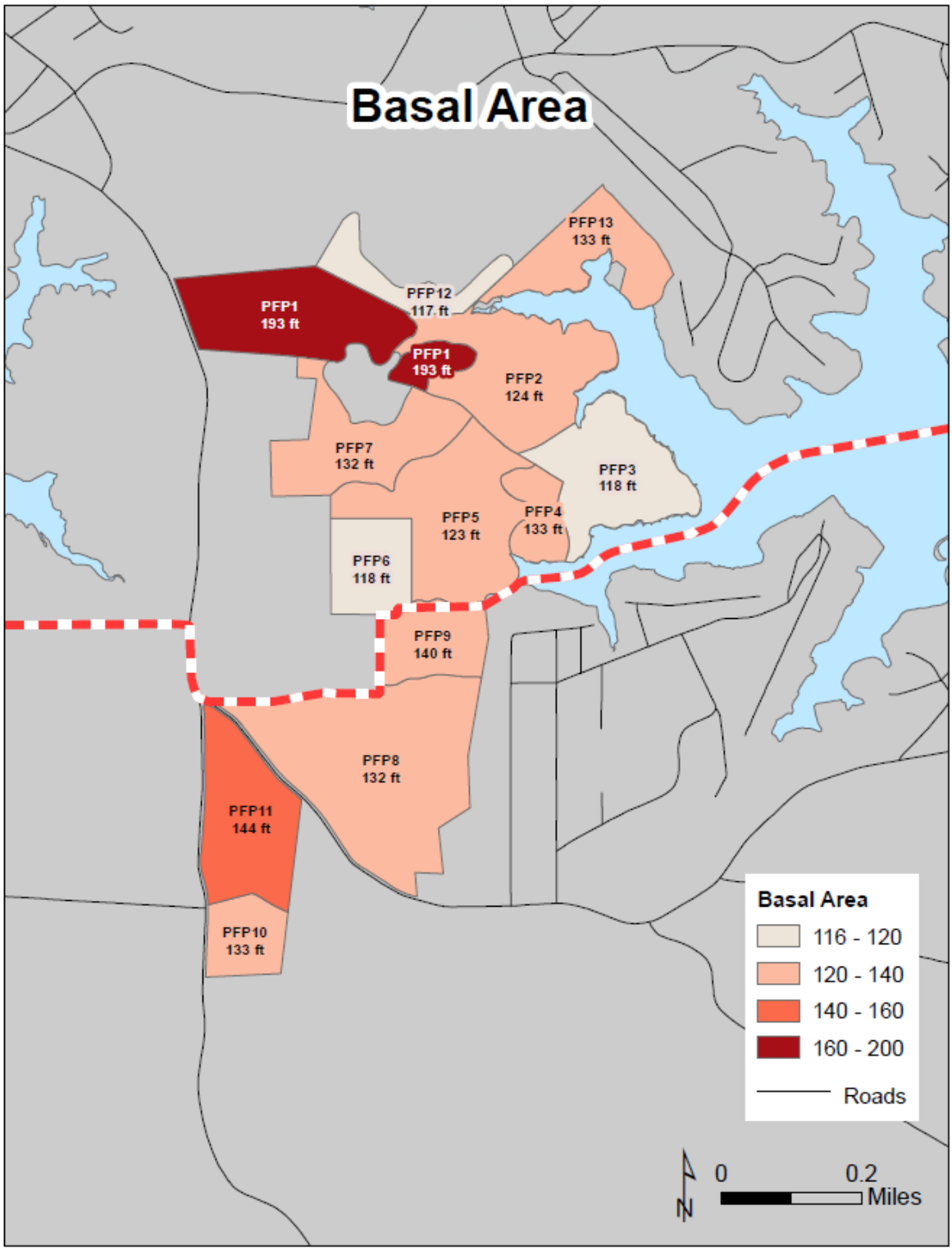
3.5.4 Overstory Vegetation

Selected NED data of overstory characteristics are presented by stand in Table 3.5.4, including the basal area, average diameter, % canopy closure, relative density, and effective age. Figure 3.5.4A presents the distribution of basal area by stand, and Figure 3.5.4B presents the distribution of closure of the canopy (percent) by stand. In addition to these characteristics, the County's tree canopy data layer was queried to estimate the average height of tree canopies, as a additional reflection on their maturity. Detailed maps of tree heights, based on LiDAR data, are presented in each stand report in the Appendix. The average tree height for each stand is also presented herein in Figure 3.4.5C.

Table 3.5.4: Selected Overstory Vegetation Characteristics, by Stand.

Stands	Stand Area (ac.)	Basal Area (sq. ft./ac.)	Stems/ ac.	Avg. dbh (in.)	Canopy Closure (%)	Relative Density (%)	Effective Age
PFP1	24.90	192.90	454.00	8.29	85.00	133.00	67
PFP2	23.10	124.30	692.20	3.73	85.00	100.00	93
PFP3	18.90	118.00	136.60	11.07	76.00	76.00	108
PFP4	5.70	133.30	317.10	6.86	85.00	71.00	65
PFP5	25.00	122.90	158.00	10.42	81.40	62.00	102
PFP6	9.90	118.00	104.10	13.06	80.00	75.00	108
PFP7	21.60	131.70	258.70	8.85	80.00	86.00	75
PFP8	41.50	132.00	165.60	10.32	79.10	89.00	107
PFP9	9.90	140.00	241.10	9.65	73.00	89.00	82
PFP10	7.50	132.50	178.30	10.87	85.90	86.00	84
PFP11	18.50	144.00	705.20	3.73	82.00	105.00	103
PFP12	7.40	116.70	333.60	6.00	80.00	76.00	92
PFP13	13.40	133.30	422.40	4.76	78.30	92.00	140

Top: Figure 3.5.4A: Basal Area, by Stand.



Bottom: Figure 3.5.4B: Percent Canopy Closure, by Stand.

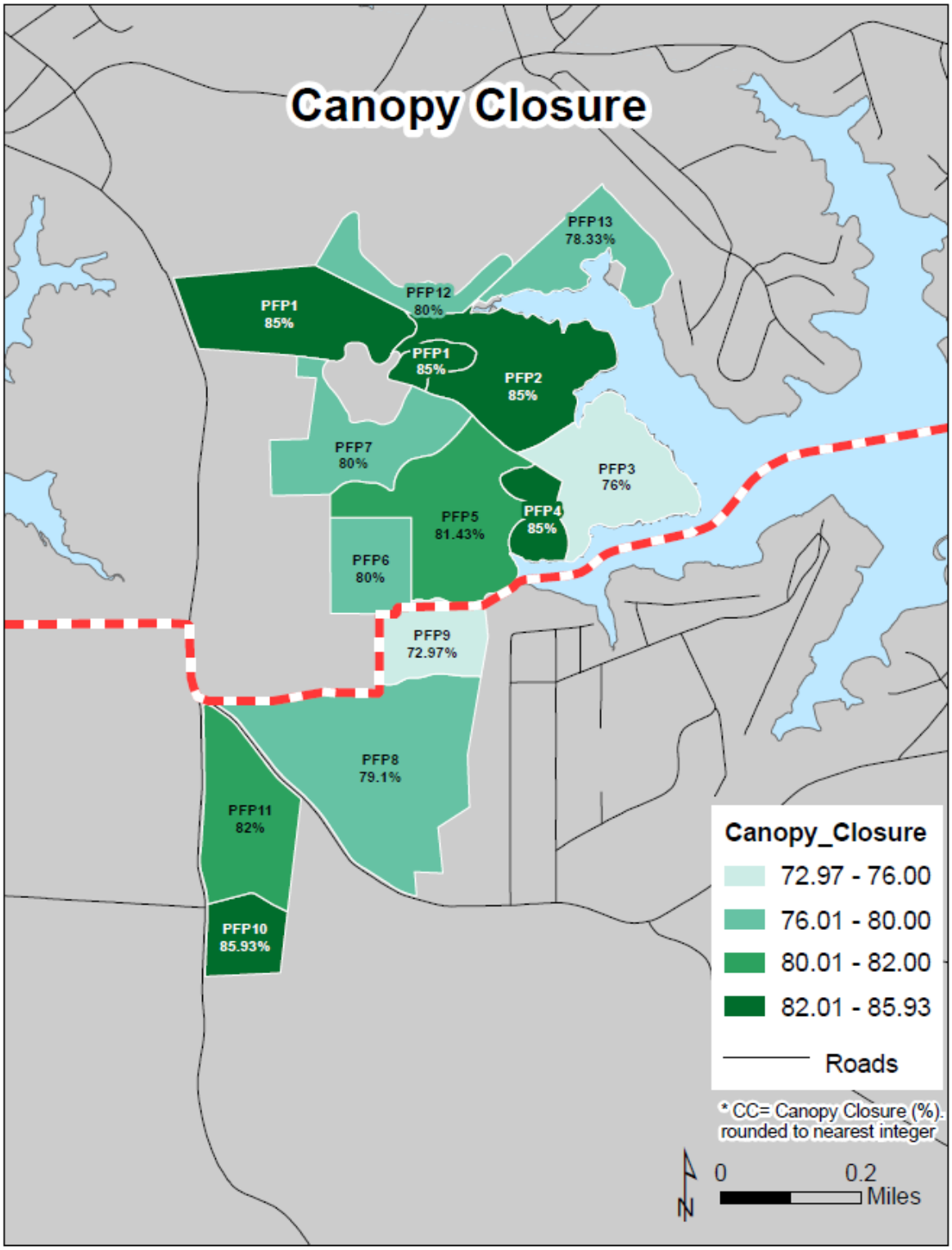
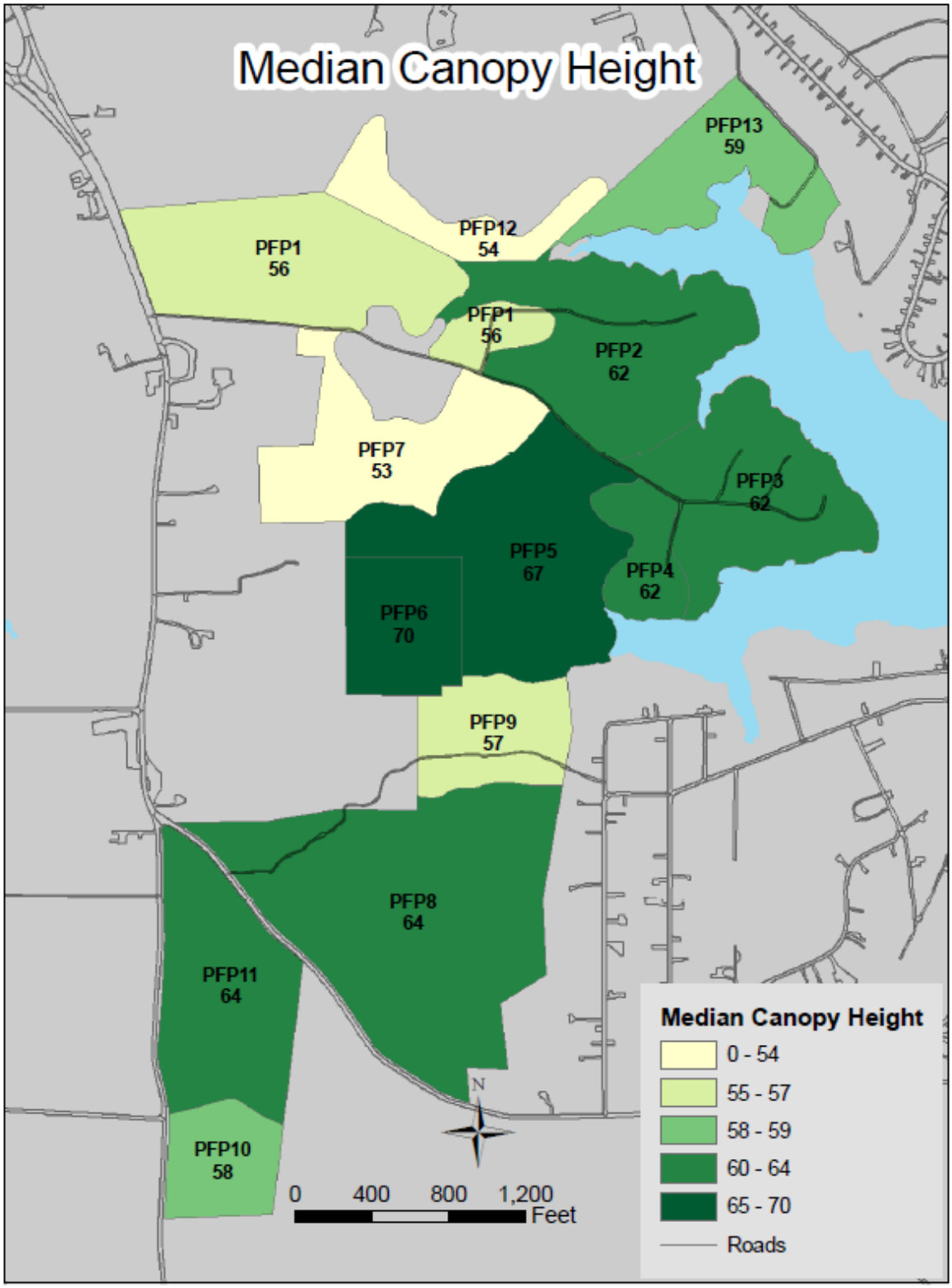


Figure 3.5.4C: Median Canopy Height in Feet, by Stand.



3.5.5 Regeneration

The total number of stems per acre for understory and ground layer regeneration are presented by stand in Figure 3.5.5A, and the species composition of regeneration is presented in Figure 3.5.5B.

Figure 3.5.5A: Number of Stems per Acre

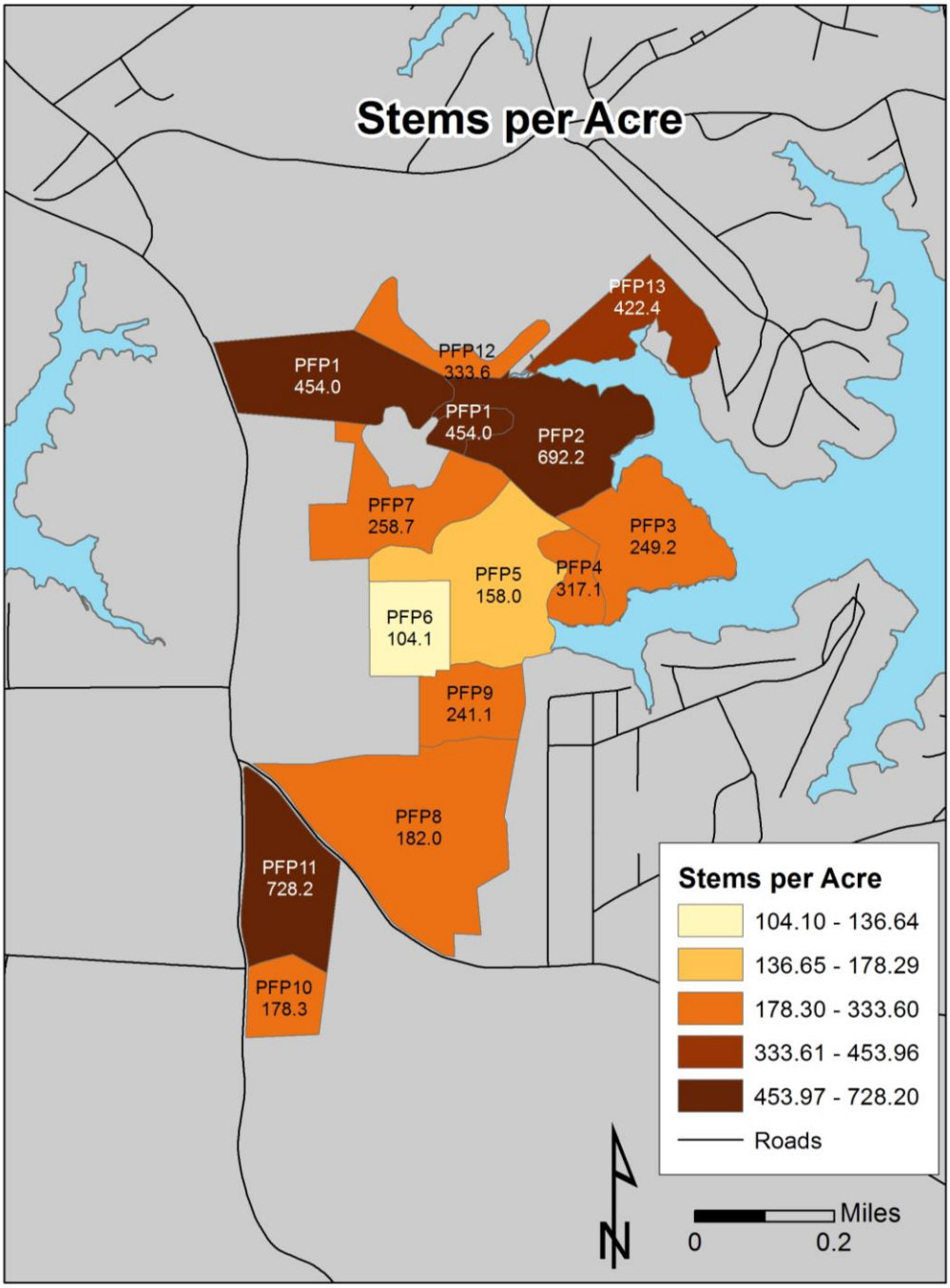
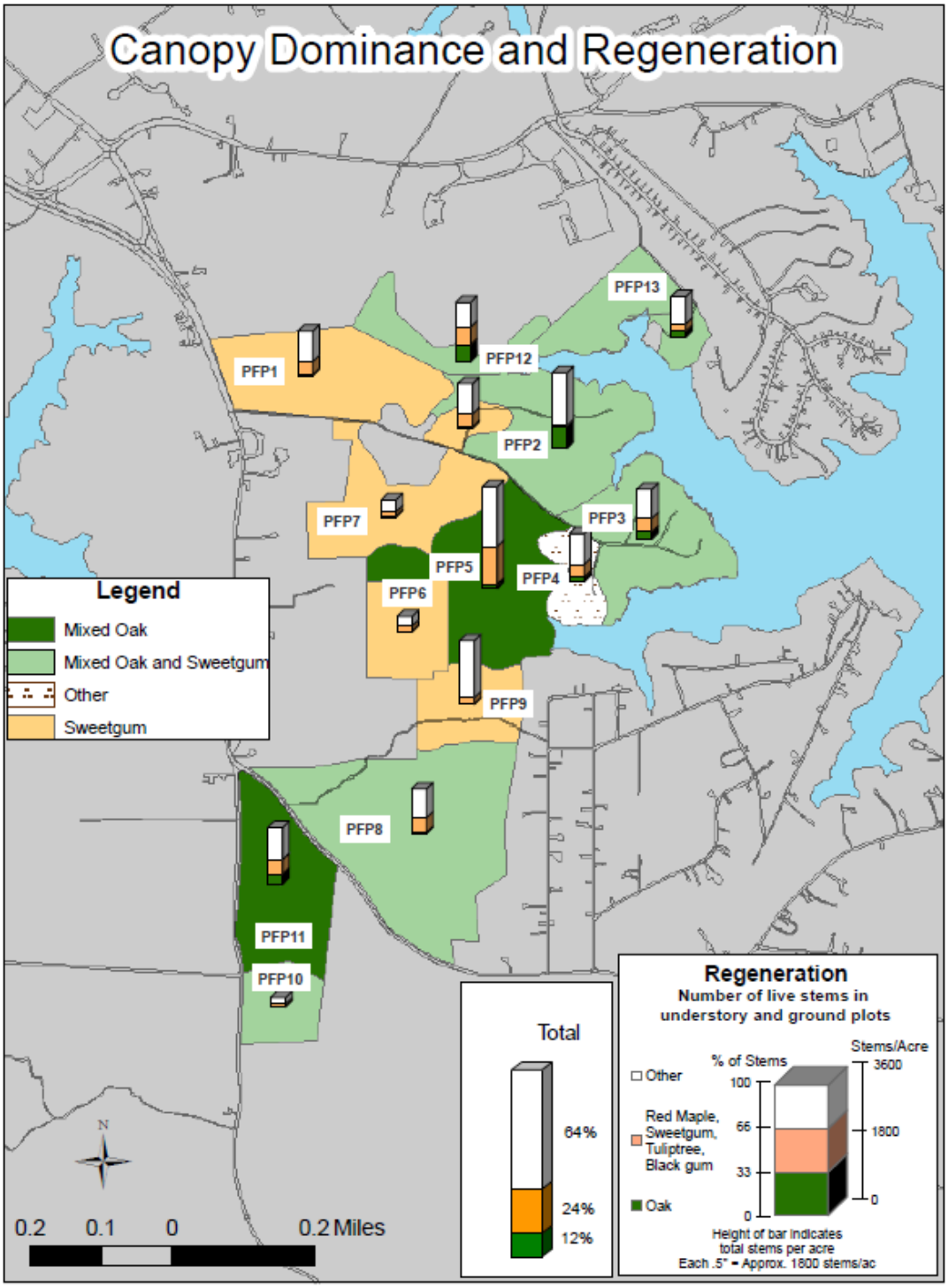


Figure 3.5.5B: Composition of Regeneration by Species.



3.5.6 Midstory Cover (% of Total Possible Cover by Type)

Table 3.5.6 presents the % of total possible cover of deciduous and coniferous trees in the midstory layer stands. The PFP forest system is comprised almost entirely of deciduous trees.

Table 3.5.6: Midstory Cover.

Stands	Deciduous	Coniferous	Mixed
PFP1	4.00	0.00	0.00
PFP2	4.00	0.00	0.00
PFP3	9.00	0.00	0.00
PFP4	7.00	0.00	0.00
PFP5	3.00	0.00	0.00
PFP6	6.00	0.00	0.00
PFP7	2.00	0.00	0.00
PFP8	7.00	0.00	0.00
PFP9	10.00	0.00	0.00
PFP10	1.00	0.00	0.00
PFP11	8.00	0.00	0.00
PFP12	13.00	0.00	0.00
PFP13	7.00	0.00	0.00

3.5.7 Ground Cover Attributes

The percentage and average height of shrubs for each stand are presented in Table 3.5.7. The table also includes the total number of species identified in the ground layer and the most abundant species. The species counts ranged from only 4 species for Stands 9 and 13 to 17 species for Stand 2, with an average of 10 species per stand. Arrowwood and Red maple are the most common species in the shrub height layer.

Table 3.5.7: Selected Ground Cover Attributes.

Stand	% Shrub Cover	Avg Shrub Ht (ft.)	Species Count	Most Abundant Species
PFP1	27	3.60	11	arrowwood, spicebush and red maple
PFP2	22	4.10	17	beech, blueberry and honeysuckle
PFP3	25	7.40	9	red maple, sweetgum and devils walking stick
PFP4	30	4.80	12	red maple, sweetgum and black cherry
PFP5	21	4.20	13	sweetgum, holly and red maple
PFP6	17	3.90	10	spicebush, black haw and arrowwood
PFP7	14	4.40	12	black haw , arrowwood and red maple
PFP8	25	5.00	13	blueberry, red maple and arrowwood
PFP9	27	4.30	4	red maple dogwood and black cherry
PFP10	7	4.30	7	arrowwood , blueberry and red maple
PFP11	30	4.40	11	red maple serviceberry and arrowwood
PFP12	31	5.00	9	sweetgum, white oak and black cherry
PFP13	22	5.50	4	red maple, sweetgum and serviceberry

3.5.8 Timber Assessment

Sustainability

The distribution of area in the various size classes across the entire Pottery Farm Park forest system is detailed in the following table:

Size Class	Balanced Range (%)	Actual %	Difference
Regeneration	5 to 10	0	-5
Saplings + Poles	35 to 45	10.97	-24.03
Small sawtimber	25 to 35	52.21	17.21
Large sawtimber	10 to 15	36.81	21.81

Stocking: Basal Area and Relative Density

Stocking is a measure of how well the growing space available for trees is being occupied. It is most useful when determined on a stand-by-stand basis. There are several different measures that estimate how “crowded” a forest stand is, based generally on how many trees there are and their size and species. This section addresses basal area and relative density as measures of stocking.

As presented in Figure 3.5.4A above, the Pottery Farm Park study area contains stands that range in basal area from 118 to 192.9, with a weighted average of 133.7 sq. ft. per acre. These data include live trees of acceptable and unacceptable growing stock. The species present are listed in the table below by overall relative dominance for the entire study area.

Relative density is a measure of tree crowding that accounts both for the size of each tree and the amount of space typically occupied by a tree of that size and species, so it is an especially useful measure in mixed species stands. A relative density of 100 percent implies that the growing space is fully occupied and trees must either slow their growth to survive or some trees will be crowded out and die, making room for more vigorous ones. On most stocking charts, 100% relative density is represented as the A-line. If relative density is at least 60% and below 100%, trees can fully occupy the growing site. At 60% (the B-line), maximum stand growth occurs near this level, and enough trees occupy the site to discourage detrimental effects on growth form. At 40% (the C-line), this is the lower limit of stocking necessary to reach 60% (B-line) stocking in ten years on average sites. The PFP study area contains stands that range in relative density from 62 to 133 with a weighted average of 87.6 percent relative density.

Species	Basal Area (sq.ft/ac)	Relative Dominance (%)	Relative Density (%)	Total (%)
Sweetgum	11.61	46.98	7.38	44.93
Red maple	4.33	17.51	3.05	18.58
Tuliptree	2.12	8.56	0.73	4.46
White oak	1.84	7.45	1.49	9.1
Chestnut oak	1.08	4.37	0.82	5.01
Southern red oak	0.88	3.56	0.66	4.04
Virginia pine	0.37	1.51	0.23	1.42

Species	Basal Area (sq.ft/ac)	Relative Dominance (%)	Relative Density (%)	Total (%)
Willow oak	0.37	1.48	0.28	1.68
Black cherry	0.36	1.44	0.34	2.08
American beech	0.34	1.36	0.28	1.68
Pin oak	0.31	1.25	0.24	1.47
Black oak	0.25	0.99	0.19	1.19
Hickory	0.17	0.7	0.16	1
Ash	0.15	0.6	0.09	0.53
Northern red oak	0.11	0.43	0.09	0.55
Sassafras	0.1	0.41	0.09	0.57
Blackgum	0.08	0.31	0.06	0.39
Locust	0.07	0.27	0.04	0.27
Scarlet oak	0.06	0.26	0.05	0.3
American holly	0.06	0.24	0.04	0.22
Serviceberry	0.03	0.13	0.05	0.29
Persimmon	0.03	0.11	0.03	0.18
Cottonwood	0.02	0.08	0.01	0.08

Timber Volume

Timber volume is a good estimate of the productivity of forested sites. The data in the table below refer to net volume, which is calculated or estimated by deducting from gross volume the loss of sound wood to insects, diseases, or other damage. The trees include both live and dead trees of acceptable and unacceptable growing stock. Summary volume data for the study area include the following:

- Timber volume for the entire study area totals 1,752,420 board feet of sawtimber plus 354,877cubic feet of pulpwood.

- The board foot volume of stands within the study area ranges from 2,876 to15,084 , with an area-weighted average of 7,712 board feet per acre.
- Net pulpwood volume of the stands ranges from 821to 2,717 with an area-weighted average of 1,561 cubic feet per acre.
- Net sawlog volume of the stands ranges from 399 to 1,913 with an area-weighted average of 1,023 cubic feet per acre.
- Total cubic volume of the stands ranges from 2,155 to 3,116 with an area-weighted average of 2,585 cubic feet per acre.

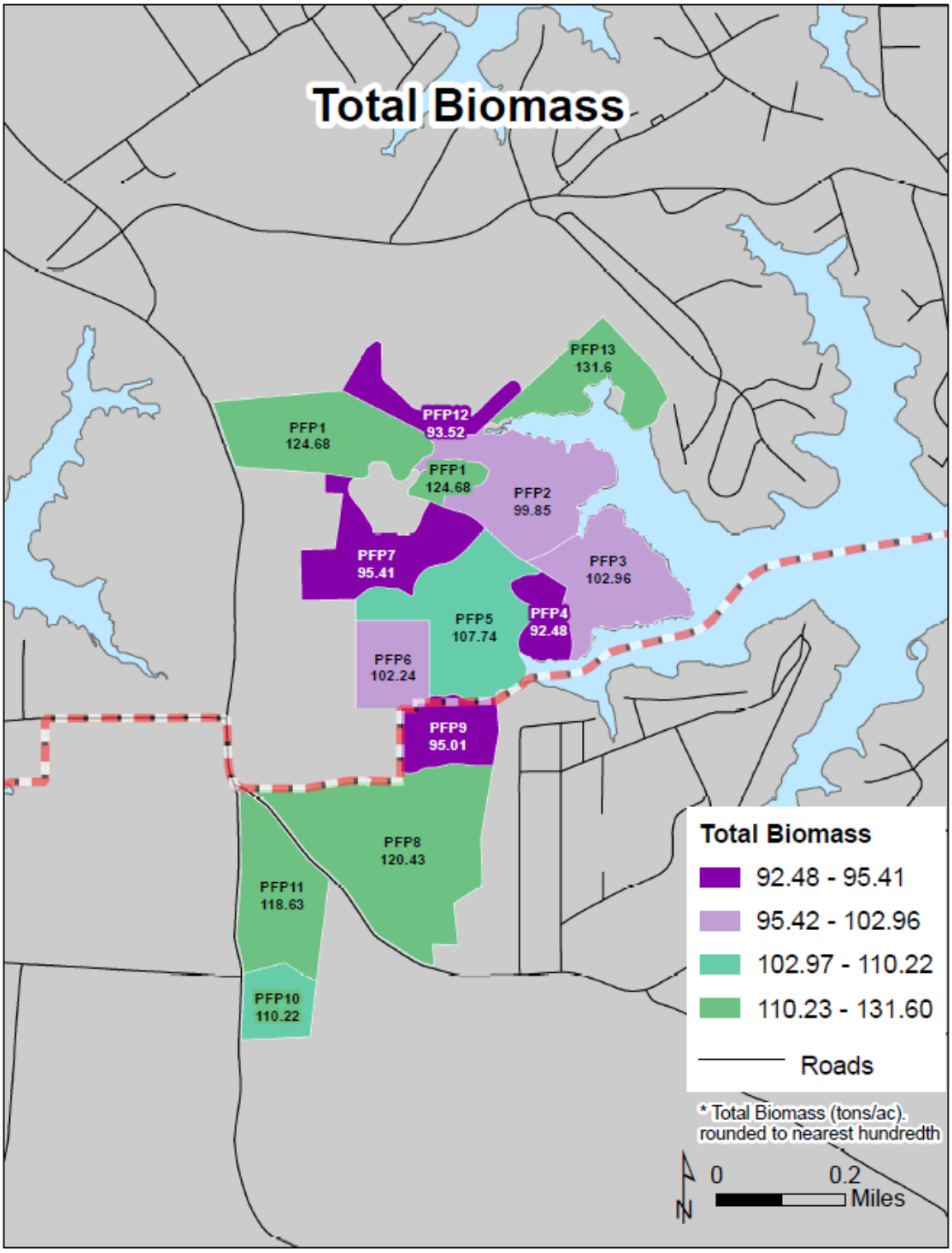
Volumes by species across the entire study area are presented, sorted by net board feet volume.

Species	Sawtimber (board ft.)	% of Total	Sawtimber (cubic ft.)	% of Total	Pulpwood (cubic ft.)	% of Total	Total (cubic ft.)	% of Total
Sweetgum	626,764.3	35.8	88,739.4	38.2	171,123.2	48.2	259,862.6	44.2
Tuliptree	272,162.8	15.5	33,862.5	14.6	20,291.6	5.7	54,154.1	9.2
White oak	235,272.3	13.4	30,103.1	12.9	20,281.2	5.7	50,384.3	8.6
Red maple	142,009.7	8.1	23,285.7	10	72,159.4	20.3	95,445.1	16.2
Chestnut oak	129,403.3	7.4	14,938.3	6.4	11,322.7	3.2	26,261.0	4.5
Southern red	117,982.8	6.7	15,331.6	6.6	11,174.3	3.1	26,505.9	4.5
Willow oak	74,530.9	4.3	8,373.5	3.6	8,306.3	2.3	16,679.8	2.8
Pin oak	45,939.3	2.6	5,312.7	2.3	4,925.7	1.4	10,238.3	1.7
Black oak	37,467.6	2.1	4,325.5	1.9	3,233.8	0.9	7,559.3	1.3
American beech	18,521.0	1.1	2,064.2	0.9	5,759.3	1.6	7,823.5	1.3
Northern red oak	17,742.8	1.0	1,972.3	0.8	1,385.5	0.4	3,357.8	0.6
Scarlet oak	14,292.3	0.8	1,588.7	0.7	705.8	0.2	2,294.6	0.4
Black cherry	10,250.1	0.6	1,189.7	0.5	7,530.8	2.1	8,720.4	1.5
Hickory	6,250.8	0.4	968.7	0.4	3,621.8	1	4,590.5	0.8
Ash	2,322.7	0.1	263.0	0.1	3,192.2	0.9	3,455.2	0.6
American holly	1,971.3	0.1	240.7	0.1	862.3	0.2	1,103.0	0.2
Virginia pine	-	-	-	-	4,658.6	1.3	4,658.6	0.8
Serviceberry	-	-	-	-	-	-	-	-
Sassafras	-	-	-	-	432.0	0.1	432.0	0.1
Persimmon	-	-	-	-	-	-	-	-
Black locust	-	-	-	-	779.3	0.2	779.3	0.1
Cottonwood	-	-	-	-	652.5	0.2	652.5	0.1
Blackgum	-	-	-	-	2,519.1	0.7	2,519.10	0.4
Total	**1,752,884.00**	**100.0**	**232,559.50**	**100.0**	**354,917.50**	**100.0**	**587,477.00**	**100.0**

The distribution of total biomass in tons per acre by stand is presented in Figure 3.5.8 below. Biomass reflects the amount of carbon sequestered in the tree tissues (leaves, branches, trunks, and roots).

Stand ID	Above Ground Biomass	Root Biomass
PFP-1	104.71	19.98
PFP-2	83.94	15.91
PFP-3	86.66	16.31
PFP-4	77.46	15.02
PFP-5	86.07	16.17
PFP-6	90.65	17.09
PFP-7	80.19	15.22
PFP-8	101.35	19.07
PFP-9	79.87	15.14
PFP-10	92.71	17.51
PFP-11	99.76	18.86
PFP-12	78.65	14.87
PFP-13	101.70	20.82

Figure 3.5.8: Total Biomass (tons/acre) by Stand.



Visual Quality

This study area consists of 227.4 acres, and five forest types. The largest tree observed was a 46-inche dbh, White oak. Variability among the stand size classes is medium (3 out of a maximum of 5). Big trees are those where the dbh > 18 inches.

Stand	Acres	Forest Type	Avg. dbh (in.)	Big Trees* (stems/ac.)	Big Tree Basal Area (sq.ft./ac.)
PFP1	24.9	bottomland hardwoods	8.29	0.00	0.00
PFP2	23.1	oak bottomland hardwoods	3.73	17.30	41.40
PFP3	18.9	oak bottomland hardwoods	11.07	21.80	54.00
PFP4	5.7	mesic mixed pine-hardwoods	6.86	13.90	30.00
PFP5	25	oak/poplar bottomland hardwoods	10.42	30.40	67.10
PFP6	9.9	bottomland hardwoods	13.06	24.50	66.00
PFP7	21.6	bottomland hardwoods	8.85	7.10	21.70
PFP8	41.5	oak bottomland hardwoods	10.32	28.40	65.00
PFP9	9.9	sweetgum	9.65	4.70	10.00
PFP10	7.5	oak bottomland hardwoods	10.87	20.80	42.50
PFP11	18.5	oak bottomland hardwoods	3.73	25.30	58.00
PFP12	7.4	bottomland hardwoods	6.00.	15.40	36.70
PFP13	13.4	oak bottomland hardwoods	4.76	35.10	103.30

The amount of cover in the shrub and midstory layers is closely related to the screening ability of vegetation. The table below presents the percent of vegetative cover of a total possible cover for each of these forest layers.

Stand	Midstory (%)	Shrub Layer (%)	Ground Layer (%)
PFP1	4.0	27.0	61.9
PFP2	4.0	22.0	43.9
PFP3	9.0	25.0	23.4
PFP4	7.0	30.0	68.7
PFP5	3.0	21.0	41.7
PFP6	6.0	17.0	70.0
PFP7	2.0	14.0	67.5
PFP8	7.0	25.0	35.6
PFP9	10.0	27.0	59.0
PFP10	1.0	7.0	64.0
PFP11	10.0	30.0	28.2
PFP12	13.0	31.0	30.0
PFP13	7.0	22.0	16.7

3.6 MANAGEMENT QUESTIONS AND ANSWERS

The County's forestry consultant, Mar-Len Environmental, Inc., was asked to answer the following questions based on the field assessments of the County-owned forests of the Pottery Farm Park:

1. **Are there forest areas that show evidence of forest pests, (including deer) or disease that need to be treated?**

Yes: Some of the Sweetgums are suffering from a typically fatal disease known as bleeding canker (bleeding necrosis, Botryosphaeria canker). The disease favors stressed trees and many of the Sweetgum stands are highly overstocked. There is really no treatment. Recommendations are to remove diseased trees when thinning stands to reduce overcrowding. Vines are hindering the development of healthy crowns and should be cut. Deer impact is evident through browsing and buck rub with the most activity observed in Stand 6.

2. **Are the forest areas sufficiently diverse with respect to species composition and age classes of trees?**

Yes: Some of the stands have a history of being farmed in the 1930's and have gone through secondary succession to the current forest state. Currently 23 species of overstory where found in the forest community. Stand structure includes 5 forest cover types based on the top dominant overstory species in each stand. Pole size trees account for 10.97 % of the site while small sawtimber and large sawtimber account for 52.22 and 36.80 respectively.

3. **Do the forest areas show evidence of adequate regeneration or regeneration potential?**

No and Yes. The potential for regeneration is excellent because high quality trees were found in most stands for a variety of species. However, the invasive plant community occupies space and/or hinders the development of high quality regeneration such as oak and poplar. Deer selectively browse regeneration, favoring high value species such as oak and poplar. The closed canopy (mean 80%) is ideal for survival of shade tolerant species such as red maple, beech, and black gum. Regeneration was present for 17 species with an average of 1,383 seedlings/sapling per acre across stands. While all Oak species combined comprise only 13.3% of all regeneration, Black cherry, Red maple, Black gum, and Sweetgum – all species not desirable as dominant canopy species represent 59.9% of all regeneration.

4. **Are there forest areas of very high quality that should be or have the potential to be managed for "old growth" conditions?**

Yes. Oaks are co-dominant in 4 of the stands. Stands 3, 5, and 13 can be actively managed for old growth through forestry. Stand 8 is too sensitive for management, but can be freed of vines and exotic, invasive species near target trees to assist in the development of the oaks towards old growth conditions. Oaks have the ability to live hundreds of years. All of the forest can be managed toward old growth and guidelines are provided in the recommendations should the County be interested in considering other areas for old growth management.

5. Are the forest areas adequately protecting water quality, including streams and wetlands?

Yes. The entire forest system has adequate canopy closure and multiple layers of vegetation that help intercept rainfall. As stated in Section 2.3 of this report, forests play a major role in maintaining or improving the water quality of wetlands, streams, and the Chesapeake Bay by slowing the movement of soil particles and nutrients from the land to waterways. Oak forests maintain a higher ratio of carbon to nitrogen in forest floor litter than other deciduous forest types because of high lignin content, which slows the decomposition rate of downed debris, and the movement of soluble nitrogen compounds through the landscape (Finzi et.al. 1998).

6. Are the forests adequately protecting areas from soil erosion?

Yes. Nowhere throughout the study was area surface erosion noted, with the exception of ATV trails within the forest areas.

7. Are there human uses of the forest areas that threaten forest health?

Yes. ATV's have eroded trails that cross over waterways and through forested wetlands, changing the flow pattern and the forest floor's ability to absorb rainfall due to compaction. Regeneration is also being destroyed due to the creation of unplanned trails, and the openings are allowing exotic species to spread.

8. Is there evidence that the forest provides adequate habitat for desirable wildlife that would be expected to inhabit the forest?

Yes. The study area has the potentially to provide crucial habitat for forest interior dwelling bird species, as well as for forest-dependent reptiles, amphibians, and mammals. The natural character of the site should make it a vital habitat for waterfowl, fish, bald eagles, and a resting area for other migratory birds.

9. Are there areas of the forest that could benefit from silvicultural activities to improve forest health and vitality or ecosystem services of the forest?

Yes. The relative density of stands in this forest system ranges from 62% to 133% with a weighted average of 87.6% relative density. Eight stands are overcrowded with a relative density of >85%. Twelve of the 13 stands have 45% or more undesirable trees.

The lack of regeneration is primarily caused by deer browse, invasive plant species competition and the dense canopy in most stands. The closed canopy has made an ideal environment for shade tolerant species such as Red maple, Black gum, and American beech.

3.7 HABITAT CHARACTERISTICS FOR WILDLIFE

Components of Eastern Deciduous Forest Habitat Structure and Composition

Forest structure refers to the presence of a series of vertically spaced zones of vegetation that occur between the crowns of the tallest trees and the forest floor, including:

- The Overstory, which is divided into
  - canopy – the tallest, oldest trees, whose presence in the canopy exerts dominance over the entire forest ecosystem
  - midstory – younger trees of the existing canopy or other tree species that are competing for canopy space as the older trees age and decline
- The Understory - younger trees of the canopy species or species whose maximum height at maturity is lower than the lowest part of the canopy; grape vines and poison ivy vines may reach this layer, or grow into the midstory
- The Shrub layer – still younger trees and other plants that grow as shrubs
- The Herbaceous layer – tree and shrub seedlings, wildflower species, ferns
- The Forest floor – small grasses, wildflowers, ferns, mosses, logs, fallen leaves, coarse woody debris, twigs, fruits and seeds, other detritus, and rocks.

This vertical spatial arrangement of diverse plant life forms, from the tallest canopy trees to the smallest forest floor plants, provides a wealth of habitat types for mammals, birds, amphibians, reptiles and countless insects and arthropods to forage and breed, build nests, rear young, and move about in relative safety from attacks by predators.

Forests that contain streams and wetlands also expand the suite of habitats to include aquatic communities of macroinvertebrates - crayfish, clams, snails, aquatic worms and insects - that serve as food sources for both aquatic and some terrestrial predators, including fish, birds, and mammals. Forest streams also provide spawning areas for full-time freshwater fish, and in coastal streams, anadromous fish species that spawn in freshwater, but migrate to brackish or saltwater habitats in their adult stages.

Forest structure, including the degree of canopy closure and the density of the understory also affects the growth patterns and reproduction of plants in the lower layers by controlling seasonal light penetration through and moisture gradients within the forest layers. In addition to soil quality and nutrient availability, light intensity and moisture levels regulate both the growth rates of plants throughout the forest and the regeneration of tree species, some of which will eventually fill canopy openings as the current canopy trees decline.

Forest composition refers to the specific types of trees, shrubs, and lesser vegetation that grow in each forest layer. Because plant species have different light, moisture, and soil requirements for growth and sustainability, the species composition of a forest reflects the environmental site conditions, including soil type and the topographic position in the landscape, which determine light and moisture availability. At any given time, forest composition also reflects former natural or human-made disturbances. Severe disturbances that kill or remove canopy trees – wind and ice storms, fire, widespread disease or insect infestation, and some types of intensive forest harvesting – can bring about significant changes in the composition of the recovering forest. The degree to which this can happen depends upon the frequency and duration of each disturbance. Frequent, severe disturbances can also reduce forest plant biological diversity by degrading habitats for many of the forest plant species, while encouraging the colonization of the disturbed forest by aggressive, invasive plant species, both native and exotic types, that

often suppress the regeneration and growth of the forest canopy species.

Native plant species diversity is as important as forest structure for the maintenance of habitat diversity because the types of foods produced by different plant species affect the diversity and abundance of the resident animal community. From leaves, twigs, and bark to buds, flowers, fruits, and seeds, the foods produced by plants and the animals that feed directly on the plants or feed by preying on the plant eaters, all constitute valuable components of the complex forest food web. Typically, greater diversity in the forest plant composition is reflected in a greater diversity in the animal communities of a forest, because animal species tend to thrive and produce more offspring when their preferred foods are abundant and adequate shelter is available to protect their young.

The Importance of Oak Species in the Forest Habitats of the Mid-Atlantic Region

Thousands of years of oak dominance in the forests of the mid-Atlantic region have generated myriad interdependent relationships between oak trees and wildlife species. Oaks are keystone species because of their critical importance as reliable sources of abundant foods for wildlife. In numerous ways, oaks also play a significant role in sustaining the health and productivity of upland forests and forested wetlands (Fralish 2004). The annual deposition of lignin-rich leaves that remain intact throughout the winter protect forest floor soils from the erosive forces of precipitation, while providing shelter for the forest floor animal community (Johnson et al. 2002), (Finzi et al. 1998). Oak litter also helps to keep aquatic habitats from being fouled and degraded by excessive sediment loading, while providing nourishment for a community of aquatic macroinvertebrate species (Sweeney 1993) that, in turn, provide an important food source for fish. Oaks are more efficient than are other forest tree species in managing nutrient recycling in the forest ecosystem. Oak-dominated forests throughout the eastern U.S. typically express tighter control on nitrogen cycling than do beech/maple forests, releasing lower levels of nitrates from organic forest floor litter to adjacent streams (Lovett et al. 2004). These functions help to keep forest soils in place, to recharge groundwater, and to maintain high quality habitats for aquatic and terrestrial wildlife, and for the benefit of human communities as well.

One of the most visible, nutritious, and critically important wildlife foods is the acorn crop, which is produced annually, but in much greater abundance in two to five year cycles called mast years. Acorns are a preferred food for White-tailed Deer, Gray Squirrel, White-footed Mouse, Wood Duck, Blue Jay, and some other large game birds and woodpeckers, but are also consumed by foxes, raccoons and other omnivores, especially in the winter months when food sources become scarce (Martin et al. 1961). Acorns also serve a duel role as food supply and shelter for acorn weevil larvae that overwinter in the nuts, increasing the spring supply of foods for insect eaters. The size of the acorn crop not only influences the number of offspring produced by the feeding animals, but also the populations of their predator species, all of which show the greatest increases, not only in population, but also in the health and fitness of the young, in the spring following a mast year acorn crop.

Another plant source for wildlife is available in the buds, leaves and twigs that are directly consumed by browsing mammals. Equally important, the leaves are also fed upon by adult insects or their larvae, converting the plant food into more nutritious, protein-rich foods for animals that may feed on the insects. At this level in the food web, oak foliage plays a crucial role in the survival of the hatchlings of almost all eastern forest bird species. This group consists of permanent residents as well as short and long distance migrants that include forest interior dwelling species (FIDS).

Breeding activity in FIDS and other perching birds is timed to a steady supply of caterpillars, many of which rely on the foliage of forest trees for their only food source (Holmes et al. 1991). The caterpillars of 534 species of forest moths, feed primarily on the young leaves of oak species at a time when forest birds are foraging for hatchling food, most of which consists of caterpillars (Tallamy, 2007). The availability of this critical food source depends, in turn, upon the presence of an oak-dominated forest community. Oaks are also primary hosts for gall wasps, whose larvae extend the food supply into the summer and fall (Cornell 1983). For all these life-sustaining functions, oak forest communities anchor a complex food web that supports the entire range of feeding levels, from herbivores to carnivores and omnivores in the deciduous forests of the mid-Atlantic and southern regions.

Canopy Dominance

Canopy dominance for habitat value was assessed in two different ways: by measuring the percent basal area by tree species, and by observing the relative height of individual trees of any species within the canopy. In the first case, basal area (the cross sectional area) of all the canopy trees in a particular species, compared to the total basal area of all the trees in the canopy was used to calculate % relative dominance by species. These data indicate the tree species with the greatest presence in the canopy, and help to estimate the types and abundance of food resources available for the animals that feed or nest in the canopy. Relative dominance is also important in helping to predict probable future changes in canopy composition by identifying the dominant midstory tree species that could replace canopy trees as they decline. When the composition of the dominant midstory species is significantly different from the dominant species in the canopy, it is reasonable to expect that the future forest will have a different composition, as well as a different dependent animal community.

Alternatively, dominant trees were identified by observing their relative position in the canopy. In this case, dominance is assigned to trees that extend above the other trees in the canopy and are able to receive sunlight from above and all around the crowns. (Co-dominant trees receive sunlight from above but only limited sunlight from the sides because one or more sides of the crown are crowded by the dominant trees.) Data about this type of dominance is typically used in timber stand management, but it is also valuable for estimating the amount of quality habitat for high canopy nesters, e.g., Red-shouldered Hawk, Scarlet Tanager, and Red-eyed Vireo, all of which were documented as breeding in the Pottery Farm forest in the 1987 Breeding Bird Atlas Survey (please see Table 3.7.3 below). High canopy trees also provide abundant food resources for treetop insect gleaners, including the vireo and tanager mentioned above, as well as some kinglets and gnatcatchers. Height dominance in the midstory can also be helpful in estimating the abundance of nesting habitats for birds that tend to feed in the lower canopy and may nest in the same areas. Both of these dominance assessment methods are important for preparing management plans for the restoration of oak dominance in the forest.

The assessment of the PFP forest, using basal area, found no oak dominance in the canopy of the assessed forest, however oak is co-dominant with Sweetgum, Red maple, or Tuliptree in 4 of the 13 stands. Only one example of oak dominance was found in the midstory in stand 11. The height dominance assessment revealed canopy dominance by oaks in 176.9 acres in 9 of the 13 stands or 77.8% of the 227.3 acres assessed. However, the closing canopy in all stands surveyed casts deep shade on the lower forest layers, allowing .0the shade-tolerant Red maple to proliferate (found in every stand in the mid and understory), by suppressing the growth of the oak regeneration as well as other preferred species.

Table 3.7.1A: Stand Forest Types and Dominant Tree Species in the Canopy and Midstory (using % Basal Area)

			CANOPY				MIDSTORY	
Stand	**Acres**	**Forest Type**	**Dom.**	**Co-dom.**	**Size Class**	**% Cover**	**Dom.**	**Co-dom.**
PFP1	24.9	bottomland hardwoods	SG		pole	85.0	SG	
PFP2	23.1	oak bottomland hardwoods		SG-RM	small saw	85.0		BC-SG
PFP3	18.9	oak bottomland hardwoods		SG-CO	large saw	76.0	RM	
PFP4	5.7	mesic mixed pine-hardwoods		TT-VP-SG	small saw	85.0	SG	
PFP5	25.0	oak/poplar bottomland hardwoods		TT-Oak	small saw	81.4		BE-RM
PFP6	9.9	bottomland hardwoods		SG-RM	large saw	80.0		RM
PFP7	21.6	bottomland hardwoods	SG		small saw	80.0		SG-RM
PFP8	41.5	oak bottomland hardwoods		RM-SG-Oak	large saw	79.1	RM	
PFP9	9.9	sweetgum	SG		pole	73.0	SG	
PFP10	7.5	oak bottomland hardwoods		RM-SG	small saw	85.9	RM	
PFP11	18.5	oak bottomland hardwoods		SG-RM	small saw	82.0	WO	
PFP12	7.4	bottomland hardwoods		SG-RM	small saw	80.0	RM	
PFP13	13.4	oak bottomland hardwoods		SG-WO-CO	large saw	78.3		RM-SG

Table 3.7.1B: Stand Forest Types and Dominant Tree Species in the Canopy and Midstory (using Position in the Overstory)

			CANOPY				MIDSTORY	
Stand	**Acres**	**Forest Type**	**Dom.**	**Co-dom.**	**Size Class**	**% Cover**	**Dom.**	**Co-dom.**
PFP1	24.9	bottomland hardwoods	SG	RM	pole	85.0	RM	SG
PFP2	23.1	oak bottomland hardwoods	SRO TT	SG	small saw	85.0	BC RM	HICK
PFP3	18.9	oak bottomland hardwoods	SRO TT WO	SG	large saw	76.0	RM SG	SAS
PFP4	5.7	mesic mixed pine-hardwoods	TT	VP	small saw	85.0	RM	SG
PFP5	25.0	oak/poplar bottomland hardwoods	SRO WO TT	SG	small saw	81.4	SG	RM
PFP6	9.9	bottomland hardwoods	SG	RM	large saw	80.0	SG	RM
PFP7	21.6	bottomland hardwoods	SG OAK TT	RM	small saw	80.0	RM	PERS
PFP8	41.5	oak bottomland hardwoods	WO WIL O	TT RM	large saw	79.1	RM	BG
PFP9	9.9	sweetgum	SG	RM	pole	73.0	RM	DG
PFP10	7.5	oak bottomland hardwoods	WO PINO SG	RM SG	small saw	85.9	RM	BG
PFP11	18.5	oak bottomland hardwoods	WO WIL O PIN O	SG RM	small saw	82.0	RM	SG
PFP12	7.4	bottomland hardwoods	SRO TT WO	SG REM	small saw	80.0	RM	SG
PFP13	13.4	oak bottomland hardwoods	CO WO SRO	SG	large saw	78.3	RM	SG

Note: all stands in the mid-story are sapling/pole size class.

Key to Species:

BC – Black cherry	PERS – Persimmon	SRO – So. red oak	WO – White oak
BG – Black gum	PINO – Pin oak	SG – Sweetgum	WILO – Willow oak
CO – Chestnut oak	RM – Red maple	TT – Tuliptree (Tulip poplar)	
HICK – hick	SAS – Sassafras	VP– Virginia pine	

In 1987, a Habitat Assessment Study, conducted in the Pottery Farm forest by the Baltimore County Department of Environmental Protection and Resource Management (DEPRM), found numerous oak trees co-dominating with Sweetgum, Tuliptree, and Red maple.throughout the forest. This study also recorded FIDS breeding activities in multiple site visits during the breeding safe dates for FIDS. These observations were supported by documentation of FIDS breeding activity in the Maryland – D.C. Breeding Bird Atlas Survey of 1983-1987, as shown in Table 3.7.2, and Table 3.7.3 (species list).

Table 3.7.2: MD and DC Breeding Bird Atlas Surveys: Documented Species and Activities for the Middle River Quad Map

	2002 - 2006 Period		1983 - 1987 Period	
	Breeding Activity		Breeding Activity	
Block	**Confirmed**	**Probable**	**Confirmed**	**Probable**
SE	**1**	**3**	**4**	**5**
SW	**0**	**2**	**3**	**1**
CE	**0**	**2**	**1**	**1**

Most of the breeding activity was seen in the southeast block, which contains more than 99% of the PFP forest. The 1983 - 1987 Breeding Bird Atlas Survey also showed some activity in the blocks to the west and north of the study forest. In contrast, the latest Breeding Bird Atlas Survey of 2002 - 2006 shows a marked decline in FIDS breeding activity in all of the blocks, but especially in the southeast block, the focus of the 2009 PFP forest assessment.

The results of the 2002 -2006 BBA survey can be viewed on the Patuxent Wildlife Research Center's website at http://www.pwrc.usgs.gov/bba/index.cfm?fa=explore.ResultsByBlock&BBA_ID=MDDC2002. The data for three blocks of the USGS Middle River quad were examined: the SE block, which contains >99% of the PFP site, and the CE and SW blocks, parts of which are adjacent to the PFP site.

Table 3.7.3: Detailed Breeding Bird Atlas Data on FIDS Presence for the Middle River

FIDS Species	**2002 - 2006 Project Breeding Activity**			**1983 - 1987 Project Breeding Activity**		
Middle River Quad SE block	**Confirmed**	**Probable**	**Possible**	**Confirmed**	**Probable**	**Possible**
Red-shouldered Hawk*		T		FL		
Broad-winged Hawk*						
Barred Owl*		P				
Whip-poor-will					T	
Hairy Woodpecker		P			T	

Pileated Woodpecker						X
Acadian Flycatcher			X		T	
Wood Thrush			X		T	
Yellow-throated Vireo			X			
Red-eyed Vireo			X	FY		
American Redstart*			X			
Prothonotary Warbler				ON		
Ovenbird			X		T	
Louisiana Waterthrush*						X
Scarlet Tanager	FL			FY		
Adjacent CE block						
Red-shouldered Hawk*			X			
Broad-winged Hawk*						
Barred Owl*			X	FY		
Whip-poor-will						
Hairy Woodpecker						X
Pileated Woodpecker						
Acadian Flycatcher						
Wood Thrush		T				
Yellow-throated Vireo						
Red-eyed Vireo						
American Redstart*						
Prothonotary Warbler						
Ovenbird			X			X
Louisiana Waterthrush*						
Scarlet Tanager		T				X
Adjacent SW block						
Red-shouldered Hawk*			X	FL		
Broad-winged Hawk*				ON		
Barred Owl*						
Whip-poor-will						
Hairy Woodpecker		T		ON		
Pileated Woodpecker						
Acadian Flycatcher					T	
Wood Thrush						
Yellow-throated Vireo						
Red-eyed Vireo						
American Redstart*						
Prothonotary Warbler						
Ovenbird						X
Louisiana Waterthrush*						
Scarlet Tanager		T				X

*highly area-sensitive

Breeding Codes:
FL - recently fledged
FY - adult carrying food for young
ON - occupied nest

Probable Codes:
P - pair observed in suitable breeding habitat
T - territorial behavior

Possible Code:
X - species heard or seen in breeding habitat within safe dates

The block data displayed above do not include other species of FIDS that are listed in *A Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area*, because they were not observed in the PFP forest during either of the BBA surveys. These species include:

Brown Creeper	Black and White Warbler*
Veery	Worm-eating Warbler*
Northern Parula	Swainson's Warbler*
Black-throated Green Warbler *	Kentucky Warbler*
Cerulean Warbler*	Hooded Warbler*

*highly area-sensitive

As a result of the 1987 DEPRM Habitat Assessment Study, the PFP forest was designated a Habitat Protection Area mainly because of its proximity to the much larger Lower Back River Peninsula forest, the PFP forest's relatively mature age, and moderately low edge-to-interior ratio, all of which qualified this forest as a potentially significant FIDS habitat, according to the requirements of the Chesapeake Bay Critical Area Program. The findings of the 2010 Forest Health Assessment provide important clues that might explain the greatly reduced use of this forest as a breeding site by FIDS.

In Table 3.7.1A, the basal area assessment shows a canopy composition of either Sweetgum dominance, or co-dominance by Sweetgum and Red maple or other non-oak species in 9 of the 13 stands totaling 128.5 acres (56.5%) of PFP. Oaks do not show clear dominance in any of the 13 stands, but are co-dominant in four stands totaling 98.8 acres (43.5%). In contrast, the assessment using tree height (Table 3.7.1B) reveals dominance by oak trees in 9 of the 13 stands. In every case, these trees are in the sawtimber size classes from 11.5 to greater than 23.5 inches in diameter. In the midstory, data in the basal area assessment show only one stand of 18.5 acres (8.1%) of the forest dominated by oak, while in the tree height midstory assessment, oaks are completely absent. These results strongly suggest that the canopy oaks represent the remains of a former forest that was dominated by oaks in the past, but is losing oak dominance to Sweetgum and Red maple in the present forest. This is an important finding about the relative value of this forest as FIDS breeding habitat because, as was mentioned above, the foliage of oaks and associated species in oak forest types are preferred foods for the caterpillars of hundreds of forest moth species, which constitute the major food supply for non-raptor FIDS and many other bird hatchlings in the spring.

Sweetgum has little value as a food for the larval forms of moths and butterflies. Only the caterpillars of several giant silkmoth species feed on Sweetgum foliage, and only during the summer months, after the FIDS hatchling crop has fledged and changed diets to include adult insects. This means that Sweetgum has no known food value for the hatchlings of the spring breeding FIDS, as is shown by its exclusion from the ranking table below. Some other wildlife species that feed on Sweetgum include gold finches, purple finches (not found at the PFP forest), squirrels, and chipmunks, all of which feed on the seeds, but this food source is not considered significant for these species (Martin et al. 1961).

Also missing from the ranking is Tuliptree (Tulip Poplar), another forest tree whose foliage is also consumed mainly by the caterpillars of summer-feeding silkmoths. Tuliptree does have additional value in the winged seeds that persist in woody cones, and can be valuable winter foods for adult seed-eating birds and small mammals; however the density of Tuliptree in the PFP forest is very low.

Based upon the assessment of the PFP forest composition, the only other species that could be expected to provide a food supply for the FIDS hatchlings would be the second canopy dominant, Red Maple, which supports the caterpillars of about half of the moth species supported by oaks.

Table 3.7.4: Tree Species Ranked by Ability to Support the Caterpillars of Forest Moth Species

Plant Host Species	# of Species Supported
Oak	534
Willow	456
Cherry, Plum	456
Birch	413
Poplar, Cottonwood	368
Maple	285
Elm	213
Hickory	200
Ash	150
Basswood, Linden	150
Walnut, Butternut	130
Beech	126
Chestnut	125

Source: Adapted from Tallamy, 2007.

The 1987 DEPRM habitat study noted the presence of significant Gypsy Moth damage in the adjacent Lower Back River Peninsula (LBRP) forest. The Maryland Department of Agriculture has confirmed a continuing cycle of Gypsy Moth infestation damage for decades in the entire forest block that includes both the LBRP and PFP forests. The caterpillars of this exotic, introduced species favor the foliage of oak species, particularly white oaks and chestnut oaks, but will also feed on many other tree species, except for Tuliptree. Although Sweetgum is tolerated as a food, it is not likely to have been a principal food source for the caterpillars in a forest filled with the much-preferred oak trees.

Even though the 2010 assessment of PFP found only minor Gypsy Moth damage in stand 8, a 41.5-acre stand of large sawtimber size class (greater than 23.5” diameter) with White Oak co-dominating in the canopy with Red Maple and Sweetgum, this stand may represent a remnant of the former oak-dominated forest that was attacked by the moths in earlier outbreaks because of the concentration and abundance of high quality food in the canopy. Recurring infestations, if not treated to suppress the moth, would likely have resulted in a major forest disturbance, causing a significant shift in tree species dominance (Hix et al. 1991) as oaks and other preferred trees for FIDS hatchlings were repeatedly defoliated and killed. There may have been salvage timber harvesting of the dead and dying oaks, which would have opened up the canopy, allowing the opportunistic, shade intolerant Sweetgum to spread quickly throughout the forest, ultimately filling the canopy gaps left by the harvested trees.

A closed canopy typically limits the growth of regenerated oaks, which need large light gaps for seedlings to grow into the understory and ultimately, the canopy. At the same time, closed canopies encourage the proliferation of shade-tolerant species like Red Maple, which is currently the situation in the PFP forest. Because Sweetgum does not have the food value provided by the keystone oaks and the associated species in oak-dominated forest communities, a significant shift in the composition of the dependent animal community would also be expected. Most obvious at the PFP appears to be a noticeable reduction in FIDS breeding activity.

The continuing loss of oak dominance in the PFP forest canopy may be only one of several factors contributing to the reduced use of the forest by FIDS. What might be perceived as a less severe disturbance, but accumulates in significance over time, particularly for ground-nesting animals, is the increased use of ATV's in the forest. ATV's can disrupt forest regeneration by damaging forest floor habitats while potentially introducing the seeds of exotic, invasive plants into the forest on the wheels of the vehicles (Webster et al. 1991). Persistent ATV use can disrupt soil structure, alter surface water patterns, change the forest floor plant community composition, and destroy the habitats of ground-nesting animals.

The PFP forest is showing signs of these continuing stresses. As a dedicated, significant FIDS breeding habitat, this forest can be returned to the condition that justified its conservation status in 1987. With forest management to reduce the density of Sweetgum throughout the forest and to control the proliferating Red Maple in the midstory, this forest can be returned in time to an oak-dominated ecosystem for the benefit of the FIDS and the other animals and plants that typically inhabit coastal plain deciduous forests of the mid-Atlantic region.

Patch Analysis of the Habitats in the PFP Forest

Patch analyses were conducted using the NED program to examine the habitat value of defined patches within the forest. Patches were defined as *adjacent forest stands that shared the following characteristics in four categories:

- Patches with the same forest type, all tree size classes included,
- Patches with trees of the same size class, all forest types included,
- Patches with specific forest types and size classes, and
- Patches with similar % canopy closure.

*Adjacent stands that were separated by a road were considered parts of a different patch.

These categories were analyzed for ecological features that could address the specific needs of different wildlife species and breeding guilds to determine the extent of suitable breeding habitat for each. Because the PFP forest had been dedicated a Habitat Protection Area for FIDS, the patch analysis concentrated on the habitat requirements of these bird species. For example, in the case of the non-raptor FIDS, forest type is the most important indicator of hatchling food availability (caterpillars) for reproductive success in breeding adults. For this purpose, the analysis identified patches with the greatest number of stands of the same forest type that typically have oak species as major components of the forest canopy.

Most of the documented FIDS for this forest nest on branches in medium to large size class trees (classified as small and large sawtimber in forestry); therefore, oak forest types with these

size classes were also important. For ground-nesting FIDS, the analysis also included canopy gap size, because light gaps influence the density of the shrub and ground layer, which may provide critical cover from predators for the nests and hatchlings of these FIDS.

For the raptor FIDS, hawks and owls, which are not dependent upon the caterpillar crop for hatchling food, the important patch factors are large tree size classes and percent canopy closure. The hawks require large-diameter trees with thick branches for suitable nest sites. The owls need natural or excavated cavities (produced by woodpeckers in previous seasons) in large size trees for their young. Successful raptor rearing also depends heavily upon nesting in a forest with an open understory to facilitate hunting and capturing prey for both the adult birds and their hatchlings.

Results of the Patch Analysis

1. Patches with the same forest type, all tree size classes included.

The table below shows the distribution of delineated forest types in the PFP study site. Historically, oak species are typically found in the first three types, either as dominant or co-dominant speciesin the mid-Atlantic region. The pure Sweetgum stand is not a recognized forest cover type, but an intermediate stage often found in the recovery of bottomland hardwoods types after major disturbances. The single patch of mesic, mixed pine hardwoods was delineated as a forest type because of the presence of Virginia Pine.

Forest Type	Patch Count	Total # of Stands in the Patches	Total Acres of Patches	% of site
oak bottomland hardwoods	3	6	122.9	54.1
bottomland hardwoods	3	4	63.8	28.
oak/poplar bottomland hardwoods	1	1	25.0	11.0
sweetgum	1	1	9.9	4.40
mesic mixed pine-hardwoods	1	1	5.7	2.5
Totals	9	13	227.4	100

The patch analysis revealed that the two most common forest types are oak bottomland hardwoods and bottomland hardwoods, which together cover 186.7 acres (82.1%) of the study area. . Within the 6 patches representing these forest types, there was no clear oak dominance in the canopy of any stands (see Table 3.7.1A). Oak species were found to be co-dominant in only three stands (3, 5 and 13) totaling 73.8 acres (32.4%) of the two most common forest types. The only other area that showed oak co-dominance was in stand 5, an oak/poplar bottomland hardwoods type. . In contrast, Sweetgum had a significant presence in all of the thirteen forest stands, dominating the canopies of three forest patches totaling 44.7 acres (19.6% of the site) and showing basal area co-dominance with mostly Red Maple, but alsoTuliptree or oak species in all of the remaining patches totaling 182.6 acres (80.3% of the site). Another indication of the significant influence of Sweetgum on the future canopy composition of the PFP forest was found in the absence of oak species in the midstory of all but one of the thirteen delineated stands. This historically oak-dominated forest has undergone a transition to a Sweetgum/Red Maple forest.

Signs of former oak dominance in the PFP forest may be inferred from the data in Table 3.7.1B. In this assessment, a reversal in species dominance was seen with large size class oaks

showing clear dominance in nine of the thirteen stands and co-dominance by non-oak species including Red maple and Sweet gum. This situation strongly suggests that the PFP forest has been undergoing a series of one or more disturbances i in which oak species are being removed through natural or human means, enabling the opportunistic, shade-intolerant Sweetgum and Red maple to fill the midstory. As the present canopy oaks decline and die, and there are few or no midstory oaks to take their places, this forest will likely shift to a Sweetgum Red maple forest unless management is employed to restore oak regeneration and growth in the PFP forest.

2. Patches with trees of the same size class, all forest types included.

Size Class	Patch Count	% of site
Small saw timber (11 to 17,5 in. dbh)	2	47.8
Large saw timber (greater than 23.5 in. dbh)	4	36.8
Pole (5 to 11 in. dbh)	1	15.4

* dbh – diameter at breast height

This analysis shows that three of the seven patches in 63.2% of the site contain trees that may be too small for the nests of raptor FIDS. This size class distribution suggests that the largest size class trees were removed from this site, because the downed woody debris does not contain the remains of large saw timber trees.

This finding is especially important because the 1983 – 1987 Breeding Bird Atlas Survey documented confirmed breeding activities for the area sensitive Red-shouldered Hawk in the PFP forest. In the 2002 – 2006 survey, territorial display in the hawk was observed, but breeding activities were not documented.

3. Patches with specific forest types and size classes.

This category did not add any additional information, but confirmed what had been revealed in the first two patch analyses.

4. Patches with similar % canopy closure

This analysis revealed that eight of the nine delineated patches throughout the forest have a canopy cover exceeding 75%. These patches cover 217.4 acres (95.6%) of the PFP forest, and include twelve of the thirteen forest stands assessed. When coupled with other assessment data that show only three of the thirteen stands with less than 20% shrub cover, this analysis indicates that there may not be sufficient open understory for raptor FIDS hunting, but that 83% of the forest has an average of 26% shrub cover for ground or shrub-nesting non-raptor FIDS.

3.8 MAJOR FINDINGS OF THE FOREST ASSESSMENT

The following are major findings about the health of the 227.2-acre forest ecosystem owned by Baltimore County at Pottery Farm Park:

FIDS Habitat Sustainability: (Figure 1.2). The Basal Area analysis showed no clear oak dominance in the canopies of any of the stands in the PFP forest; co-dominance with non-oak species (mostly Sweet gum) was observed in only four of the thirteen stands assessed. Additionally, oak species were not found in the midstory of all but one stand. However, the analysis using tree height in the canopy, revealed oak dominance or co-dominance in 77.8% of PFP canopy., an indication that this forest had been dominated by oak species in the pastThis is a major finding because of the critical importance of oaks in the life cycles of the forest interior dwelling bird species (FIDS) of the PFP forest. Their documented breeding activities in the 1983-87 Breeding Bird Atlas Survey was a major factor in dedicating the forest as a Habitat Protection Area in 1987.

In the deciduous forests of the eastern U.S., there is a critical interdependence between oak trees, the hatchlings of songbirds, including FIDS, and the caterpillars of forest moths.
Oak foliage is the preferred food of the caterpillars of more moths (534 species) than any other tree species in the forest, and the caterpillars are the most abundant and easily collected food source for the hatchlings. The birds time their nesting and egg-laying activities to coincide with the highest populations of feeding caterpillars in the spring of each year. The interrelationships are so strong that oaks are identified as “keystone species.” Whatever affects the survival of the oaks also directly affects the reproductive success of its dependent animal communities.

Without management to maintain and enhance oak dominance, the relative proportions of size classes and forest types within the forest ecosystem will continue to change, reducing the quality of habitats that have supported a FIDS community in the past.

Forest Sustainability: The distribution of size classes is not balanced, meaning that some size classes are under-represented or over-represented. The majority of the stands approximately 90% range in diameter from 11.5” to 23.5”.

Tree Condition: Half of the forest stands have a significant percentage of unhealthy trees, called “Undesirable Growing Stock” (UGS) by foresters. These are trees with growth deformities or other qualities of form, damage, or disease that will prevent the trees from reaching optimal height, age, and ecological functional capacity. Stands 2, 3, 6, 7, 8, 10, and 12, totaling nearly 130 acres, consist of more than 50% of undesirable trees.

Measures of Stocking (tree crowding): The basal area of all trees (square feet of trees per acre) ranges from 118 to 192.9, with a weighted average of 133.7 sq. ft. per acre. With 13 stands with a BA of $\geq$110, the overall forest system is over-stocked. Relative density is another measure of tree crowding that accounts both for the size of each tree and the amount of space typically occupied by a tree of that size and species. The relative density of stands in this forest system ranges from 62% to 133% with a weighted average of 87.6% relative density. Eight stands are overcrowded with a relative density of >85%.

Regeneration: Regeneration was present for 17 species with an average of 1,383 seedlings/saplings per acre across stands. While all Oak species combined comprise only 13.3% of all regeneration, Black cherry, Red maple, Black gum, and Sweetgum – all species not desirable as dominant canopy species – represent 59.9% of all regeneration. Overall,

regeneration is not over abundant due to several factors including: a mostly closed canopy, which blocks light for the seedlings of shade-intolerant tree species, deer browsing pressure, and the distribution of exotic, invasive plant species that compete for habitat and nutrients.

4.0 FOREST MANAGEMENT PLAN

This section presents the recommended Forest Management Plan for the POTTERY FARM PARK properties owned by Baltimore County. The Plan is organized as follows:

4.1 PURPOSE AND GOALS OF THE FOREST MANAGEMENT PLAN
4.2 DESIRED FUTURE CONDITION
4.3 MANAGEMENT OBJECTIVES AND RECOMMENDATIONS
4.4 SILVICULTURAL METHODS FOR REGENERATION
4.5 ENVIRONMENTAL CONCERNS
4.6 TIMBER STAND IMPROVEMENT
4.7 MANAGEMENT RECOMMENDATIONS FOR WILDLIFE
4.8 BEST MANAGEMENT PRACTICES FOR MAINTAINING FOREST HEALTH

4.1 PURPOSE AND GOALS OF THE FOREST MANAGEMENT PLAN

The purpose of this plan is to provide decision support for implementing sustainable forest management practices for the PFP properties owned by Baltimore County. This is accomplished by assessing current forest health conditions and recommending forestry prescriptions necessary for achieving the desired future condition of the forest ecosystem.

The goals of the Forest Management Plan are to restore and maintain a healthy forest ecosystem, including to:

- Restore the natural distribution of native forest vegetation throughout multiple forest layers.
- Restore natural tree regeneration to levels adequate to quickly recover control of hydrology and nutrient cycling following large-scale disturbances.
- Restore the forest's ecological integrity and habitat potential by reducing the environmental stresses imposed by exotic invasive plants.

4.2 DESIRED FUTURE CONDITION

From the perspective of sustainable forest management, the desired future condition of the forest system on the PFP is characterized by a forest ecosystem that is:

- Vigorous and diverse,
- Actively regenerating at levels adequate to sustain the forest,
- Protective of water quality and Nutrient assimilating,
- Deliberately patterned to allow specific forest community types to occupy their optimum sites,
- Resistant to disturbances that would degrade water quality, and
- Resilient, capable of restoring forest dominance of the land after large or intense disturbance.

If the recommended Management Plan for the County-owned forests of the Pottery Farm Park is implemented, the following long-term conditions are expected:

- Forest health will be restored and maintained,
- Regeneration will occur at levels adequate to sustain the forest,

- Structural diversity will exist at all levels,
- Insects and diseases that are the most pressing threat to the forest will be controlled,
- Deer will be controlled to a population level where the forest can regenerate
- Invasive plants will be eradicated and/or controlled,
- Forest stands will be thinned to reduce environmental stress and promote oak regeneration as sunlight reaches the forest floor,
- Wetlands and their buffers will be protected with the assurance of a sustainable forest,
- Neotropical migratory birds will be assured an adequate forest interior area and the presence of nut-bearing trees.

4.3 MANAGEMENT OBJECTIVES AND RECOMMENDATIONS

General Stand Management Recommendations

The management recommendations prioritize actions for improving and maintaining forest health and ecological conditions. Management recommendations include silvicultural practices to improve forest health with an emphasis on natural regeneration and sustainability. The eradication of invasive plants and the reduction of deer population are also prioritized.

All silvicultural recommendations are for the purpose of reducing stocking to allow crop trees room to grow (TSI-Timber Stand Improvement) or to establish natural regeneration. All plants require sunlight to become established and survive. Adequate sunlight is crucial for successful regeneration. Trees that compete best for full sunlight are often found in the upper canopy of the forest.

In addition to the stand-specific recommendations presented below, vines in crowns and dense invasive plant communities should be controlled throughout the PFP forest. While deer are not a significant problem at this time for the overall forest system, their populations should be monitored. If deer populations increase, then forest management practices that increase regeneration may be compromised. In that case, deer must be controlled prior to any type of activities to increase regeneration in ALL stands, as well as removal and control of undesirable vegetation that hinders the development of the desired natural regeneration. A study by Hix et al (1991) found repeated browsing on oaks gives competing vegetation such as red maple, black gum, beech and exotic species a greater advantage of occupying the forest. A recommended deer population is 15-20 deer per square mile.

Stand-Specific Management Recommendations

Stand-specific existing conditions, management objectives, and recommended actions are presented in the following table.

Stand	Acres	Relative Density	Basal Area	Existing Stand Condition	Stand Management Objectives	Recommended Actions	Year
PFP1	24.9	133.0	192.9	48% undesirable trees	Reduce stress from overstocking	T.S.I, reduce B.A. to 80, control invasives after thinning	1
PFP2	2 3.1	100.0	124.3	60% undesirable trees	Improve regeneration	T.S.I, reduce B.A. to 70, control invasives after thinning	2
PFP3	18.9	76.0	118.0	54% undesirable trees	Manage for Old Growth/Improve regeneration	T.S.I, reduce B.A. to 75, control invasives after thinning	2
PFP4	5.7	71.0	133.3	45% undesirable trees	Favor Tuliptree, reduce stocking	T.S.I. reduce B.A TO 80, control invasives after thinning	3
PFP5	25	75.0	118.0	37% undesirable trees	Manage for Old Growth/Improve regeneration,	T.S.I, reduce B.A. to 80, control invasives after thinning	6
PFP6	9.9	62.0	122.9	59% undesirable trees	Release mast trees; improve regeneration favor Oaks	Control invasives , reduce B.A to 60 ,T.S.I.	4
PFP7	21.6	86.0	131.7	55% undesirable trees	Reduce stress from overstocking	T.S.I., reduce B.A. to 75, control invasives after thinning	4
PFP8	41.5	89.0	132.0	50% undesirable trees	Stand too sensitive for management, Old Growth	Cut vines and treat invasives near acceptable regeneration	1
PFP9	9.9	89.0	140.0	50% undesirable trees	Reduce stocking improve crown health.	Remove vines in crowns, deuce B.A.to 80, control invasives	1
PFP10	7.5	86.0	132.5	64% undesirable trees	Stand too sensitive for management, Old Growth	Cut vines and treat invasives near acceptable regeneration	5
PFP11	18.5	105.0	144.0	57% undesirable trees	Stand too sensitive for management, Old Growth	Cut vines and treat invasives near acceptable regeneration. Stabilize ATV trails in wetlands	3
PFP12	7.4	76.0	116.7	71% undesirable trees	Stand too sensitive for management,	Invasive plant control.	7
PFP13	13.4	92.0	133.3	45% undesirable trees	Encourage multiple layered canopies	Manage for Old Growth	7

Note: All forested wetlands must be flagged, buffered, and avoided during all silvicutural improvements.

4.4 SILVICULTURAL METHODS FOR REGENERATION

The sustainability of the forest, and its value, both ecological and commercial, are dependent upon the continued recruitment of small trees, seedlings, shrubs, and herbaceous plants. Silvicultural treatments that guide the existing forest community toward the development of advanced regeneration (seedlings, saplings, etc.) are called ***reproductive methods*** and are rightly considered to be part of a complete silvicultural system. Compounding the constraints on the choice of regeneration systems is the presence of White-tailed deer populations, which is the principal cause of the present lack of suitable advanced regeneration in the eastern forests.

Single Tree Selection Method

Selection is a regeneration method in which individual trees are periodically (commonly every 10-15 years) harvested based on their density, size, species, quality, condition, and spacing. Selection is used to create and maintain an uneven-aged Stand. When individual trees are selected for harvest (individual-tree selection), they are replaced either by new seedlings or by small trees already present. Individual-tree selection is best suited for shade-tolerant species (e.g., Red Maple and Black Gum). Aesthetically, individual selection has the least visual impact of any regeneration method. The overall integrity and appearance of the forest is only slightly modified, and after a few years much of the residue from the harvest will have decomposed.

SELECTION	
Advantages	Disadvantages
• Maintains continuous forest cover on land. • Usually perceived as having less visual impact. • Forest usually less susceptible to wind, insect, and disease damage. • Reproduction not exposed to heavy competition from herbs and shrubs. • Can combine intermediate and regeneration harvests into one. • Some form of natural reproduction will occur. • Beneficial to some forms of wildlife.	• Takes more skill to implement than other regeneration methods. • More expensive in terms of inventory, marking, and harvesting. • Trees harvested are variable in size. • Some damage to residual trees may result. • Some residual trees may develop epicormic branching. • May be detrimental to some Wildlife species requiring openings and early successional vegetation.

4.5 ENVIRONMENTAL CONCERNS

Protecting the soil and water resources is an important concern during forest regeneration activities. The removal of trees typically requires the use of heavy equipment that disturbs the porous organic layer of the forest floor. The mineral soil is then exposed to the erosive forces of raindrops and surface runoff. Soil may move down slope off the area and become sediment in the streams. The implementation of best management practices (BMP's) can substantially

reduce soil erosion and its negative effects.

BMP's include such activities and considerations as the proper location and construction of skid trails and management roads; preservation of forested buffer strips along streams; diversion of runoff into the forest from roads and trails; and seeding of landings, roads, and trails upon completion of the harvest. Specifications and guidelines are presented for Timber Harvest Regulations in the BMP section.

Prior to any silvicultural operations, a Maryland licensed forester should certify that erosion and sediment control plans for Forest Harvest Operations have been designed in accordance with current ordinances, regulations, standards and criteria as stated in Maryland's Critical Area Law for Forest Harvest Operations. Specifications and guidelines are presented in the BMP section.

4.6 TIMBER STAND IMPROVEMENT (TSI)

The 2009 forest health assessment found that the majority of all stands are overstocked and in need of thinning to reduce environmental stress and to allow continued growth of acceptable high quality trees. Timber stand improvement practices remove trees of undesirable form, quality, condition, growth rate, or species. Removal of poor trees will stimulate the growth of better trees.

A licensed forester should mark trees selected to be removed to reduce stocking to the ideal level as recommended in the individual stand reports.

<u>Trees targeted for cutting include:</u>

- Suppressed trees that will not live until the next thinning.
- Trees too crooked, forked, or with too many limbs.
- Trees with fire scars and injuries from insects, disease, wind, or ice.
- Species that do not thrive in the site conditions.
- Trees that are slow growing.
- Any tree that will not contribute to the net value of the stand before the next thinning.
- Wolf trees with large crowns that occupy too much growing space or shade out more desirable species.

<u>Trees targeted to leave as crop trees include:</u>

- High quality trees.
- Fast growing trees.
- Mast producing and den trees for wildlife.
- Trees located so that all available growing space is used efficiently.
- Desired species of acceptable growing stock.

Note: Harvesting should be avoided in areas where forest interior dwelling bird species (FIDS) are breeding from April through August.

4.7 MANAGEMENT RECOMMENDATIONS FOR WILDLIFE

All wildlife species have four basic requirements for survival: food, water, cover from predators and sites for rearing offspring in safety. The PFP forest was dedicated a Habitat Protection Area in 1987 because of its potential value as a significant habitat for forest interior dwelling birds (FIDS), as mandated by the Chesapeake Bay Critical Area Program requirements. The qualifying components of the forest included location in the CBCA Critical Area, large forest

size, relative maturity of the canopy trees, and the presence of extensive wetlands within the forest. The presence of FIDS breeding activities was documented in the 1983 – 87 Breeding Bird Atlas (BBA) surveys, and confirmed in a DEPRM Habitat Assessment Study conducted within the same time period. There are no records of surveys in the PFP forest for other wildlife categories, including mammals, amphibians, or reptiles. For these reasons, the management plan focus is on protecting or restoring habitat elements that favor reproductive success in the FIDS that were documented in the 1983-87 BBA survey, but were not found in the most recent BBA survey from 2002 to 2006.

In order for a forest to qualify as potential FIDS habitat, it must meet either of the following conditions:

1. Forest tracts greater than 50 acres and at least 10 acres of interior habitat (forest > 300 feet from the nearest forest edge).
2. Riparian forests that are, on average, at least 300 feet in total width and greater than 50 acres in total forest area. The stream within the riparian forest must be perennial.

High quality FIDS habitat consist of predominantly mature hardwood or mixed hardwood/pine forest tract at least 100 acres in size, of which forest interior habitat comprises at least 25% of the total forest area, and contains one or more of the following conditions:

1. at least one highly area-sensitive species or Black-and-white Warbler, as a probable or confirmed breeder
2. riparian forest bordering a perennial stream or river and, on average, at least 600 feet in width
3. mature river terrace, ravine, or cove hardwoods, located at least 300 feet from the nearest forest edge
4. at least 5 contiguous acres of old growth forest, located at least 300 feet from the nearest forest edge
5. contiguous forest acreage of greater than 500 acres.

FIDS include a large and diverse group of bird species with different migration strategies and breeding habitat requirements, but with a common need for relatively mature forest in large enough blocks to provide sufficient interior habitats for their breeding activities, and for the protection of their eggs and hatchlings from predation by edge predators. The group includes long distance migratory species. Neotropical migratory song birds breed in North America and winter in the Caribbean and Central and South America, as well as short-distance migrant and resident species of hawks, owls, and woodpeckers. Additional detail about their habitat requirements is presented in Section 3.7. The loss and fragmentation of habitat, especially on the breeding grounds, have been implicated as important factors in the population declines of some FIDS, especially those that are classified as highly area sensitive.

A source of concern for the PFP forest is continuing habitat degradation due to over browsing of native forest vegetation by white-tailed deer, and the proliferation of exotic, invasive plant species. The Pottery Farm Park is considered regionally important given its relatively large size and location within a predominantly forested landscape. The following are general Wildlife recommendations:

1. **Reduce the availability of feeding areas for non-forest dwelling birds.**

   Control the habitat for Brown-headed Cowbirds, Common Grackles and European Starlings in artificial non-forested habitats (e.g., grassy roadside berms, forest openings, frequently mowed fields) using the following management practices:

   a. Along roads that must be maintained, maintain canopy closure over the roadbed and establish a soft forest-roadside edge.

   b. In fields, maintain a grass height of at least 10 inches during April - August.

2. **Monitor and control white-tailed deer populations at or below carrying capacity to reduce over browsing of forest understory vegetation.**

   The loss of forest structural diversity and changes in forest composition due to high deer densities have had substantial and long-term impacts on the ecological integrity of the forest communities and their ability to support FIDS. Forest interior dwelling species that require a dense shrub and/or herb layer probably have been most seriously affected (e.g., Hooded Warbler, Kentucky Warbler). Effective forest breeding bird conservation requires maintenance of deer densities at or below habitat carrying capacity. A combination of regulated hunting and a reduction in the amount of hard edge habitat are recommended.

3. **Implement the following field mowing practices for the conservation of the Whip-poor-will,** a FIDS species that breeds in open upland forest with adjoining clearings and brushy fields, and that was documented as a probable breeder in the LBPR forest in the 1983-87 BBA, but not seen in the 2002-06 BBA.

   a. Do not mow fields during April-August, the probable breeding season for the Whip-poor-will (Robbins and Blom, 1996). .

   b. If mowing must occur during April-August, minimize impacts to potentially foraging Whip-poor-wills using the following guidelines:

   (1) Limit mowing to those periods outside of May-mid- July, the presumed peak nesting period for the Whip-poor-will (an uncommon nester in all parts of Maryland (Robbins and Blom, 1996).

   (2) Mow on a rotational basis, leaving at least half of the field un-mowed during May-mid July, or for at least 6 consecutive weeks within this period. Allow the un-mowed portion to occur in one large contiguous block or, minimally, leave un-mowed areas in large blocks

   (3) Maintain a cutting height of at least 10 inches.

   c. Do not mow at night.

4. **Create snags.**

   Standing dead trees (snags) and dead parts of live trees offer opportunities for FIDS woodpecker species to excavate nest cavities, and for FIDS owl species to utilize abandoned cavities for their hatchlings.

   Snags can be created by girdling, which involves cutting a band between 1"-6" wide through the bark and completely around the tree. This practice will kill the tree, thus

creating a snag. Maples or tuliptree of poor form make excellent candidates for snag creation because of their soft wood, which is easily girdled, and also more easily excavated by cavity-building wildlife species. By selecting trees of poor form, the quality of the forest can be improved at the same time. At least one tree per acre that is greater than 18 inches in diameter should be chosen because forest interior Pileated Woodpeckers will not utilize smaller trees. Oak trees should not be used for creating snags because of the contribution that oak species make to the caterpillar population that comprises the main food supply for the hatchlings of most of the non-raptor FIDS. Favoring the oaks as crop trees will also ensure good crown growth and good acorn production for forest regeneration.

4.8 BEST MANAGEMENT PRACTICES FOR MAINTAINING FOREST HEALTH

Best Management Practices (BMPs) are basic actions required in a forest to keep the major components of the forest healthy and to allow the forest to perform at its highest potential. A forest stabilizes soil, purifies ground water, and provides a habitat for plants, animals, and an abundance of microorganisms.

Implementation of these BMPs is subject to permits for forest harvests under the Chesapeake Bay Critical Area and other State of Maryland regulations. Because permit requirements may change, they are not included herein.

The following are descriptions of the BMPs relevant to forest management for the POTTERY FARM PARK:

4.8.1 Oaks and Acorns
4.8.2 Conservation of FIDS and Harvesting Practices
4.8.3 Invasive Plant Control
4.8.4 Control Methods for Sweetgum Succession
4.8.5 Forestry Aesthetics
4.8.6 Forest Diseases and Insects
4.8.7 Timber Harvesting in the Critical Area

Sections 4.9.3, 4.9.4, and 4.9.6 were prepared by Steve Allgeier, Horticulture Consultant, University of Maryland, Carroll County Extension. Section 4.9.5 is from the American Forest & Paper Association, Washington, DC.

4.8.1. Oaks and Acorns

Oaks are the most ecologically important trees in the Chesapeake Bay Watershed and should be favored as a forest cover type (The Conservation Fund, 2006). Quercus is the genus in which all oaks are classified. This genus has three subgenera, of which only two are found in the United States: Lepidobalanus, which includes the white oaks, and Erythrobalanus, which includes red and black oaks. The red oak group takes two years to produce an acorn while white oaks develop acorns annually. Both produce maximum acorn production from age 50 to 200 years (Society of American Foresters, 1975).

All plants require sunlight to become established and survive. Adequate sunlight is crucial for successful oak regeneration. Trees that compete best for full sunlight are often found in the upper canopy of the forest.

On average, most oak species produce an abundant acorn crop once every three to five years. Many factors impact acorn production, including tree diameter and crown canopy location. Most

Oaks continue to produce acorns well in the 20 inch plus diameter range: White Oak 26”, Chestnut 30”, Red 20”, Scarlet 26”, and Black Oak 30”. Large diameter oaks that have a dominant or co dominant place in the canopy and well-rounded crowns that are exposed to full sunlight will produce more acorns than trees that are partly shaded.

All oaks produce flowers sometime between February and May. White oaks take only three months for their flowers to develop into mature acorns. Red oak acorns require a full 15 months (two growing seasons) to mature. Currently, the only way to distinguish good acorn producers from poor producers is by monitoring acorn production of individual trees. This can be done by conducting a visual survey to identify good acorn producers. The average number of acorns produced by each crop tree can be ranked on the current year acorn production as Excellent, Good, Fair, or Poor (Table 4.8.1). Trees ranked as Excellent or Good producers should be marked as the best producers in the stand for the year of the survey. Normally the survey is conducted once each year and should be conducted for three years prior to a timber harvest that thins the oak stand to allow adequate sunlight to reach the forest floor. A three-year survey is best because it enables the identification of between 85-100 percent of the best acorn producers.

Table 1. A ranking of acorn production for individual trees[1]

Rank	Average number of acorns per branch[2] White Oaks	Red Oaks
Excellent	18+	24+
Good	12-17	16-23
Fair	6-11	8-15
Poor	5 or less	8 or less

[1]Adapted from: Johnson, P. S. 1994. How to manage oak forests for acorn production. TB-NC-1. USDA Forest Service. North Central Forest Experiment Station 4 pp.
[2]Counted within 24 inches of branch tips, on healthy branches growing in the top 1/3 of the crown.

The best time to conduct an acorn survey is between the second and last week in August. During this time acorns are developed enough to be seen from the ground, while acorn predators will not have had enough time or opportunities to eat the entire crop. Trees are evaluated by looking at the top ½ of the tree with binoculars to estimate the average number of acorns growing within 24" of each branch tip. Acorns on "White Oaks" occur near the tips of the branches (Figure 4.8.1), whereas acorns on "Red Oaks" occur on last year's growth (Figure 4.8.2).

Left: Figure 4.8.1: In white oaks, mature acorns are located near the tips of the current year’s growth. White oak acorns are best viewed from a location where you can see the outside edges of the tree crown.

Right: Figure 4.8.2: In red oaks, mature acorns are located on last year’s growth and appear to be clustered tightly against the twigs. Red oak acorns are best viewed from directly below the tree crown.

It is important to note that weather conditions that result in poor acorn production include extended periods of rain and/or high humidity during the flowering period. These conditions reduce a tree's ability to pollinate. On average, a deer eats about 2.2 lbs. of acorns per day. Between autumn and early winter, this equates to about 200 lbs. of acorns per deer.

4.8.2 Conservation of Forest Interior Dwelling Birds & Harvesting Practices

Each state has FIDS guidelines for harvesting. The Maryland Department of Natural Resources' FIDS/Forestry Chesapeake Bay Critical Area Timber Harvest Plan Guidelines contains the following standard practices :

1. Forest areas that are potentially viable breeding habitats should be identified, and these forested areas should be avoided during the spring through summer breeding season.
2. Blocks of old growth and mature forests should be maintained with four to ten dead or dying trees per acre to provide nests sites and food sources for many species.
3. Forest managers should favor selective harvesting over clear cuts, especially along stream corridors and in forests interiors.
4. Development should avoid the practice of clear cutting to build roads and trails in forest interior. Buildings and roads should be located within 300 ft of the forests edge and contiguous forested areas should be left intact.

Maryland's FIDS/Forestry Task Force guidelines document identifies several coastal plain forest types that meet the requirements to be considered FIDS habitat. They include:: Virginia Pine, Mixed Hardwood/Pine, Upland Hardwoods, River Terrace/ Ravine/Cove Hardwoods, and Riparian Forest.

The PFP forest does not meet the strict definitions of the forest types listed above. It contains both bottomland forest types (oak and southern bottomland hardwoods) and upland types (mixed mesic hardwoods and oak-hickory), however in all types, oak species are drastically underrepresented compared to what would be expected in typical bottomland and upland types for the mid-Atlantic region. This is critically significant for the conservation of FIDS, because these forests, which are currently dominated by Sweet Gum and Red Maple, have been severely disturbed and are not providing adequate food supply for the reproductive success of the non-raptor, oak-dependent FIDS breeding guild.

The standard conservation methods for all forest types include planning timber harvests to maximize the amount of contiguous forest that is pole-stage or older, encouraging the retention of snags in timber harvest areas and of dead and downed woody debris on the forest floor ,and following the rule of no harvesting during the April 1-August breeding season. Additional conservation methods unique to described forests types follow.

The FIDS/Forestry Task Force guidelines for timber harvesting in upland and bottomland hardwoods include the following:

Upland hardwoods are forests in which pine comprises less than 25% of the total basal area. Like upland mixed hardwood-pine forests, single-tree selection is usually preferred. However, as forest tract size and the percentage of forest cover in the surrounding landscape increases, other silvicultural options are possible such as clear cutting, limited group selection and patch clear cutting. The guidelines cite that new permanent forest openings are not permitted in the forest interior portions of a forest tract, which is defined as forested areas greater than 300 feet from the nearest forest edge. In non-interior forested areas, when permitted forest openings

should be small and located adjacent to an existing forest edge. Converted stands must be managed so that some hardwoods are maintained in the understory, midstory and canopy, and arranged in such a way that maximizes the amount of contiguous, hardwood-dominated and mixed hardwood-pine forest interior habitat. While single-tree selection is the recommended harvest strategy, other options are listed below:

1. Focus even-aged management with a long rotation cycle near the periphery of the forest tract and use single-tree selection in the more interior portions. Plan harvests so that older successional stages are adjacent to each other.
2. Use even-aged management with a long rotation cycle and plan harvests so that older successional stages are adjacent to each other.
3. Single-tree selection harvests must retain at least 70% canopy closure throughout the harvest area.
4. Riparian forests occur adjacent to perennial streams, rivers and expansive forested wetlands. They are usually dominated by hardwoods but may include mixed hardwood-pine stands. In mature or older forest conditions, these areas provide exceptional habitat for many FIDS. Due to this, as part of conservation methods, neither new forest openings nor conversion of riparian hardwood or mixed hardwood-pine forest to loblolly pine forests are permitted.

The complex River Terrace/Ravine/Cove Hardwoods forest types occur near or adjacent to streams, rivers and extensive forested wetlands. These are considered FIDS hotspots, as they often support highly sensitive species that could likely be absent in similar sized forests. On the Maryland coastal plain, these forest types usually occur on relatively steep but short, dissected slopes along stream and river courses. The majority are hardwood-dominated but may include some mixed hardwood-pine growth. These forests are generally limited to a relatively thin 50-300 foot band of forest sandwiched between more upland and lowland forest types; and tend to have relatively high horizontal and vertical structural vegetative diversity; and often contain microhabitats important to certain FIDS. Due to this, no harvesting is encouraged whenever possible and no new permanent forest openings are permitted. Conservation methods dictate that single-tree selection only is permitted if these forest types occur within high quality FIDS habitat.

It is preferred to not disturb the trees and their habitat because once these areas have been harvested reforestation is only a small source of aid.

Because of the evidence of severe disturbances in the PFP forest, it is more appropriate to use the Task Force's Forest Restoration for FIDS guidelines in order to restore oak dominance in the PFP forest. The following are examples of forest restoration that would create or enhance the extent and quality of FIDS habitat:

1. Increase the width of riparian forest corridors to at least 300 feet and, ideally, to 600 feet or more.
2. Reforest existing openings in forest tracts, especially those located in forest interior areas.
3. Reforest existing non-forested areas along the edge of a forest tract. Select areas that maximize the forest area: edge ratio and total forest tract size.
4. Allow existing woods roads to reforest or reduce their width so that canopy closure is maintained over the road.
5. Establish a core area where little or no harvesting occurs. Select areas at least 5 acres

in size and locate them, if possible, in the most interior part of the forest and adjacent to other areas with little or no harvesting (e.g., Critical Area Buffer, steep slopes).

These guidelines concentrate on allowing planting and natural regeneration to extend riparian buffers and fill in canopy gaps. They are based upon the premise that no catastrophic disturbances have seriously altered the dynamic equilibrium in a classical oak-dominated forest. This is not the case in the PFP forest. The guidelines contain no provisions for reducing the density of opportunistic, pioneer species like Sweetgum or opening up canopy gaps to allow oak regeneration. Both of these management techniques are essential to restoring oak dominance and ecological function for the FIDS breeding guild in the PFP forest.

References

Askins, R.A., M.J. Philbrick, and D.S. Sugeno. 1987. Relationship between the regional abundance and the composition of forest bird communities. *Biological Conservation* 39:129-152.

Department of Natural Resources. 1994. *Maryland's Deep Forest Birds Are Declining*, Wildlife Fact Sheet. State of Maryland.

Yahner, Richard H. 1995. *Eastern Deciduous Forests, Ecology and Wildlife Conservation*. Minneapolis: University of Minnesota Press.

4.8.3 Invasive Plant Control

The following descriptions and preferred control methods are provided for the major invasive plants at the POTTERY FARM PARK Properties. Open fields and edges adjacent to the forest, which are more prone to invasive plants, should be inspected. Invasive plants should be controlled to prevent their spread into the forest.

Forest Restoration

The restoration process can be done on any scale with the following sequential order to add balance to the required silvicultural activities. Mechanical, manual and chemical treatments will all be part of the tool box for eradication and control. A small tractor or Bob-cat, on level to moderate slopes, can push or pull out some of the larger shrubs and vines that are hindering the development of native plants. Smaller shallow rooted plants can be pulled out manually and treated chemically by spot spraying selected shrubs and vines or cut stumps. The control will be vital to the success of the re-establishment. Prior to eradication of any alien plants, native shrubs in close proximity, if using a chemical treatment, should be flagged for identification to remain and be protected from chemicals.

- **Vines** should be controlled first. Grapevine is a native vine and an excellent wildlife food but should be cut if it becomes too aggressive. Vines can be controlled by the three methods described above. The larger vines too tall to spray should be cut first and then sprayed. **Systemic** herbicides are most effective and include "Glyphosates" such as Round-up and "Triclopyr" such as Garlon. Both herbicides will absorb into the roots when sprayed on the foliage and kill the entire plant. Garlon is also effective as a stump treatment when used to paint/treat freshly cut stumps. Both Roundup and Accord, when applied as foliar sprays, should be used when the plants are in full foliage and actively growing.

- **Alien Shrubs** have a strong hold on the forest with every field plot having alien shrubs. Where possible the larger shrubs can be pushed or pulled out with equipment, preferably before they are full with seed. Where cutting is available, stumps should be treated with Garlon to prevent re-sprouting. Smaller shrubs can be dug out or sprayed. Foliar spray is most effective but should be limited to spot spaying, not broadcast spraying, which could damage natives. Systemics are effective for foliage application.
- **Follow up** is necessary. No treatment will be effective with one application because sprouting and root suckering usually occur. Birds also spread seeds and new plants may become established due to available sunlight once larger shrubs are removed. Sites should be inspected throughout the growing season and spot spray the leafed out plants or cut and treat the stumps.

The following descriptions and preferred control methods are provided for the major invasive plants at the POTTERY FARM PARK properties. The source of photos is from *Least Wanted* (Swearingen, Jil M., U.S. Fish and Wildlife Service, National Park Service, Washington, DC, United States, http://www.nps.gov/plant/alien).

Multiflora rose (*Rosa Multiflora*)

Characteristics: thorny shrub, with clusters of white to pink flowers. Multiflora rose develops bright red fruit or rose hips. It is spread by wildlife dispersing the seed and by forming new plants.

Control: Frequent cutting or mowing of the plants through the growing season is effective. Application of triclopyr to freshly cut stumps and spraying re-growth with a herbicide during the growing season may be the most effective.

Japanese Honeysuckle (*Lonicera japonica*)

Characteristics: Japanese honeysuckle is a semi-evergreen vine, with white to yellow tubular flowers. It is spread by seeds dispersed by wildlife.

Control: prescribed burning and herbicides are a good method of control. While mowing may reduce the spread of vegetative stems, spraying herbicides on the leaves of the plant is found to be most effective. It may be necessary to re-spray sprouting plants.

Honeysuckle Shrub (*Lonicera spp.*)

Characteristics: a tall bush from 6 to 15 feet high, with white to yellow flowers and red to orange fruits with many seeds. It is spread by wildlife dispersing seeds and by vegetative sprouting.

Control: Hand removal of small plants and treatment with herbicides are the only methods of treatment.

Oriental bittersweet (*Celastrus orbiculatus*)

Oriental Bittersweet (Celastrus orbiculatus) growing at Trustom Pond National Wildlife Refuge Photo by Lisa Goul

Characteristics: woody, deciduous vine with glossy finely toothed leaves. Oriental bittersweet has abundant clusters of small greenish flowers, globular greenish yellow fruits and red seeds.

Control: vines can be pulled out by the root, or cut to ground level. Re-sprouting leaves can be sprayed with a herbicide.

Tear Thumb (*Polygonum perfoliatum*)

Characteristics: fast growing weeds with vine-like stems and light blue green triangular leaves. Spines on stems are downward curving. Tear thumb bears a blue fruit and black seeds.

Control: The roots pull out easily to remove plants by hand. The most effective treatment is spraying with glyphosate and later applying a pre-emergent to the soil to prevent seeds from germinating.

Japanese Stilt Grass (*Microstegium vimineum*)

Characteristics: The leaves are pale green, lance-shaped, asymmetrical, 1-3 in. (3-8 cm.) long, and have a distinctive shiny midrib. Japanese stilt grass is especially well adapted to low light conditions. It threatens native plants and natural habitats in open to shady, and moist to dry locations. Where deer are over-abundant, they may facilitate its invasion by feeding on native plant species and avoiding stilt grass.

Control: For extensive stilt grass infestations, a

systemic herbicide such as glyphosate is a more practical and effective control method. Care is needed to avoid application to non-target plants because glyphosate is a non-specific herbicide that will kill or damage most plant species it contacts.

Japanese Barberry (*Berberis thunbergii DC*.)

Characteristics: This multi-branched dense shrub grows to 2.5 m (8.2 ft). Seedlings may grow 2-4 ft in one season. The semi-evergreen leaves are alternate, or grow in alternate clusters. They are entire, and 0.4-1.2 in. long. Leaves are bright green to burgundy, and wedge-shaped at the base. Twigs are brown, three-ridged downward from the node, with simple thorns.

Recent studies show that high population of Japanese Barberry is related to the tick population and the spread of Lyme disease. Jeff Ward reported at the MA-EPPC conference, August 2007, that ticks doubled in Connecticut where Japanese Barberry was present. There is an 8.8 times increased risk of Lyme disease in Japanese Barberry dominated areas. "The Connecticut researchers found that questing adult ticks were most abundant in areas dominated by Japanese barberry, and that about 44% of the ticks found in barberry were infected with Borrelia burgdorferi, -- the spirochete causative agent of human Lyme disease. However, only 10% of the less abundant ticks from non-barberry areas were infected. These findings suggest a great probability of humans becoming infected with Lyme disease in barberry dominated areas." Thus, there is an 8.8 times greater risk in Japanese barberry patches. (http://www.ma-eppc.org/Conference2009/SWilliams-TickLBR arberry.pdf)

Control: Mowing is appropriate for initial small populations. Repeated mowing or cutting will control the spread of Japanese barberry but will not eradicate it. Stems should be cut at least once per growing season as close to ground level as possible. Apply a 2% solution of glyphosate or triclopyr and water plus a 0.5% non-ionic surfactant to thoroughly wet all leaves.

Tree-of-Heaven (*Ailanthus altissima*)

Characteristics: a rapidly growing, deciduous tree in the mostly tropical quassia family (Simaroubaceae). Mature trees can reach 80 feet or more in height. Ailanthus has smooth stems with pale gray bark, and twigs that are light chestnut brown, especially in the dormant season. The wood of Ailanthus is soft, weak, coarse-grained and creamy white to light brown in color. All parts of the tree, especially the flowers, have a strong, offensive odor, which some have likened to cat urine.

Control: Targeting large female trees for control will help reduce spread by seed. Young seedlings may be pulled or dug up, preferably when soil is moist. Care must be taken to remove the entire plant including all roots and fragments as these will almost certainly re-grow. It can be effectively controlled using any of several readily available general use herbicides such as triclopyr or imazapyr. Follow label and state requirements. The herbicides may be applied as a foliar (to the leaves), basal bark, cut stump, or hack and squirt treatment. Basal bark application is one of the easiest methods and does not require any cutting. It works best during late winter/early spring and in summer. The cut stump method is useful in areas where the trees need to be removed from the site and will be cut as part of the process. The hack-and-squirt or injection method is very effective and minimizes sprouting and suckering when applied during the summer.

(http://www.nps.gov/plants/alien/fact/aial1.htm , www.nps.gov/plants/alien)

Trumpet Creeper *(Campsis radicans)*

Characteristics: Trumpet creeper is a deciduous or partly evergreen vine that climbs by aerial rootlets and twining stems. Stems can grow up to 12 m long and have numerous aerial rootlets. Leaves are opposite, pinnately compound and coarsely toothed, composed of 7, 9, or 11 leaflets. Leaflets are somewhat shiny and dark green. Flowers are yellow-orange to red, tubular, and up to 8 cm long and 4 cm wide at the mouth. Flowers are born in clusters of four to a dozen and bloom from July through August. The fruit is a flat, tapered capsule, 8-13 cm long with seeds that are flat and winged.

Control: prescribed burning and herbicides are a good method of control. While mowing may reduce the spread of vegetative stems (on R/W), spraying herbicides on the leaves of the plant is found to be most effective. It may be necessary to re-spray sprouting plants.

Wisteria *(Wisteria)*

Characteristics: a deciduous, perennial, leguminous woody vine that is invasive throughout much of the Eastern U.S.

Control: Cut climbing or trailing vines as close to the root collar as possible. This technique, while labor intensive, is feasible for small populations, as a pretreatment for large impenetrable infestations, or for areas where herbicide use is not desirable. Wisteria will continue to resprout after cutting until its root stores are exhausted. For this reason, cutting should begin early in the growing season and, if possible, sprouts cut every few weeks until autumn. Cutting will stop the growth of existing vines and and prevent seed production. However, cut vines left coiled around trunks may eventually girdle trees and shrubs as they continue to grow and increase in girth. For this reason, the vines should be removed entirely or at least cut periodically along their length.

Privet (*Ligustrum vulgare*)

Chinese privet

Characteristics: stout shrub with many branches, oval leaves on short stalks. Privet has small white flowers that grow in clusters at the end of branches and blue black berries. It is spread by seeds dispersed by wildlife; new growth also grows from stumps.

Control: dig out all small plants or spray leaves of large plants with a herbicide and triclopyr on fresh cut stumps.

4.8.4 Control Methods for Sweetgum Succession

A Sweetgum early succession problem exists throughout the POTTERY FARM PARK properties. It is currently creeping into the forest from adjacent fields.

General Species Characteristics: Liquidambar styraciflua L (Sweet gum) is a large deciduous hardwood tree, which can grow to over 100 feet in height and 3 to 5 feet in diameter, with a symmetrical,

cone-shaped crown. The bark is grayish brown, deeply furrowed into narrow, somewhat rounded ridges. The leaves are alternate, simple, and palmately lobed with 5-7 points resembling a star in shape, dark green and lustrous above, and paler underneath. The fruit is a dangling brown, woody spiny tipped "gum ball" with seeds brownish and winged. Sweetgum produces an abundance of lightweight seed. The tree begins to produce seed when 20 to 30 years old, and crops remain abundant for 150 years. Fair seed crops are produced each year, with bumper crops every 2 to 3 years.

Control: Application of herbicide to the cut stumps must be conducted immediately after cutting, within 5-15 minutes of the cut, with water soluble formulations, or longer with oil mixtures, to ensure uptake of the chemical before the plant seals the cut area off. The mixture may be painted on with a paint brush or sprayed on using a spray bottle or backpack sprayer. A mixture of 20% Garlon® 4 plus 80% oil diluent, as for basal bark spraying (above), may be used. In this case the whole stump surface and sides to the ground line would be sprayed. Another option is to use Garlon® 3A at 100%, treating only the outer 1/3 of the stump surface. Be prepared to follow-up with a foliar application the next year to control any stump sprouts or root suckers that emerge.

4.8.5 Forestry Aesthetics

Forestry operations should be conducted in an aesthetically acceptable manner due to the fact that they are often highly visible to the public, who are often unfamiliar with forest science and practices. Planning is important to assuring that forest operations meet aesthetic expectations.

For forest roads, the planning should focus on traffic patterns, seasonal changes and safety in addition to noise, dust, mud, and water quality. Operations should avoid tracking mud onto paved roads, rutting and damaging roads, and erosion and sedimentation. Water movement within the forests roads can be controlled with proven techniques including crowning, wing ditches, and broad based dips. The number and width of roads necessary to meet management objectives should be minimized, and the roads should be well maintained. Any temporary roads should be closed upon completion of use, and access should be controlled to minimize unauthorized traffic.

Harvest planning will reduce adverse impacts of timber harvesting on visual quality significantly. Considerations include timing, harvest method/area size/shape, and felling and skidding, along with logging decks and landings. Harvesting in highly sensitive areas during wet seasons or during periods of active recreational use should be avoided. Harvest practices should also avoid excessive rutting, leaving high stumps or broken, damaged and hung trees, felling or leaving tree tops in waterways, and damaging residual trees. When it comes to log decks and landings always avoid decks and landings in view of travel routes. Common recommended practices are to dispose properly of trash and litter, promptly stabilize log decks and landings and scatter or dispose of slash and stumps, screen log decks and landing from view as long as possible with vegetation or dog legged roads, and restore log decks and landings by creating wildlife food plots.

Following the above guidelines may not always be enough. It is important to inform those environmentally concerned that the work has been performed well and reassure them that the forests are cared for. The most effective way is by using forest signs. Strategically placed signs convey a positive image for many reasons. Not only do they describe the forest practices being viewed, but they tell the story of the forests renew ability and sustainability, showing pride in the work done.

4.8.6 Forest Diseases and Insects

Forest management through the assistance of forest professional is a way of achieving and maintaining woodland health. The first step in managing a forest is through regular health assessment of the dominant tree species. Many tools are used to help forest professional maintain healthy forest ecosystems. Long-term monitoring through yearly assessments of a forest's well-being is necessary to maintain and protect the overall fitness of the forest.

This section describes the diseases and insects that are commonly observed in the dominant woodland species (**Oaks, Red Maple, Sweet Gum, and Tulip Poplar**) throughout the POTTERY FARM PARK area and possible actions if detected.

Oaks

Oaks are susceptible to a number of diseases and insect infestations, including:

1. **Oak Decline**
2. **Oak Wilt**
3. **Bacterial Leaf Scorch**
4. **Smooth Patch Disease**
5. **Oak Anthracnose**
6. **Gypsy Moth**
7. **Orangestriped Oakworm**

The sub-sections below describe these threats to oak health.

1. Oak Decline

Although the most frequent outbreaks of oak decline have been in southern New England, the Middle Atlantic States, and the Southeastern States, the disease has occurred throughout the range of oak in both forest and urban situations (fig. 1). It is not limited to any one species or species group. Outbreaks have been most frequent and severe among red (*Quercus rubra*), scarlet (*Q. coccinea*), pin (*Q. palustris*), and black oak (*Q. velutina*) in the red oak group and among white (*Q. alba*) and chestnut oak (*Q. prinus*) in the white oak group.

<u>Disease Progression</u>

Trees are weakened by environmental stresses such as drought, waterlogging, or frost or by pests such as defoliating or sucking insects. Weakened trees are then invaded and killed by insects and diseases that cannot successfully attack healthy trees. Usually the progression of decline is slow, occurring over several years.

Trees affected by oak decline show a general and progressive dying back from the tips of the branches. Other symptoms include production of chlorotic, dwarfed, and sparse foliage; development of sprouts on main branches and stem; and premature autumn leaf color and leaf drop. Often, growth is reduced before the appearance of symptoms. The amount of food stored as starch is reduced, especially in the roots.

The initiating stress factors associated most frequently with oak decline are drought, frost injury, or insect defoliation. Trees on ridge tops and in wet areas suffer most severely from drought. Frost often affects trees growing in valleys and frost pockets. Defoliated trees that refoliate the same season may exhibit dieback symptoms the next

year. Other factors such as leaf diseases and soils that are waterlogged, compacted, or shallow have occasionally been implicated in oak decline. Waterlogging is especially important in the heavier clay soils of the Midwest. Stress factors may be more frequent and severe in urban forests, where trees are often subjected to disturbances associated with human activities.

These stress factors often weaken trees so much that they succumb, sometimes suddenly, to the root killing and girdling actions of insects and diseases. The two major pests associated with oak decline are *Armillaria mellea* (Vahl: Fr.), a root disease commonly called armillaria root rot, and *Agrilus bilineatus* (Weber), the twolined chestnut borer.

Diagnosing Oak Decline

Dieback symptoms can result from the effects of stress alone. Indeed, stress, if sufficiently severe or prolonged, can result in tree mortality. However, the continued decline and death of stressed oaks usually results from lethal attacks by armillaria root rot and twolined chestnut borers. Final symptoms of oak decline primarily reflect the root killing and girdling effects of these organisms. In attacked trees, leaves sometimes fail to develop in the spring or wilt shortly after budbreak; sometimes they wilt or brown suddenly in the latter part of the growing season.

Pockets of oak mortality resulting from the interaction of stress, insects, diseases, and site factors.

A characteristic of oak decline is that it may develop suddenly on many trees in the area affected by the initiating stress factor. Within the affected areas, however, decline and mortality occur in patterns, which may reflect the intensity and severity of the stress, the distribution of the hosts, the aggressiveness of armillaria root rot, and the abundance of twolined chestnut borers, coupled with site features such as poor or excessive soil drainage and frost pockets.

In many instances, the species that are affected and their location can provide dues to the cause of oak decline. For example, symptoms only on white oaks or only on red oaks might suggest that preferential insect defoliation was the cause. Frost may be implicated if damage is limited to trees growing in depressions or valley bottoms.

Symptom development can also indicate the stage of decline and approximate beginning of the problem. The age of bole sprouts and patterns of radial and terminal growth can be used to estimate the date of the events that triggered their development. Although some trees die soon after being stressed, others may not succumb for 5 years or more. The timing of peak mortality, if known, can give some indication of when the stress may have occurred. For example, mortality is usually highest 2 years after heavy insect defoliation. Such tree growth information, when coupled with an analysis of weather and forest records, can be used to develop a composite picture of the cause and stage of the oak decline problem.

In the diagnosis of oak decline, it is important to determine if stress factors are associated with the specific problem and, at the same time, to rule out the involvement of primary pathogenic organisms such as the oak wilt fungus.

Oak wilt (see detailed description below) caused by the fungus *Ceratocystis fagacearum* (Bretz) Hunt has been reported from the Lake States east to Pennsylvania and south to Texas. It has not been found in New England, New York, or New Jersey. All oak species are susceptible to the fungus. Red oaks are more susceptible than white oaks.

Control

The unique relationship of cause and effect, and patterns of distribution of oak decline must be considered, and control efforts should focus on reducing or preventing the predisposing stress factors.

In the forest, factors such as drought and frost cannot be controlled. However, management can reduce their effects. Thinning can reduce competition for moisture and nutrients and promote better physiological condition of the remaining trees. Silvicultural practices designed to encourage species best adapted to the site can help reduce the effects of drought or frost. Removal of weak and dying trees may also reduce or delay population buildup of the two lined chestnut borer. Stress from insect defoliation can be reduced or eliminated in high-value forest stands by spraying the trees with insecticides.

Landowners can get specific information on insecticides available for control from cooperative extension agents or local forestry officials.

In urban sites, additional control measures are feasible. Moisture shortages can be alleviated by watering, mulching to reduce competition from sod, and reducing or avoiding soil compaction. Trees can also be treated to control sucking and defoliating insects and disease organisms that cause defoliation. Nutritional deficiencies can be corrected by fertilizing. These practices eliminate some forms of stress and promote good physiological condition.

Oak decline is initiated by stresses, which can disappear before effects are manifested. A systematic evaluation of the problem can usually reveal the initiating factors and the agents responsible for mortality. Practices to promote good tree health can reduce the potential impacts of damage by oak decline.

At this point none has been observed in at APG or the immediate area surrounding the base.

Source: http://www.na.fs.fed.us/spfo/pubs/fidls/oakdecline/oakdecline.htm

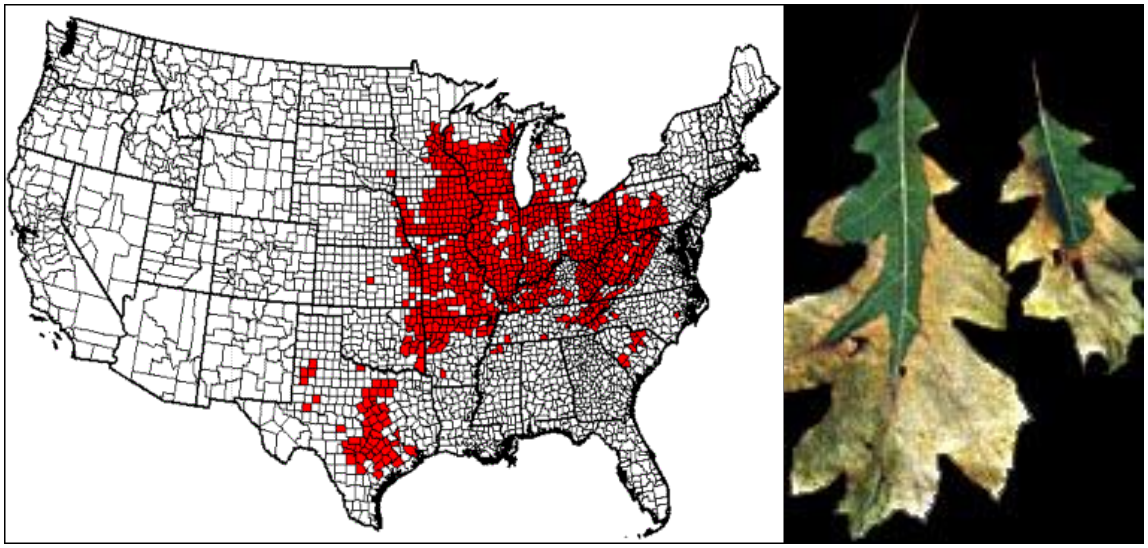
2. Oak Wilt

Oak wilt is an aggressive disease that affects many species of oak (*Quercus* spp.). It is one of the most serious tree diseases in the eastern United States, killing thousands of oaks each year in forests, woodlots, and home landscapes.

Distribution

Oak wilt was first identified in 1944. The fungal pathogen that causes the disease, *Ceratocystis fagacearum,* is thought by most to be native to the eastern United States, but difficulty in isolating and identifying the fungus delayed recognition of the extent of its

impact until the 1980's. Some plant pathologists think that oak wilt is an exotic disease, arriving in North America in the early 1900's, but the fungus has never been reported from any country other than the United States. The disease has also become much more apparent in some local areas since the 1980's because of increased tree wounding, due primarily to home construction in oak woods. The current known distribution of oak wilt is shown in red. In 1998, oak wilt was distributed over much of the eastern United States.



Hosts

Oaks can be organized into three main groups, based on leaf shape: red oaks, white oaks, and live oaks. Trees in the red oak group have fan-shaped leaves with sharply pointed tips; those in the white oak group have fan-shaped leaves with rounded or blunt tips; and trees in the live oak group have oval leaves with rounded tips (Fig. 2). Oaks most commonly killed by the disease are listed in Table 1.

All species in the white oak group are moderately resistant to oak wilt, but if infected, trees can be killed over a period of one to several years. Resistance in white oaks appears to be related to characteristics of physiology and morphology. Upon wounding, infection, or as a part of the natural aging process, white oaks tend to form minute plugs called ***tyloses*** in their sapwood vessels. These plugs make the wood of white oaks impermeable to water, and also appear to prevent the fungus from moving throughout the vascular system of the tree.

The tendency for white oaks to form tyloses also explains why these are the species of choice for wood used in cooperage for storing wine and whiskey. The presence of tyloses ensures that barrels made from white oak wood will not leak.

Throughout the range of oak wilt in the United States, red oaks are the most important hosts, but susceptibility varies somewhat by species. Mortality in red oaks can occur within 3 weeks after infection by the oak wilt pathogen under some circumstances. Recovery from oak wilt infections in red oaks can occur, but is rare. Although the disease is not known west of Texas, inoculation studies have shown that most oaks in the red oak group, including several western species, are susceptible to the disease,

and are at risk should the fungus ever be transmitted to them in their native habitat (Appel, 1994).

Symptoms

Oak wilt disease symptoms progress differently in red oaks and white oaks.

Red Oak Group: Oak wilt is usually identified in red oaks by the symptoms of rapid leaf discoloration and wilting. Often the initial symptom is a subtle off-green color shift that may be visible in the upper portion of the tree crown. This symptom is apparent in the northern part of the disease range in late June to early July. Shortly after this initial color shift, the leaves begin to wilt from the top of the crown downward. As the disease progresses, individual leaves quickly discolor, taking on a "bronzed" appearance. The discoloration progresses around the margins of the leaf from the tip to the base (Fig. 7B). The progressing discoloration may be interrupted by the leaf veins, as shown in the white oak leaf in Fig. 7A, or may affect the entire upper portion of the leaf, as shown in the red oak leaf in Fig. 7B.

Leaves are cast rapidly as the infection progresses. Commonly, infected trees are almost entirely defoliated within a few weeks of symptom onset. Fallen leaves usually are brown at the tips and margins, and sometimes green at the base and along the lower veins. Trees are often killed in groups or disease "centers," when infection occurs through grafted roots.

Occasionally the outer ring of vessels of diseased trees will be plugged with a brown substance that may be visible in cross sections as a ring or a series of dark spots through the outer sapwood, and in tangential cuts as longitudinal streaking of wood exposed after removing the bark. However, this is not always obvious to an untrained observer, especially in the red oaks. The discoloration may be very light or appear as flecks in such sections. Discoloration is most readily seen in tangential cuts on branches.

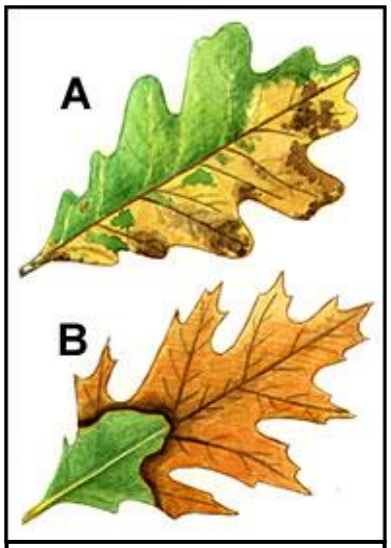


Figure 7. Symptoms of oak wilt in **A**. white oak, **B**. red oak

White Oak Group: White oaks usually die slowly, one branch at a time, over a period of one to many years. Wilting and death of leaves on individual branches occur in a similar fashion to the disease in red oaks, but usually progresses much more slowly. Affected leaves exhibit a pattern of discoloration similar to that seen in red oaks, with discoloration proceeding from the margins to the base, sometimes interrupted by the leaf veins (Fig. 7A). Brown streaking in the outer growth rings is often readily apparent even to an untrained observer in infected white oaks and bur oaks, but may be missing.

http://www.na.fs.fed.us/ - *Northeastern Area USDA Forest Service*

Control

Stopping spread of the fungus through common root systems is most important and can be done by mechanical barriers using a vibratory plow with a 5-foot blade. Barriers in

recommended: a primary line outside of apparently healthy trees and a secondary barrier outside of every obviously infected tree. The fungus can be in a tree for 2-3 weeks without leaf symptoms appearing. Barrier placement requires experience. If buried utilities are present, the soil sterilant, Vapam, can be used, but it is not nearly as effective as the mechanical barrier.

Following these guidelines for when to prune and when to paint can prevent overland spread by insects.

High Risk Period: April, May and June: don't wound or prune! If trees are accidentally wounded or pruning is unavoidable, cover the wounds immediately-within minutes-with one of the preferred materials such as water-based paint or shellac.

Low Risk Period: July through October. On rare occasions - depending on weather conditions and insect populations - infections may occur. Covering wounds is optional.

Safe Period: November through March. This is the preferred time for pruning since the fungal pathogen and insect vectors are inactive.

Tree climbing irons should never be used on living oak trees.

As further precaution, infected red oaks on which spores may form in spring should be eliminated by debarking, burning, burying, or wrapping and sealing in 4-6 ml plastic until July 1. Experience is needed to detect these trees before spores are produced. The spores are carried by the sap beetles to wound oaks during May and June.

Logs from wilting, or recently wilted trees should not be moved in any form, including firewood, to areas where oak wilt is not present. Oak wilt mats may form on these logs. Long distance movement of firewood obtained from such logs has accounted for establishment of oak wilt centers in distant areas that previously had been unaffected by the disease.

In high value white oaks, systemic injection with propiconazole by qualified arborists may prevent infection of trees adjacent to oak wilt affected ones. Propiconazole treatment of white oaks exhibiting early symptoms of oak wilt (less than 30% of crown affected) can also prevent further disease development for at least 2 years.

http://www.extension.umn.edu/distribution/naturalresources/DD3174.html - University of Minnesota College of Food, Agriculture and Natural Resources

3. Bacterial Leaf Scorch

Symptoms

Trees infected with *Xylella fastidiosa* exhibit marginal leaf necrosis, or browning, bordered by a pale halo band separating the dead or scorched tissue from the green tissue. Leaf discoloration begins at the leaf margin and moves toward the midrib. Symptoms recur each year and spread over the tree's crown, thus, reduction in growth and dieback are common in affected trees.
In the early stages of this disease, portions of the tree remain unaffected, while other branches exhibit symptoms typical of the disease. Infected leaves in red oaks exhibit a

pronounced, marginal discoloration with a dull red or yellow halo between scorched and green tissues (see below). Due to determinant growth, all leaves on oak develop symptoms at the same time. As the disease progresses, more branches develop symptoms. Within plantings, disease incidence usually appears randomly; trees neighboring severely affected trees are often not affected. Leaf symptoms in pin oak are not as distinct, but the distribution of the disease within the canopy and between trees is the same.

Symptoms of marginal leaf scorch on northern red oak. (Photograph courtesy of A. B. Gould.)

BLS is commonly found in other tree species such as sycamore, elm and red maple. In all known oak hosts, symptoms usually occur in mid- to late-summer on leaves of one or more branches in the canopy. Affected leaves may curl and drop prematurely. As the infection progresses over several years, branches die, and the tree declines. Affected trees eventually decline to the point where they must be removed. The process of tree decline may occur quickly or slowly depending on the tree or the environment. Epicormic sprouts can be prominent on severely diseased trees, and scale insects, borers, Armillaria root rot, and other biotic diseases may be present as secondary pests.

Vectors

Because this bacterium occurs in the xylem of plants, it is not surprising that all currently known vectors are xylem-sap feeding insects. A recent finding has been the identification of treehoppers (Membracidae) as potential vectors.

Management Strategies

There is no effective preventative treatment or cure for bacterial leaf scorch, so one should expect diseased trees to be gradually lost over the years. The eventual best remedy for bacterial leaf scorch is tree replacement. However, in the meantime, infected trees can be made to look somewhat presentable for a few more years if the dead wood is pruned out. Careful scouting combined with judicious pruning can help to rid the tree of symptomatic branches especially since there are no chemicals registered for treatment.

a. Leafhoppers, which spread the disease, are active most of the growing season making it impractical to control this disease by insecticidal treatments. Transmission of this disease is so unpredictable that efforts to prevent it by preventing vector feeding are likely to be futile.

b. Trunk injections with antibiotics have been shown to suppress symptoms. Treatments must be made annually in late May or early June. The antibiotic oxytetracycline has been tested as a treatment, but it only caused the remission of symptoms; it did not provide a cure.

c. Pruning has been another possible treatment; however with only limited success in

delay of scorch development. Pruning has been devoted to public safety in trees that have shown some natural resistance to the disease.

d. Mulching and irrigating during periods of little rainfall will reduce moisture stress and possibly delay scorch development.

e. The effects of fertilization are still unclear with this disease. Fertilizing should be performed when a soil or leaf analysis shows a nutrient deficiency.

f. Removing trees has been necessary to maintain safety and is considered when trees no longer add to the landscape.

US National Arboretum: http://www.usna.usda.gov/Research/BacterialLeafScorch.html

4. Smooth Patch Disease

Aleurodiscus oakesii is a small but very common and overlooked fungus that decompose the rough, dead outer bark of trees. However, its effects can be seen from quite a distance. Although *A.oakesii* is not a parasite, it lives on the bark of trees, primarily oaks. Over time this results in smooth grayish patches that are adjacent to the normal, rough bark. These patches may expand slowly over time, coalescing to form smooth grayish areas that are several feet in length.

These smooth patch fungi, however, do not cause cankers or internal decay. They cause no known harm to the tree.

Oak trees with smooth patch – Purdue Extension

5. Oak Anthracnose

Symptoms

This disease is most serious on white oaks. Individual trees can be severely damaged from repeated infection by the fungus Gnomonia quercina. Individual leaves develop irregular brown, dead areas and may be slightly cupped or distorted. The fungus also attacks and kills leaf buds and new shoots. Repeated attacks will cause a stunted, brooming effect to diseased branches.

Anthracnose fungi overwinter in leaf debris on the ground and/or in dead areas of the bark on the tree, called cankers. In early spring, spores of the fungus are produced in fruiting structures and are dispersed by splashing rain. These spores infect expanding leaf buds, shoots, or in some cases young leaves.

The infection process is favored by relatively cool temperatures and prolonged periods of leaf wetness. Therefore, the disease tends to be more severe during wet, cool springs. After infection, the anthracnose fungus colonizes leaf tissue and begins to produce new fruiting structures and spores capable of re-infecting expanding leaf tissue.

Disease development may continue throughout the spring into early summer if favorable weather persists. These diseases tend to be less of a problem during hot, dry summer weather.

Control

Anthracnose rarely causes significant damage to shade trees in the area; consequently specific control measures generally are not required. The disease also can increase susceptibility to other disease or insect problems in areas where trees are attacked year after year.

Several cultural practices can reduce the severity of anthracnose. Removal of dead leaves in the fall will help limit the amount of fungal inoculum present for infection of new leaves the following spring. However, this practice rarely eliminates the problem, especially for those anthracnose fungi that may also survive in blighted twigs on the tree.

Proper tree spacing and placement to promote good air circulation reduces the number of hours leaf surfaces remain wet, and decreases the likelihood of fungal infection. Many trees recover rapidly from anthracnose if they are maintained in a vigorous condition.

Trees should be watered and fertilized regularly. In some cases, nitrogen fertilization may actually increase the tree's tolerance or resistance to anthracnose.

Red oaks tend to have fewer problems with the disease than the white oak group; and there appears to be variation in individual elms and black walnuts to their respective anthracnose diseases. Avoid planting highly susceptible trees in areas with poor air circulation.

For forests, monitoring of overall stand health is recommended, with removal of severely diseased trees if disease pressure is high throughout stand population.

* Anthracnose foliar disease is also commonly found in other tree species such as sycamore, elm, hickory and red maple. The guidelines above are applicable.

6. Gypsy Moth

The Gypsy moth, *Lymantria dispar* Linnaeus, is one of the most notorious pests of hardwood trees in the Eastern United States. Since 1980, the Gypsy moth has defoliated close to a million or more forested acres each year. In 1981, a record 12.9 million acres were defoliated. This is an area larger than Rhode Island, Massachusetts, and Connecticut combined.

Gypsy moth infestations alternate between years when trees experience little visible defoliation (Gypsy moth population numbers are sparse) followed by 2 to 4 years when trees are visibly defoliated (Gypsy moth population numbers are dense).

The Gypsy moth is not a native insect. It was introduced into the United States in 1869 by a French scientist living in Massachusetts. The first outbreak occurred in 1889. By 1987, the Gypsy moth had established itself throughout the Northeast. The insect has spread south into Virginia and West Virginia, and west into Michigan. Infestations have also occurred in Utah, Oregon, Washington, California, and many other States outside the Northeast.

Life Cycle

The Gypsy moth passes through four stages: egg, larva, pupa, and adult (moth stage). Only the larvae damage trees and shrubs.

Gypsy moth egg masses are laid on branches and trunks of trees, but egg masses may be found in any sheltered location. Egg masses are buff colored when first laid but may bleach out over the winter months when exposed to direct sunlight and weathering.

Female gypsy moth laying eggs.

The hatching of Gypsy moth eggs coincides with budding of most hardwood trees. Larvae emerge from egg masses from early spring through mid-May.

Hosts

Gypsy moth larvae prefer hardwoods, but may feed on several hundred different species of trees and shrubs. In the East the Gypsy moth prefers oaks, apple, sweetgum, speckled alder, basswood, gray and white birch, poplar, willow, and hawthorn, although

other species are also affected. The list of hosts will undoubtedly expand as the insect spreads south and west.

Factors That Affect Gypsy Moth Populations

Natural enemies play an important role during periods when Gypsy moth populations are sparse. Natural enemies include parasitic and predatory insects such as wasps, flies, ground beetles, and ants; many species of spider; several species of birds such as chickadees, bluejays, nuthatches, towhees, and robins; and approximately 15 species of common woodland mammals, such as the white-footed mouse, shrews, chipmunks, squirrels, and raccoons.

Gypsy moth larvae emerging from egg mass.

The *Calosoma* beetle, a ground beetle of European origin, cuckoos, and flocking birds such as starling, grackles, and red-winged blackbirds, are attracted to infested areas in years when Gypsy moth populations are dense.

Diseases caused by bacteria, fungi, or viruses contribute to the decline of Gypsy moth populations, especially during periods when Gypsy moth populations are dense and are stressed by lack of preferred foliage.

Wilt disease caused by the nucleopolyhedrosis virus (NPV) is specific to the Gypsy moth and is the most devastating of the natural diseases. NPV causes a dramatic collapse of outbreak populations by killing both the larvae and pupae. Larvae infected with wilt disease are shiny and hang limply in an inverted "V" position.

Weather affects the survival and development of Gypsy moth life stages regardless of population density. For example, temperatures of -20°F. (-29°C.) lasting from 48 to 72 hours can kill exposed eggs; alternate periods of freezing and thawing in late winter and early spring may prevent the overwintering eggs from hatching; and cold, rainy weather inhibits dispersal and feeding of the newly hatched larvae and slows their growth.

Managing the Gypsy Moth

A number of tactics have the potential to minimize damage from Gypsy moth infestations and to contain or maintain Gypsy moth populations at levels considered tolerable. These tactics include monitoring Gypsy moth populations, maintaining the health and vigor of trees, discouraging Gypsy moth survival, and treating with insecticides to kill larvae and protect tree foliage. The tactic or combination of tactics used will depend on the condition of the site and of the tree or stand and the level of the Gypsy moth population. Tactics suggested for homeowners are probably too costly and too labor intensive for managers to use in forest stands.

Silvicultural Guidelines for Forest Stands and Woodlots

Several interrelated factors determine the vulnerability of forest stands and woodlots to Gypsy moth defoliation. An awareness of these factors will enable land managers and woodlot owners to prescribe silvicultural actions that will minimize the impact caused by

Gypsy moth defoliation. Three of these factors include the abundance of favored food species (mainly oaks), site and stand factors, and tree conditions.

Stands of trees that are predominately oak and grow on poor, dry sites (such as sand flats or rock ridges) are frequently stressed and often incur repeated, severe defoliations. Trees growing under these conditions frequently possess an abundance of structural features such as holes, wounds, and deep bark fissures that provide shelter and habitats for Gypsy moth larvae and aid their survival.

Stands of trees that are predominantly oak but grow on protected slopes or on sites with adequate moisture and organic matter are more resistant to defoliation by the Gypsy moth. Slow-growing trees on poor sites frequently survive a single, severe defoliation better than fast-growing trees typically found on well-stocked better sites. More trees are killed in stands that contain mainly oak species than in oak-pine or mixed hardwood stands. Subdominant trees are killed more rapidly and more often than dominant trees.

Silvicultural Treatment: What and When?

Appropriate silvicultural treatment will be determined by an anticipated occurrence of Gypsy moth defoliation, by characteristics of the stand, and by the economic maturity of the stand. Foresters refer to treatments discussed here as "thinmings." Thinnings are cuttings made in forest stands to remove surplus trees (usually dominant and subdominant size classes) in order to stimulate the growth of trees that remain.

***Pre-defollation treatments*:** When Gypsy moth defoliation is anticipated, but not within the next 5 years, predefoliation thinning to selectively remove preferred-host trees can reduce the severity of defoliation, increase the vigor of residual trees, and encourage seed production and stump sprouting. Thinnings should not be conducted in fully stocked stands that will reach maturity within the next 6 to 15 years. Thinning results in a short-term "shock effect" to residual trees. This shock effect, coupled with defoliation-caused stress, renders trees vulnerable to attack by disease organisms such as *Armillaria*.

In fully stocked stands that will reach maturity within the next 16 or more years, two kinds of thinning can be applied. The method of thinning should depend on the proportion of preferred host species present.

- If more than 50 percent of the basal area in a stand is preferred host species (mainly oaks), pre-salvage thinning should be applied. Pre-salvage thinning is designed to remove the trees most likely to die (trees with poor crown condition) from stress caused by Gypsy moth defoliation.
- If less than 50 percent of the basal area in a stand is in preferred host species, sanitation thinning can be applied to reduce further the number of preferred host trees. This will result in fewer refuges for Gypsy moth larvae and in improved habitats for the natural enemies of the Gypsy moth.

Treatment during outbreaks: If defoliation is current or is expected within the next 5 years, thinnings should be delayed because of potential "shock effect." High-value stands can be protected by applying pesticides. In low-value stands or those that are at low risk (less than 50 percent basal area in preferred host species), protective treatments are optional.

Post-outbreak treatments: After a defoliation episode, the land manager or woodlot owner should pursue efficient salvage of dead trees, but should delay decisions about additional salvage, regeneration, or other treatments for up to 3 years. At the end of 3 years, most defoliation-caused mortality will be complete and the need for treatments can be assessed on the basis of damage level, current stocking conditions, and stand maturity.

Above portions on Gypsy moth are from:
http://www.na.fs.fed.us/SPFO/pubs/fidls/gypsymoth/gypsy.htm

7. Orangestriped Oakworm

Symptoms

Identifying the Insect: The larvae of the orangestriped oakworm are black with eight narrow yellow stripes, the pinkstriped oakworm larvae are greenish brown with four pink stripes, and the spiny oakworm larvae are tawny and pinkish with short spines. Larvae are about 2 inches (50 mm) long and have a pair of long, curved "horns". The adult moths are a similar yellowish red, with a single white dot on each of the forewings.

Identifying the Injury: Young larvae feed in groups, skeltonizing the leaf. Later they consume all but the main veins and usually defoliate one branch before moving onto another. Older larvae are less gregarious and can be found crawling on lawns and the sides of houses.

Control

Natural enemies generally prevent widespread defoliation. Chemical control may be needed for high value trees, but is rarely recommended.

Red Maple

Red maple is generally considered very susceptible to defects, such as decay and structural defects in branching and form. Especially on poor sites, red maple often has poor form and considerable internal defects. Discoloration and decay advance much faster in red maple than in sugar maple.

Although many insects and diseases feed upon and infect this species, it is considered very resistant to these damaging agents. However, because of its thin bark, it is susceptible to mechanical and fire damage. Much of the time secondary decay fungus and pathogens produce significant heart rot after bark damage to trunk.

Sweet Gum

Botryosphaeria ribis canker on trunk

Distribution

Sweetgum *(Liquidambar styraciflua* L.) occurs naturally in the Southeastern United States.

Disease

Sweetgum is rarely attacked by insects but is frequently marred by trunk canker and trunk lesion caused by *Botryosphaeria ribis.* This diseases cause sunken areas on the trunk and profuse "bleeding". Infected bark and sapwood will be brown and dead. There is no chemical control for canker diseases. Severely infected trees will die or produce large cavities or rotted portions on the lower trunk. Sweetgum is predisposed to this disease when the trunk is damaged.

Leaf spots of various types may attack Sweetgum, causing premature defoliation, but are not serious.

Management Considerations - Monolithic Stands

Recently cleared coastal areas are frequently repopulated with sweet gum. The vigorous regrowth of this species will suppress the regeneration of other more desirable woody plants; virtually creating a sweet gum desert. Thus, areas that are normally dominated by other higher value species, such as oak, will be suppressed because of the aggressive repopulation of sweet gum. Stands of sweet gum on high quality sites should be thinned before the largest trees exceed 6 inches in diameter at breast height; otherwise, vigor and growth of most other tree species are reduced or eliminated.

Tuliptree (Tulip Poplar)

Distribution

Tulip poplar is exacting in soil and moisture requirements. It does best on moderately moist, deep, well drained, loose-textured soils; it rarely grows well in very dry or very wet situations. It will tolerate a pH of 4.5 to 7.5.

Pests and Potential Problems

Tulip poplar is unusually free from insects and disease. The yellow-poplar weevil, nectria canker, and fusarium canker are three of the more important enemies of this species, but are rarely considered a threat to overall stand health.

This species is prone to wind damage and ice damage in exposed situations.

Conclusion

Natural events like wildfires, wind, diseases, and insects are important factors in forest ecosystems. The ongoing challenge for forestry professionals is to achieve and maintain healthy forests with a balanced approach to the naturally occurring events.

Actively scouting or monitoring areas at risk due to unnatural or extreme conditions is the first step in maintaining healthy woodlands. Both active and passive management can have some short-term adverse impacts and cannot eliminate all forest health or wildfire hazards. A substantial and growing body of research and professional experience, however, shows that active management can produce much more reliable and positive results than a passive-management approach.

Resources:

http://www.fs.fed.us/r9/ - Eastern Region Forest Service updates on regional pest threats

http://www.forestthreats.org/ - excellent resource that examines and provides information on current and potential future threats to the eastern forests.

http://neipmc.org/ - Provides regional updates of pest threats

http://extension.umd.edu/ipm - University of Maryland IPM site

http://extension.umd.edu/hgic/resource-library/links - University of Maryland Cooperative Extension Central Maryland Research and Education Center weekly pest updates and access to plant diagnostic lab

4.8.7 Timber Harvests in the Chesapeake Bay Critical Area

Background

The Chesapeake Bay Critical Area Law in the State of Maryland requires that all “harvesting of timber in the Chesapeake Bay Critical Area be in accordance with plans approved by the district forestry board" (Natural Resources Article 8-1808(c)(10)). The State defines timber harvesting as “any tree cutting operation affecting one or more acres of forests or developed woodland within any one year interval that disturbs 5,000 or more square feet of forest floor”.

A forest management plan is required for all timber harvesting occurring within any 1-year interval and affecting 1 or more acres of forests and developed woodland in the Critical Area. The plans must be prepared by a licensed professional forester and are reviewed and approved by the Forest Service and the Wildlife and Heritage Service of the Department of Natural Resources through the District Forestry Boards and the Project Forester, and filed with an appropriate designated agency within their local jurisdiction. Plans shall include measures to protect surface and ground water quality and identify whether the activities will disturb or affect habitat protection areas as identified in COMAR 27.01.09, and incorporate protection measures for these areas as specified by the local jurisdictions. To provide for the continuity of habitat, the plans shall address mitigation through forest management techniques which include scheduling size, timing and intensity of harvest cuts, afforestation, and reforestation.

5.0 LITERATURE CITED, REFERENCES, AND GLOSSARY OF FORESTRY TERMS

5.1 LITERATURE CITED

Cornell HV. 1983. The secondary chemistry and complex morphology of galls formed by the Cynipanae (Hymenoptera): why and how? American Midland Naturalist 110(2): 225-234.

Finzi AC, Van Breeman N, Canham CD. 1998. Canopy tree-soil interactions within temperate forests: species effects on soil carbon and nitrogen. Ecological Applications 8(2): 440-446.

Fralish JS. 2004. The keystone role of oak and hickory in the central hardwood forest. In: Spetich MA, ed. Upland oak ecology symposium. Ashville (NC): USDA Forest Service. General Technical Report nr SRS-73.

Hix DM, Fosbroke DE, Hicks RR, and. Gottschalk KW. 1991. Development of regeneration following Gypsy moth defoliation of Appalachian plateau and ridge and valley hardwood Stands. In: Proceedings of the 8th Central Hardwood Forest Conference; 1991 March 6-8; University Park, PA. Gen. Tech. Rep. NE-148. Radnor, PA: USDA Forest Service, Northeastern Forest Experimental Station: 347-359.

Holmes, RT, TW Sherry, and FW Sturges. 1986. Bird community dynamics in a temperate deciduous forest: long-term trends at Hubbard Brook. Ecol. Monogr. 56:201-220 (p.104 in Martin and Finch 1995).

Holmes, RT, TW Sherry, and FW Sturges. 1991. Numerical and demographic responses of temperate forest birds to annual fluctuations in their food resources. Acta XX Congr.Internt. Ornithol. 1559-1567 (p. 104 in Martin and Finch 1995).

Johnson PS, Shifley SR, Rogers R. 2002. The ecology and silviculture of oaks. New York (NY): CABI Publishing. 503 p.

Lovett GM, Weathers KC, Arthur MA, Schultz JC. 2004. Nitrogen cycling in a northern hardwood forest: do species matter? Biogeochemistry 67: 289-308.

Martin, AC, HS Zim, and AL Nelson. 1961. American Wildlife and Plants – A Guide to Wildlife Food Habits. Dover Publications, Inc. New York.

Martin, TE and DM Finch. 1995. Ecology and Management of Neotropical Migratory Birds – A Synthesis and Critical Review of Issues. 489 p. New York (NY). Oxford University Press.

Shreve, F., MA Chrysler, FH Blodgett, and FW Besley. 1915. The Plant Life of Maryland. Maryland Weather Service. Vol. 2. p. 162

Tallamay, Douglas W. 2007. Bringing Nature Home. Timber Press, Portland, London. pp. 146-7.

Sweeney, BW. 1993. Effects of streamside vegetation on macroinvertebrate communities of White Clay Creek in eastern Noth America. Proceedings of the Academy of Natural Sciences of Philadelphia. 144:291 – 340.

Tallamay, DW. 2007. Bringing Home Nature: How You Can Sustain Wildlife with Native Plants, pp. 146-7. Timber Press, Portland.

Webster CR, Jenkins MA, Jose S. 2006. Woody invaders and the challenges they pose to forest ecosystems in the eastern United States. Journal of Forestry 04(7):366-374.

5.2 REFERENCES

Askins, R.A., M.J. Philbrick, and D.S. Sugeno. 1987. Relationship between the regional abundance and the composition of forest bird communities. *Biological Conservation* 39:129-152.

Baltimore County Department of Environmental Protection and Resource Management. 1987. Habitat Assessment Study for Baltimore County, Maryland.

Brown ML, Brown RG. 1984. Herbaceous plants of Maryland. Baltimore (MD): Port City Press. 1127 p.

Brown RG, Brown ML. 1972. Woody plants of Maryland. Baltimore (MD): Port City Press. 347 p.

Carlton MM. 1990. Literature review: water quality implications of converting forested watersheds to principally herbaceous cover – implications to the Quabbin Watershed. Boston (MA): Metropolitan District Commission. 44 p.

Davis MB. 2003. Old Growth in the East: A Survey (revised edition). Mt. Vernon (KY): Appalachia-Science in the Public Interest. 150 p.

Department of Natural Resources. 1994. *Maryland's Deep Forest Birds Are Declining*, Wildlife Fact Sheet. State of Maryland.

Dunne, T, Leopold LB. 1978. Water in environmental planning. New York (NY): WH Freeman, 818 p.

Eyre FH, ed. 1980. Forest cover types of the United States and Canada. Washington (DC): Society of American Foresters. 148 p.

Fisher RF, Binkley D. 2000. Ecology and management of forest soils. 3rd ed. New York (NY): John Wiley & Sons. 489 p.

Goodale CL, Lajtha K, Nadelhoffer KJ, Boyer EW, Jaworski NA. 2002. Forest nitrogen sinks in large eastern U.S. watersheds: estimates from forest inventory and an ecosystem model. Biogeochemistry 57/58: 239-266.

Holmes, RT. 1990. The structure of a temperate deciduous forest bird community: variability in time and space. Pp. 121-140 in Biogeography and ecology of forest bird communities. (A. Keast, ed.) SBP Academic Publications, The Hague.

Marquis D, Twery M. 1992. Decision-making for natural regeneration in the northern forest ecosystem. In: Loftis DC, McGee, editors. 1993. Oak regeneration: serious problems, practical recommendations. Symposium Proceedings; 1992 Sept 8-10; Knoxville (TN). USDA Forest Service, Southeastern Forest Experiment Station. General Technical Report nr SE-84.

Maryland Department of Natural Resources Forest Service. 2003. A comprehensive forest conservation plan for long-term watershed protection on the City of Baltimore's reservoirs. Annapolis (MD): MD DNR Report nr RNRS-2003-01. P.168.

Matthews JD. 1989. Silvicultural systems. New York (NY): Oxford University Press. P.296

McCann JM, Battin III WJ. 1999. An inventory of neo-tropical migratory land birds at the U.S. Army Aberdeen Proving Ground, Harford County, Maryland. Annapolis (MD): Maryland Department of Natural Resources, Wildlife and Heritage Division.

Pennsylvania State University College of Agricultural Sciences, Agricultural Research and Cooperative Extension. 2002. Understanding and conserving biological wealth in our forests. In: Forest Stewardship Bulletin No. 9. University Park (PA): PA State University.

Robbins, CS and EAT Blom. 1996. Atlas of the Breeding Birds of Maryland and the District of Columbia. University of Pittsburgh Press. Pittsburgh. 479 pp.

Smith DW. 2006. Why sustain oak forests? In: Dickinson MB, ed. Fire in eastern oak forests: delivering science to land managers. Proceedings of a Conference; 2005 Nov 15-17; Columbus. USDA Forest Service, Northern Research Station. General Technical Report nr NRS-P-1. p. 62-71.

Sprague E, Burke D, Claggett S, Todd A, editors. 2006. The Conservation Fund. The state of the Chesapeake forests. Arlington (VA): The Conservation Fund. 144 p.

Twery MJ, Knopp PD, Thomas SA, Rauscher HM, Nute DE, Potter WD, Mier F, Wang J, Dass M, Uchiyama H, Jajime G, Hoffman RE. 2005. NED-2: a decision support system for integrated forest ecosystem management. Computers and Electronics in Agriculture 49:24-43

USDA Forest Service. 1990. Silvics of North America. 2 volumes. Washington (DC): USDA. Agricultural Handbook nr 654.

USDA Forest Service. 2006. Northeastern forest regeneration handbook- a guide for forest owners, harvesting practitioners and public officials. nr NA-TP-03-06.

URS Corporation. 2005. Back River Neck Rural legacy – Ecological Assessment Report. Hunt Valley, Maryland.

Wagner DL. 2005. Caterpillars of eastern North America. Princeton (NJ): Princeton University Press. 512 p.

Yahner, Richard H. 1995. *Eastern Deciduous Forests*, Ecology and Wildlife Conservation. University of Minnesota Press, Minneapolis.

Web Resources

http://www.fs.fed.us/r9/ - Eastern Region Forest Service updates on regional pest threats

http://www.forestthreats.org/ - excellent resource that examines and provides information on current and potential future threats to the eastern forests.

http://neipmc.org/ - Provides regional updates of pest threats

http://extension.umd.edu/ipm - University of Maryland IPM site

http://www.pwrc.usgs.gov/bba/index.cfm?fa=explore.ResultsByBlock&BBA_ID=MDDC2002. Breeding Bird Atlas Survey

5.3 GLOSSARY OF FORESTRY TERMS

This section includes terms referenced in the report text. Thanks to Nancy Pywell, Extension forester, *Pennsylvania State University*, whose bulletin, "Forestry Terminology," provided the framework for this Glossary.

AGS – Acceptable Growing Stock. a tree that has no damage or disease, has good form and vigor, and exhibits crown condition adequate to ensure survival.

association - a collection of plants with ecologically similar requirements, including one or more dominant species from which the group derives a definite character.

basal area (of a tree) - the cross-sectional area of the trunk 4 1/2 feet above the ground; **(per acre)** the sum of the basal areas of the trees on an acre; used as a measure of forest density.

biological diversity or biodiversity - the variety of life in all its forms and all its levels of organization. Biodiversity refers to diversity of genetics, species, ecosystems, and landscapes.

BMP'S – Best Management Practices

breast height - 41/2 feet above ground level. See diameter at breast height.

browse - parts of woody plants, including twigs, shoots, and leaves, eaten by forest animals.

canopy - the continuous cover formed by tree crowns in a forest.

carrying capacity - the maximum number of individuals of a wildlife species that an area can support during the most unfavorable time of the year.

co dominant tree - a tree that extends its crown into the canopy and receives direct sunlight from above but limited sunlight from the sides. One or more sides of a co dominant tree are crowded by the crowns of dominant trees.

community - a collection of two or more species sharing the same geographical area.

crop tree - a young tree of a desirable species with certain characteristics desired for wood value, water quality enhancement, or Wildlife or aesthetic uses.

crown - the uppermost branches and foliage of a tree.

deciduous - shedding or losing leaves annually; the opposite of evergreen. Trees such as oak, maple, ash, cherry, and larch are deciduous.

diameter at breast height (dbh) - standard measurement of a tree's diameter, usually taken at 4 1/2 feet above the ground.

dominant trees - trees that extend above surrounding individuals and capture sunlight from above and around the crown.

ecology - the study of interactions between organisms and their environment.

ecosystem – a community of living organisms and non-living components in a system in which energy is transferred through a series of feeding levels, and water and nutrients are recycled.

edge – a transitional boundary between two ecological communities, for example, field and woodland or forest. Also known as an ecotone, edge habitats often support a greater diversity of wildlife than that found in either of the adjacent vegetation communities.or Consideration of an edge can reduce the impact of a timber harvest.

epicormic branching - the development of branches from buds inside the bark, resulting from an abrupt change in a tree's environment due to a range of disturbances, either natural or

human-caused.

even-aged stand - a stand in which the age difference between the oldest and youngest trees is minimal, usually no greater than 10 to 20 years.

forest - a biological community dominated by trees and other woody plants.

forest types - associations of tree species that have similar ecological requirements. Maryland forest types include Allegany hardwood, loblolly-shortleaf, northern hardwood, oak-gum-cypress, oak hickory, and oak-pine.

forester - a degreed professional trained in forestry and forest management. In Maryland, all foresters must be registered with the state.

group selection - a process of harvesting patches of trees to open the forest canopy and encourage the reproduction of uneven aged stands.

habitat -the ecosystem in which a plant or animal lives and obtains food and water.

hardwoods - a general term encompassing broadleaf, deciduous trees.

herbaceous vegetation - low-growing, non-woody plants, including wildflowers and ferns, in a forest understory.

mast - nuts and seeds, such as acorns, beechnuts, and chestnuts, of trees that serve as food for wildlife.

old-growth forest - a wooded area, usually greater than 200 years of age, which is lacking any significant Euro-American disturbance." (Maryland DNR). An old-growth forest often has large individual trees, a multi-layered crown canopy, and a significant accumulation of coarse woody debris including snags and fallen logs.

overstocked - the situation in which trees are so closely spaced that they compete for resources and do not reach full growth potential.

overstory - the level of forest canopy that includes the crowns of dominant, co dominant, and intermediate trees.

regeneration - the process by which a forest is reseeded and renewed. Advanced regeneration refers to regeneration that is established before the existing forest stand is removed.

regeneration cut - a harvest designed to promote natural establishment of trees.

release - to remove overtopping trees that compete with understory or suppressed trees.

sapling - a tree at least 4 1/2 feet tall and up to 4 inches in diameter.

sawtimber stand - a stand of trees whose average dbh is greater than 11 inches.

selection harvest - the harvest of all individual trees or small groups at regular intervals to maintain an uneven-aged forest. Selection harvests are used to manage species that do not need sunlight to survive.

shelterwood harvest - the harvest of all mature trees in an area in a series of two or more cuts, leaving enough trees of other sizes to provide shade and protection for forest seedlings.

silviculture - the art and science of growing forest trees.

site - the combination of biotic, climatic, topographic, and soil conditions of an area.

site index - a measure of the quality of a site based on the height of dominant trees at a specified age (usually 25 or 50 years), depending on the species.

snag - a dead tree that is still standing. Snags provide important food and cover for a wide variety of wildlife species.

sprout - a tree growing from a cut stump or previously established root system.

stand - a group of forest trees of sufficiently uniform species composition age, and condition to be considered a homogeneous unit for management purposes.

stand density - the quantity of trees per unit area, usually evaluated in terms of basal area, crown cover and stocking.

stocking - the number and density of trees in a forest stand. Stands are often classified as under stocked, well-stocked or overstocked.

stratification - division of a forest, or any ecosystem, into separate layers of vegetation that provide distinct niches for wildlife, such as canopy, understory, and herbaceous vegetation.

succession - the natural replacement of one plant (or animal) community by another over time in the absence of catastrophic disturbances.

thinning - a partial cut in an immature, overstocked stand of trees used to increase the Stand's value growth by concentrating on individuals with the best potential.

UGS - Unacceptable Growing Stock. trees that have poor form or vigor, or that are damaged or diseased, making them a poor risk for long term survival.

under stocked - a stand of trees so widely spaced that even with full growth potential realized, crown closure will not occur.

understory - the level of forest vegetation beneath the canopy.

uneven-aged stand - three or more age classes of trees represented.

watershed - a region defined by patterns of stream drainage. A watershed includes all the land that contributes water to a particular stream or river.

well-stocked - the situation in which a forest stand contains trees spaced widely enough to prevent competition yet closely enough to utilize the entire site.

wildlife habitat - the native environment of an animal. Habitats ideally provide all the elements needed for life and growth: food, water, cover from predators and space for rearing offspring.