

Historical Analysis and Map of Vegetation Communities, Land Covers, and Habitats of the Oversee Property New Castle County, Delaware

Red Clay Creek Watershed

Submitted to:

Delaware State Parks
Delaware Division of State Parks
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CHAPTER 1: INTRODUCTION AND METHODS

Setting of the Overseer Property

The Overseer Property is located in northern New Castle County, Delaware (Figure 1.1). The property totals 121 acres. The Overseer Property is located wholly within the Red Clay Creek watershed.

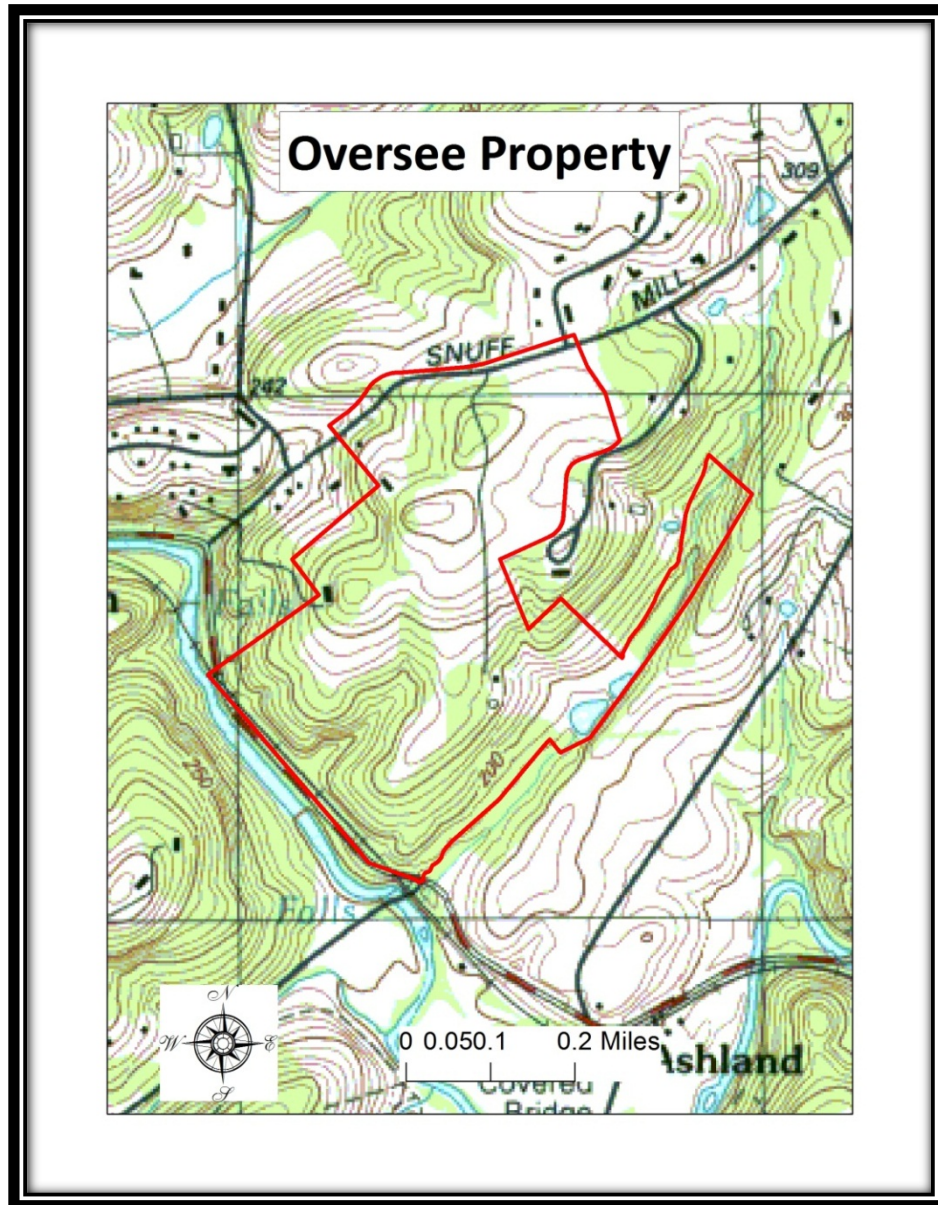


Figure 1.1. Location of the Overseer Property

Soils and Geology of the Oversee Property

Underlying Geology¹

The Oversee Property is located in the Piedmont physiographic province of Delaware. The uplands of the property are underlain by the Wissahickon Formation and the floodplains are above alluvial deposits. The Wissahickon Formation dates from the Cambrian to Ordovician Period and is described as “interlayered psammitic and pelitic gneiss with amphibolite.” Alluvial deposits date from the Holocene Period and are composed of “brown, light yellow-orange, and gray fine to coarse quartz sand, silt, clay, and fine to medium gravel.”

Soils (Figure 1.2)

Three soils are prominent in the Oversee Property and include Glenelg Silt Loam (52 acres), Gaila Loam (35 acres), and Brinklow Channery Loam (25 acres). Other minor soils include Hatboro-Codorus Complex (5 acres), and Glenelg Loam (1 acre).

Elevation

Elevations at Oversee Property range from 150 feet at Red Clay Creek to 360 feet near Snuff Mill Road.

¹ Ramsey, Kelvin W. 2005. Geologic Map of New Castle County, Delaware. Delaware Geologic Survey, Geologic Map Series No. 13.

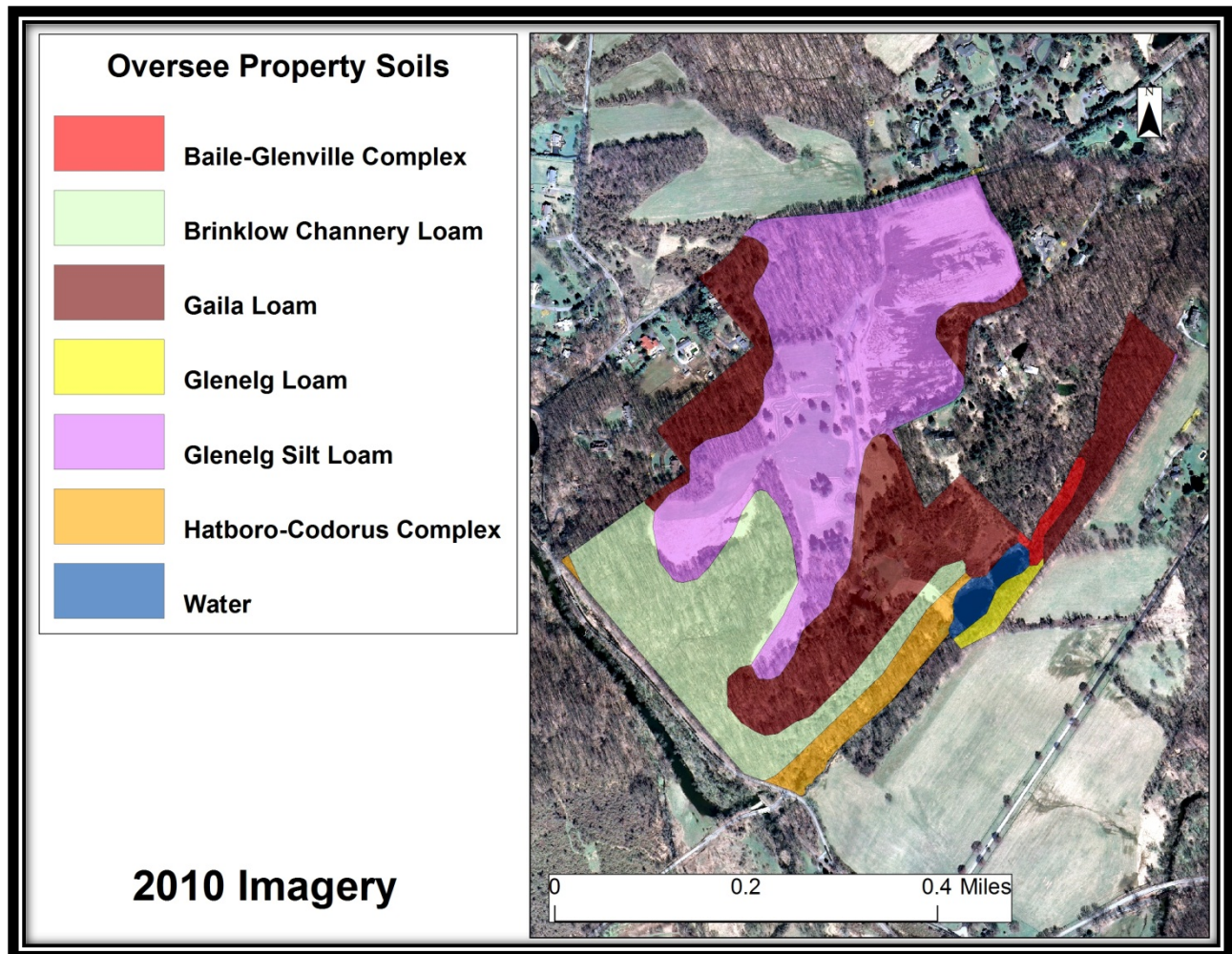


Figure 1.2. Oversee Property Soil Map

Discussion of vegetation communities in general and why they are important in management

While Natural Communities provide the optimal habitats and structure that are needed for animals to exist, vegetation communities provide an approximation of natural communities. The differences in the vegetation communities are governed by non-biotic factors and biotic factors. Non-biotic factors include things such as geology (soil type, availability of moisture, and exposure), climate, and fire regime. Biotic factors include: number and amount of predators and prey, biodiversity of the community and presence and absence of contributors to ecosystem health such as ants, fungi and bacteria and size of forest blocks. Historically these factors have not changed much other than changes brought about by larger climate shifts. Since the time of modern European settlement of Eastern North America (i.e. from about 1600 A.D.), physical factors such as fire regime and moisture availability have changed and nearly all of the biotic factors have changed resulted in a markedly different landscape today than what the original settlers saw. Today, instead of having Natural Communities, we have

Vegetation Communities, which only approximate Natural Communities and are essentially artificial shells of what they could be.

Purpose of the Study

This study was conducted with the following goals in mind:

1. Classify and map vegetation communities, land covers, and assess habitat conditions for Species of Greatest Conservation Need (SGCN)[as defined in the Delaware Wildlife Action Plan (DEWAP)] for Oversee Property based on 1937, 2002, 2007, and 2010 aerial imagery and field observations.
2. Use the maps above to determine changes in the vegetation communities over time.
3. Determine the forest blocks located within or partially within the property.
4. Produce Ecological Integrity Assessments (EIAs) for vegetation communities that are ranked S2 or higher.

Surveys were conducted during 2006, 2007, and 2012 by Robert Coxe, an Environmental Scientist with the Delaware Natural Heritage and Endangered Species Program (DNHESP) within the Delaware Division of Fish and Wildlife, Department of Natural Resources and Environmental Control (DNREC).

Vegetation Community and Land Cover Surveys

Vegetation communities and land covers were determined by qualitative analysis using observations made in the field and aerial photo-interpretation using 1937, 2002, 2007, and 2010 aerial imagery. Vegetation communities are named according to the *Guide to Delaware Vegetation Communities*² which follows the National Vegetation Classification System (NVCS). The NVCS classifies vegetation on a national scale for the United States and is linked to international vegetation classification. The NVCS helps provide a uniform name and description of vegetation communities found throughout the country and helps determine relative rarity. Descriptions of the communities are provided. A crosswalk to the Delaware Wildlife Action Plan (DEWAP) and the Northeast Habitat Classification System (NHC) is provided for each vegetation community/land cover.

Analysis of Historical Imagery

Historical imagery of the Oversee Property from 1937 and 2002, 2007 and current imagery from 2010 were examined. A vegetation community map was produced for each year in order to compare vegetation and land cover change over a 5, 65, 70, and 73 year time frame. Changes in the respective vegetation communities and land covers are discussed in the descriptions while broader changes are discussed in the nature preserve discussion. There is more imagery available (1954, 1961, 1968, 1992, and 1997) but these sets were not used due to geo-registration problems in the image tiles.

Ecological Integrity Assessment (EIA)

An EIA was conducted for those communities in the property that are ranked S2 or higher in Delaware. EIAs are an analysis being developed by Natureserve to determine the relative quality of vegetation communities across North America. Using Natural Heritage methodology, communities are ranked according to rarity (Appendix I). The vegetation communities at the Oversee Property that are included in the EIA analysis are listed in Table 2.3.

Forest Block Analysis

Current forest blocks within or partially within the property that are greater than 100 acres were mapped. Each current block is described for current total acres and current forest interior habitat, potential acres, potential forest interior habitat, vegetation communities currently present, and major drainage (Table 2.4). A block is defined as contiguous forest habitat that is contained with 30 feet of non-forested and is the method used by the Maryland's Strategic Forest Lands Assessment.³ Forest interior is forested area that is 100m from a forest edge. Potential blocks were extended out to areas of noncontiguous habitat (such as roads, power line right-of-ways, and developed areas) that were considered to be immovable. Most of the area that could be reverted to forest is currently old field

² Cox, Robert. 2010. Guide to Delaware Vegetation Communities-Summer 2010 Edition. Unpublished report.

³ Maryland Department of Natural Resources. 2003. Strategic Forest Lands Assessment. Co-op Project between Maryland Department of Natural Resources, Watershed Services, and Maryland Forest Service. 40 p.

habitat or in agricultural use. These blocks were determined for future planning in regards to improving and increasing forest interior habitat.

Natural Capital Analysis

The natural capital of each vegetation community was determined using a table in Costanza, et al.⁴ The values from the table were calculated per acre of the vegetation community and then adjusted using an inflation calculator (DollarTimes.com) from 1994 values to 2012 values. Using these methods the following values were obtained:

Estuaries (water): \$9,247/acre/year

Temperate Forest (Upland forests): \$122/acre/year

Wetlands

- General (not as below): \$5,988/acre/year

- Tidal Marsh: \$4,046/acre/year

- Swamps/floodplains: \$7,930/acre/year

Lakes (Impoundments): \$3,442/acre/year

Cropland: \$37/acre/year

Grassland/fields: \$94/acre/year

Open Ocean: \$102/acre/year

Values were rounded off to the nearest whole dollar.

⁴ Costanza, Robert, et al. 1997. The value of the world's ecosystem services and natural capital. Nature 387:253-260.

CHAPTER 2: EIAs, FOREST BLOCKS, AND GENERAL OBSERVATIONS

Summary of Findings from this study

1. **Vegetation Communities:** Thirteen vegetation communities and four land covers were found on the Oversee Property. Northern Piedmont Mesic Oak-Beech Forest (36 acres) is the largest vegetation community, followed by Northeastern Modified Successional Forest with 30 acres. Agricultural Field (23 acres) is the largest land cover.
2. **Rare Plants:** Twelve rare plants are known to exist on the Oversee Property (Table 2.1).

Scientific Name	Common Name	Rank	Last Observed
<i>Carex bushii</i>	Bush's Sedge	S2	???
<i>Carex conoidea</i>	Field Sedge	S1.1	???
<i>Carex gracilescens</i>	Slender Sedge	S2	???
<i>Carex granularis</i>	Meadow Sedge	S2	1993
<i>Carex planispicata</i>	A Sedge	S1	???
<i>Geum laciniatum</i> var. <i>laciniatum</i>	Rough Avens	S2	2002
<i>Hydrastis canadensis</i>	Golden-seal	S1	1988
<i>Muhlenbergia tenuiflora</i>	Slender Muhly	S2	1991
<i>Paronychia fastigata</i> var. <i>fastigata</i>	Cluster-stemmed Nail-wort	S2	1990
<i>Poa cuspidata</i>	Bluegrass	S2	???
<i>Salix sericea</i>	Silky Willow	S1	2002
<i>Stellaria alsine</i>	Trailing Stitchwort	S2	1993

Table 2.1 Rare Plants at the Oversee Property

3. **Rare Animals:** One rare animal is known to exist at the Oversee Property (Table 2.2).



Scientific Name	Common Name	Rank	Last Observed
<i>Ambystoma maculatum</i>	Spotted Salamander	S2	1997

Table 2.2 Rare Animals at the Oversee Property

Ecological Integrity Assessment (EIA)

Two vegetation communities are ranked S2 or higher and include Box-elder Floodplain Forest and Skunk Cabbage-Orange Jewelweed Seep. These areas are summarized in Table 2.3.

Table 2.3. EIA Vegetation Communities located in the Oversee Property

Community Map	Community Name/EIA Score	Description
	Oversee 1 Box-elder Floodplain Forest (1.3 acres) EIA = 2.70 (C rank)	This floodplain forest community is located in a floodplain of Red Clay Creek adjacent to Creek Road.
	Oversee 2 Skunk Cabbage-Orange Jewelweed Seep (0.5 acres) EIA = 4.18 (B rank)	This seepage wetland is located at the head of a tributary to Red Clay Creek.

Forest Block Analysis

Importance of Forest Blocks

Forest blocks are important for a number of animals such as bobcat and neo-tropical migratory birds which nest in forest interiors (those places that are 100 meters from the edge of a forest). Many neotropical migratory birds are considered to be breeders in forest interior areas. Due to development, road building, which causes fragmentation, agricultural fields and other non-forest land uses, habitats for these birds are increasingly being eliminated leading to reductions in populations. Predators are better able to get the birds in small woodlands and edge habitats. In Ontario it was found that 80% of the neo-tropical bird nests in small woodlands (<100 ha) were lost to predators⁵. Nests in interior forests are less susceptible to predation and are not taken over by cowbirds, which is another hazard on edge habitats. Examples of birds that may be affected by a lack of large forest tracts include Barred Owl, Black and White Warbler, Worm-Eating Warbler, Acadian Flycatcher, Ovenbird, Kentucky Warbler, Red-Shouldered Hawk and many others.

⁵ Ontario Landowner Resource Centre. 2000. Conserving the Forest Interior: A threatened wildlife habitat. Ontario Ministry of Natural Resources.


In protecting forest blocks, those blocks which are circular contain the most interior area per unit area. The next best shape is a square and linear configurations produce the least forest interior due to shape.

A study by Robbins et al. (1989) showed that most forest interior species require a forest of at least 150 ha (370 acres) in size. Very few forest tracts in Delaware are at least this size, one of the more notable being the Great Cypress Swamp.

Analysis of Forest Blocks at the Oversee Property

One forest block is present that is more than 100 acres in size and are located in whole or part in the property (Table 2.4). All forest blocks are bounded by a road, agricultural field, or other non-forested habitat. These areas are considered to be barriers to the passage of forest dwelling wildlife. A description is provided for this forest block.

Table 2.4. Forest Blocks located in whole or part in Oversee Property

Forest Block Map	Block Name/Acreage	Description
	<p>Oversee A</p> <p>Current Block = 121 acres (1 acre interior)</p> <p>Potential Block = 273 acres (66 acres interior)</p>	<p>Oversee A covers most of the woods present on the Oversee Property. It is bounded by Snuff Mill Road and Center Mill Road on the north, agricultural fields on the east, a railroad on the south, and Snuff Mill Road on the west. Four vegetation communities are located within this block and include Northeastern Modified Successional Forest, Northern Piedmont Mesic Oak-Beech Forest, Successional Tuliptree Forest, and White Pine Planted Forest. Red Clay Creek drains this block. Currently this block contains 1 acre of interior habitat. Potentially this block could be 273 acres in size and contain 66 acres of interior habitat.</p>

CHAPTER 3: BROAD TRENDS AT THE OVERSEE PROPERTY

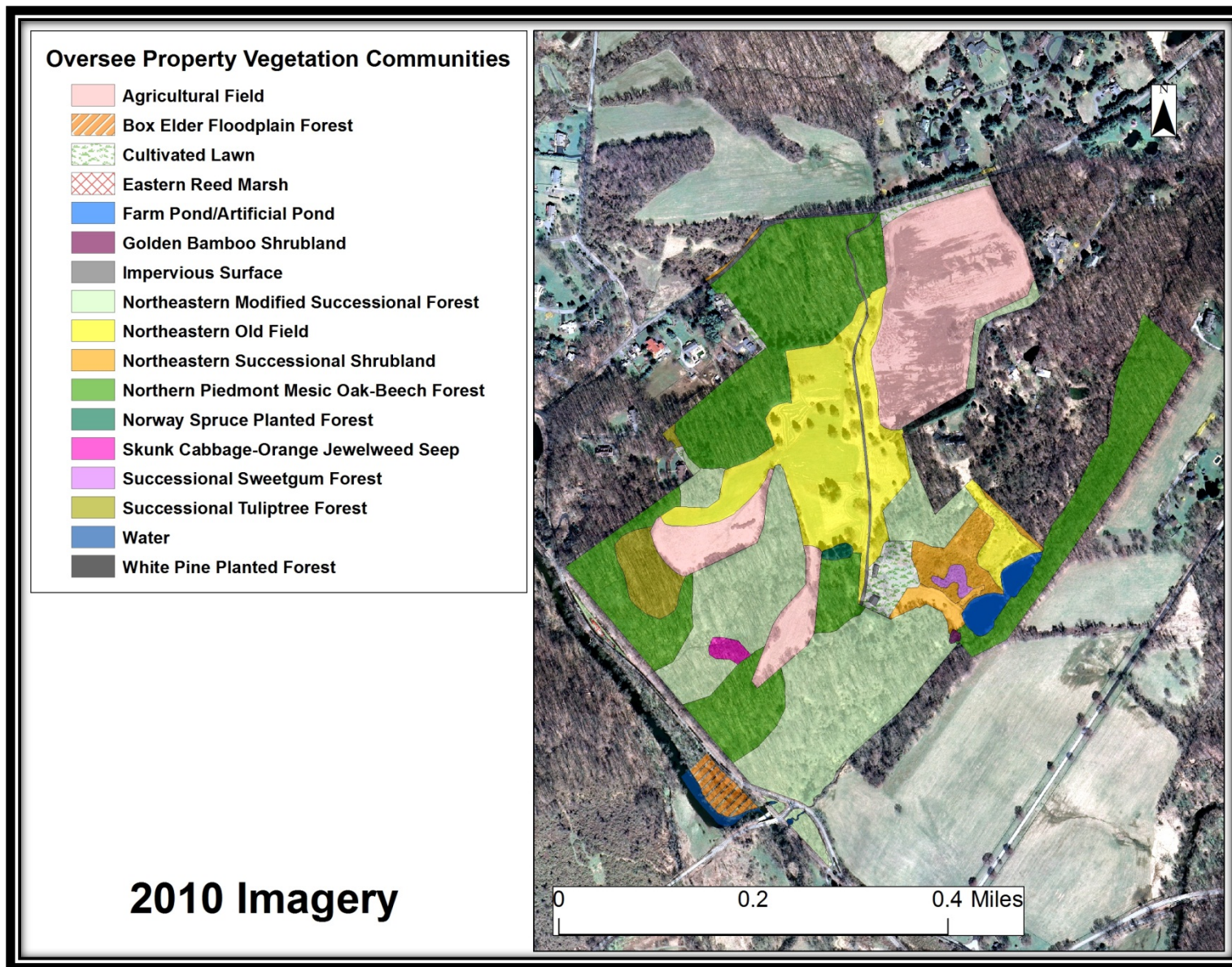


Figure 3.1. 2010 Vegetation Community Map of the Oversee Property

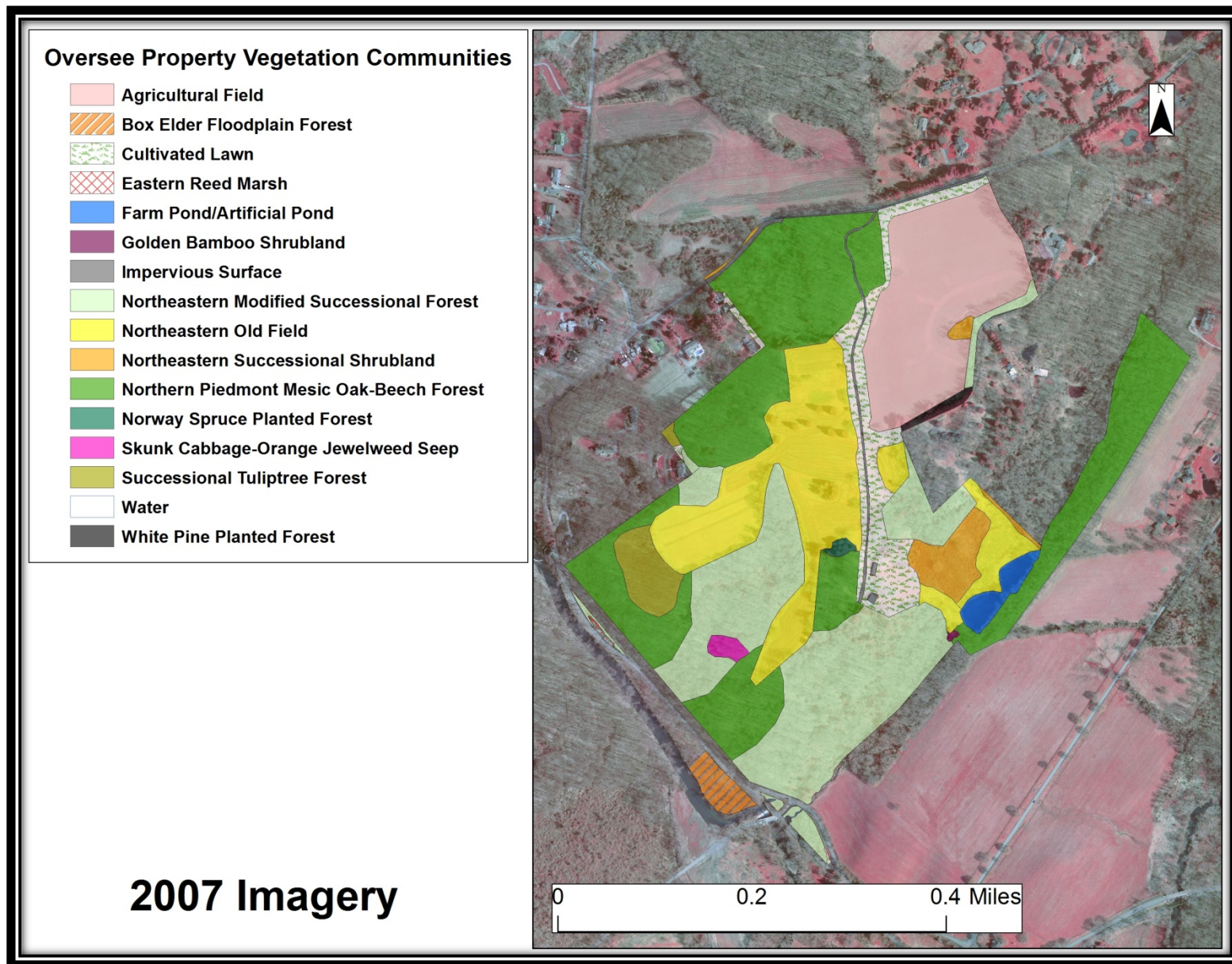


Figure 3.2. 2007 Vegetation Community Map of the Oversee Property

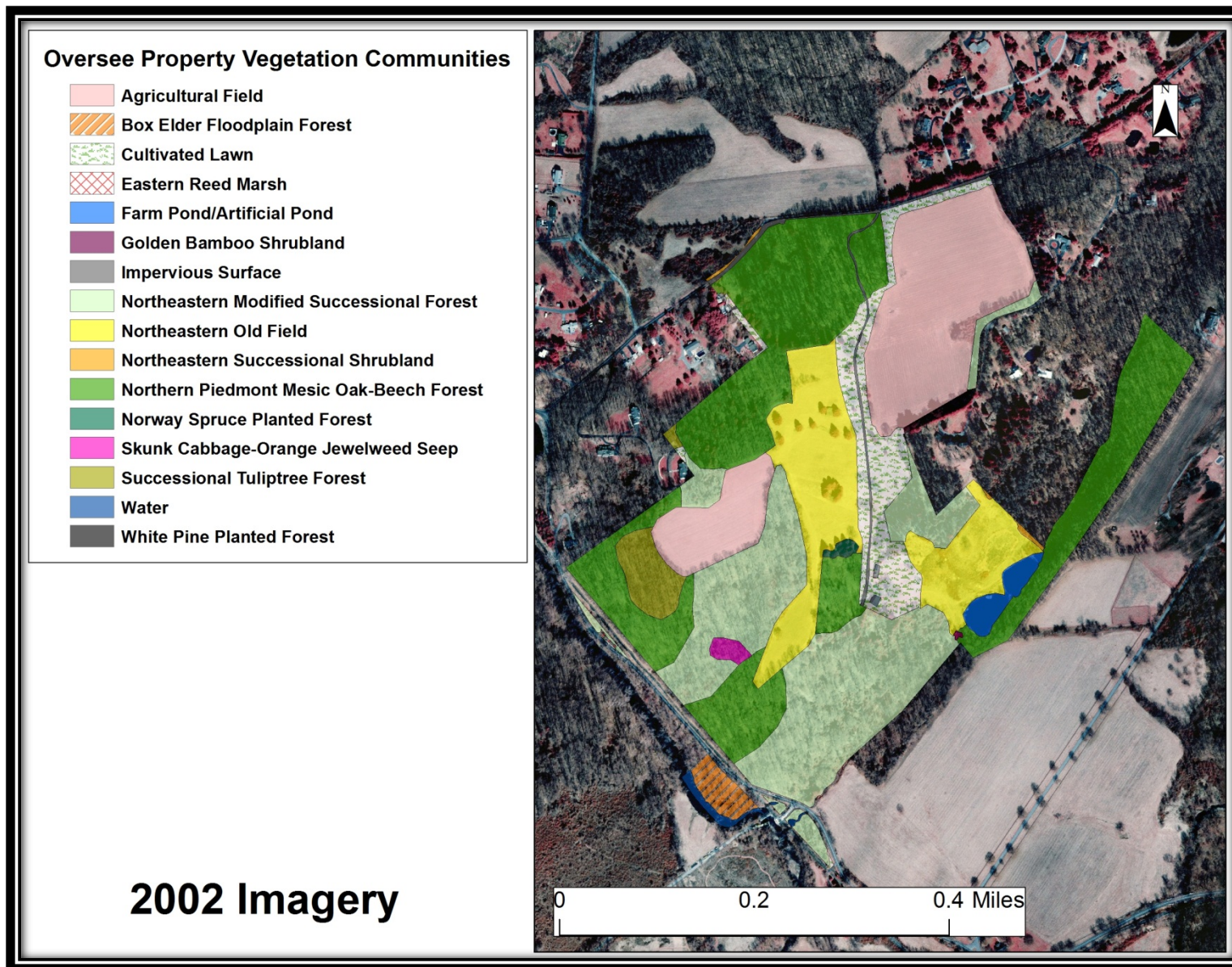


Figure 3.3. 2002 Vegetation Community Map of the Oversee Property

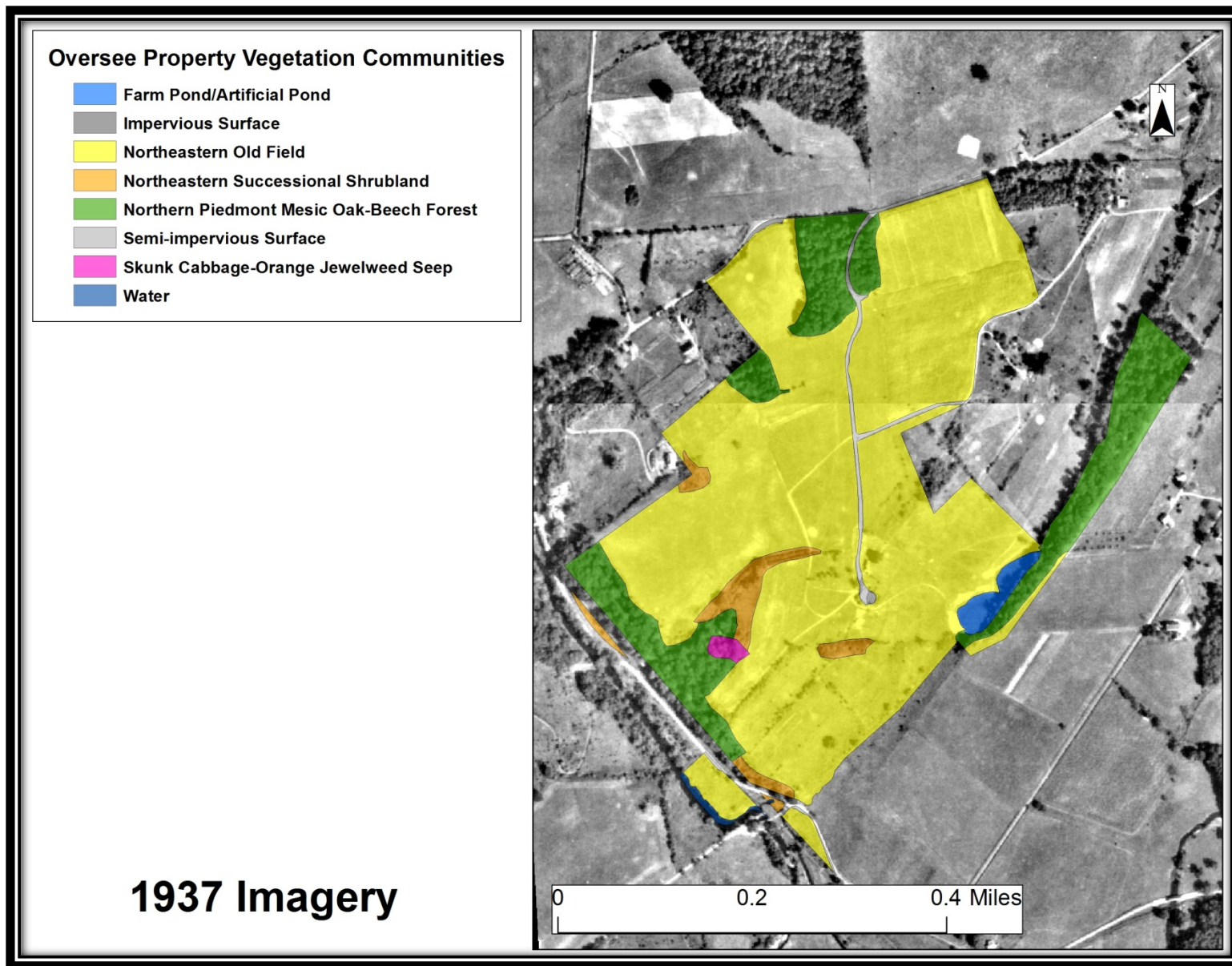


Figure 3.4. 1937 Vegetation Community Map of the Oversee Property

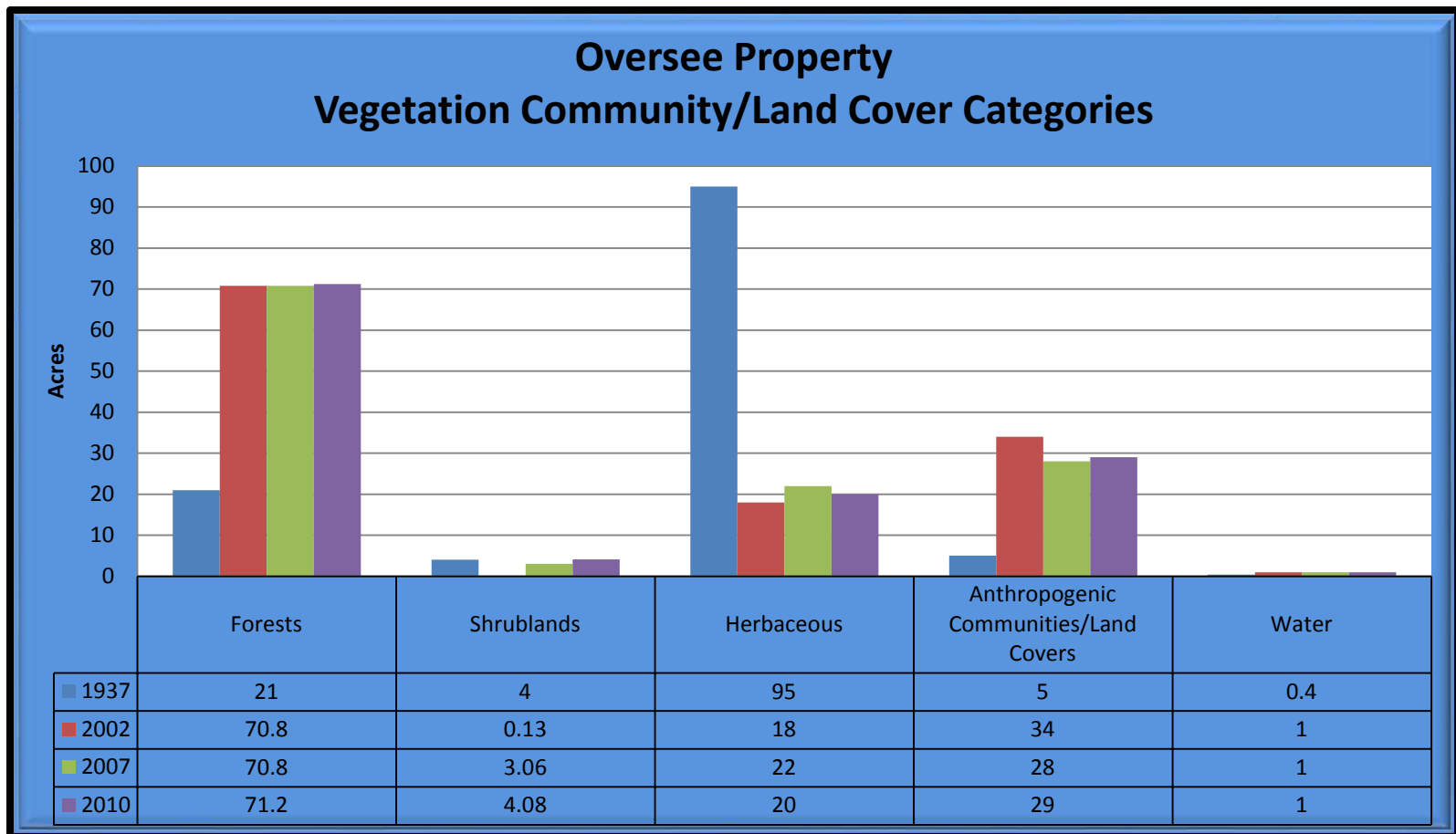


Figure 3.5. Oversee Property Vegetation Categories/Land Covers (1937, 2002, 2007, and 2010)

Oversee Property Broad Trends (Figure 3.5): Forest is the most common vegetation type in the Oversee Property. Anthropogenic communities/land covers are also notable in the property. Overall there has been an increase in every group except herbaceous communities.

Natural Capital (Table 3.1)

Natural capital of the Oversee Property has gradually increased through time with an increase in forest land.

Table 3.1. Natural Capital of the Oversee Property	
Year	Natural Capital (in 2012 dollars)
1937	\$40,335/year
2002	\$54,999/year
2007	\$56,093/year
2010	\$56,370/year

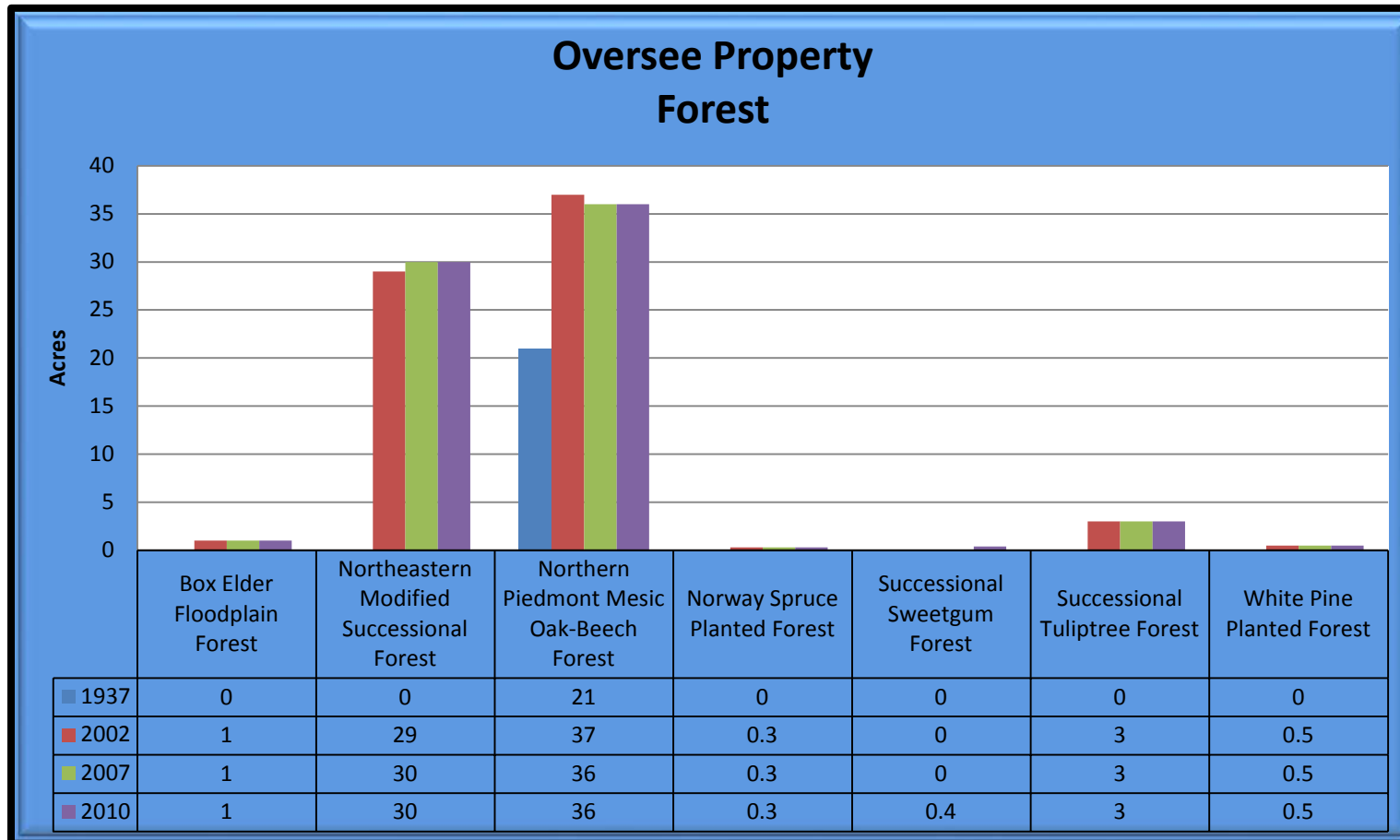


Figure 3.6. Forest at Oversee Property (1937, 2002, 2007, and 2010)

Oversee Property Forest (Figure 3.6): Northern Piedmont Mesic Oak-Beech Forest is the most common forest community in the Oversee Property, followed by Northeastern Modified Successional Forest. Overall forests have been increasing in the property.

Natural Capital (Table 3.2)

Capital of forest has gradually increased since 1937, with increases in Northern Piedmont Mesic Oak-Beech Forest and the appearance of Northeastern Modified Successional Forest and Successional Tuliptree Forest.

Table 3.2. Natural Capital of Overseer Property Forest	
Year	Natural Capital (in 2012 dollars)
1937	\$3,971/year
2002	\$25,491/year
2007	\$25,491/year
2010	\$25,566/year

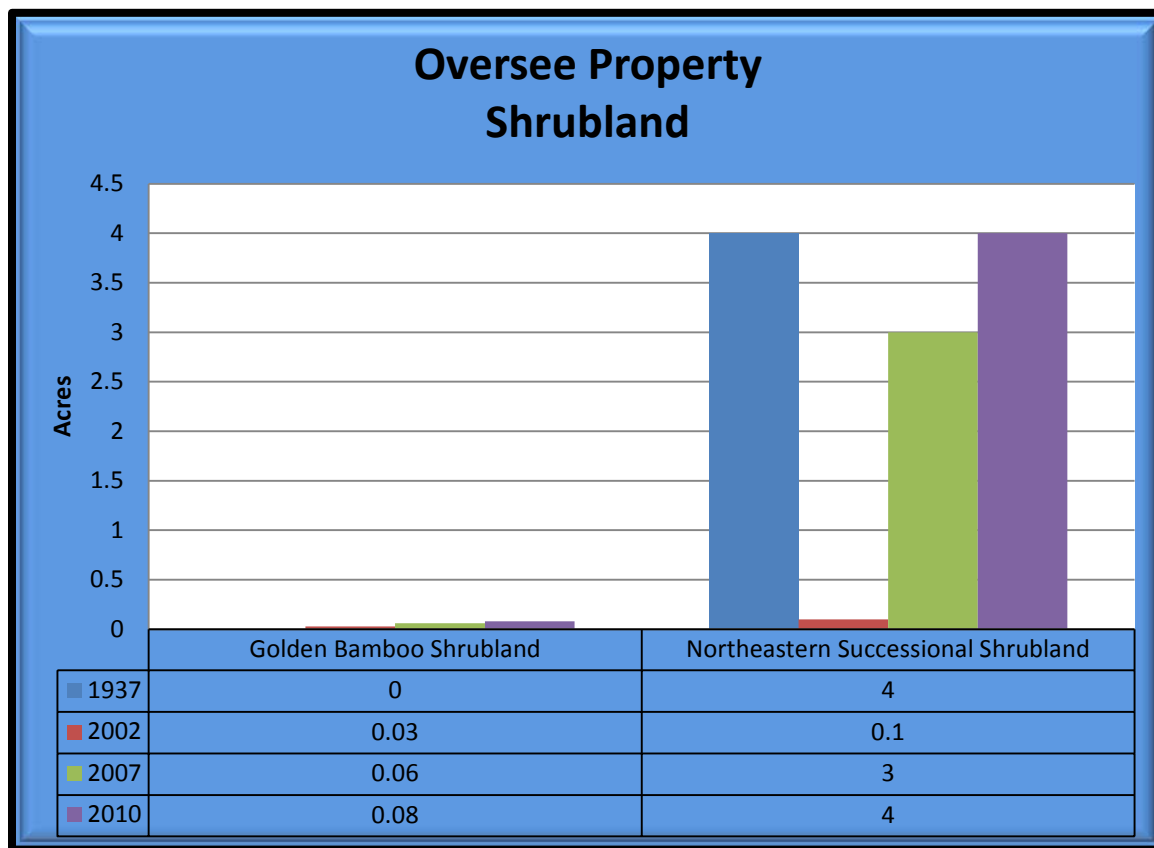


Figure 3.7. Shrubland at the Oversee Property (1937, 2002, 2007, and 2010)

Oversee Property Shrubland (Figure 3.7): Northeastern Successional Shrubland is the largest shrubland in the Oversee Property. Its acreage has oscillated as these shrublands mature into forest and then redevelop.

Natural Capital (Table 3.3)

Shrubland capital has increased slightly since 1937, but is variable because of these communities maturing into forests.

Table 3.3. Natural Capital of Oversee Property Shrubland	
Year	Natural Capital (in 2012 dollars)
1937	\$583/year
2002	\$19/year
2007	\$446/year
2010	\$594/year

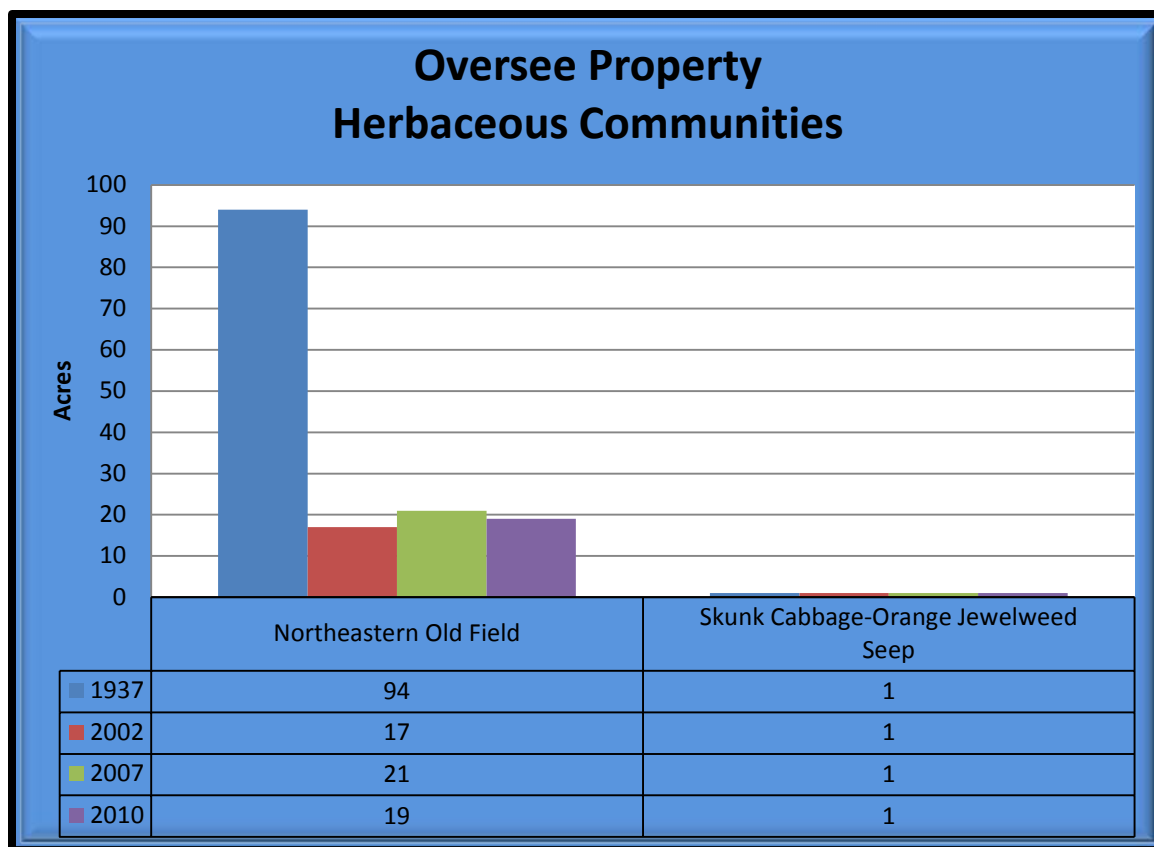


Figure 3.8. Herbaceous Communities at the Oversee Property (1937, 2002, 2007, and 2010)

Oversee Property Herbaceous Communities (Figure 3.8): Northeastern Old Field is the most common herbaceous community, out of two, on the Oversee Property. Skunk Cabbage-Orange Jewelweed is a rare community for the area.

Natural Capital (Table 3.4)

Herbaceous community capital has decreased with the maturation of Northeastern Old Field into shrubland and forest.

Table 3.4. Natural Capital of Oversee Property Herbaceous Communities	
Year	Natural Capital (in 2012 dollars)
1937	\$22,997/year
2002	\$11,758/year
2007	\$12,341/year
2010	\$12,050/year

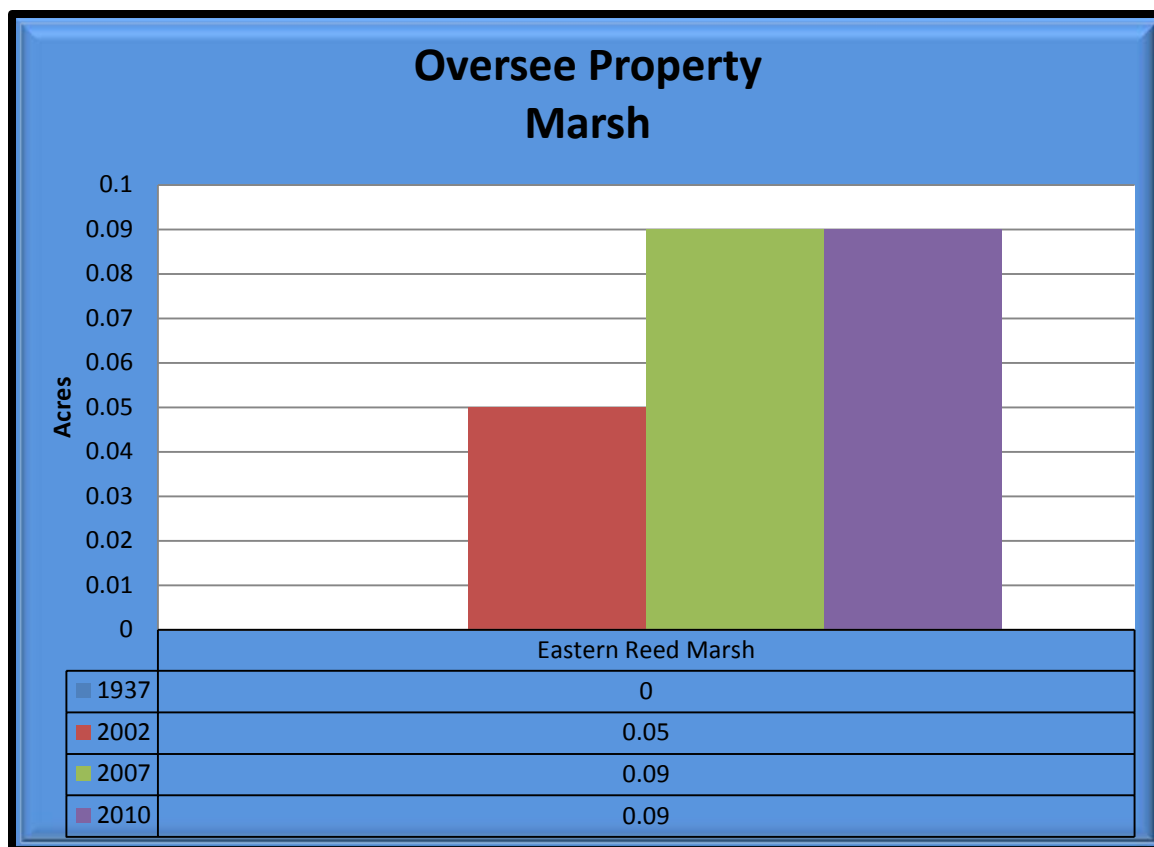


Figure 3.9. Marsh at the Oversee Property (1937, 2002, 2007, and 2010)

Oversee Property Marsh (Figure 3.9): Eastern Reed Marsh is the only marsh community and is confined to a wet area adjacent to Creek Road. This wet area appears to be increasing with time and hence the Eastern Reed Marsh has been increasing as well.

Natural Capital (Table 3.5)

Marsh capital has been increased as common reed populates a wetland between Creek Road and the railroad.

Table 3.5. Natural Capital of Oversee Property Marsh	
Year	Natural Capital (in 2012 dollars)
1937	\$0/year
2002	\$464/year
2007	\$835/year
2010	\$835/year

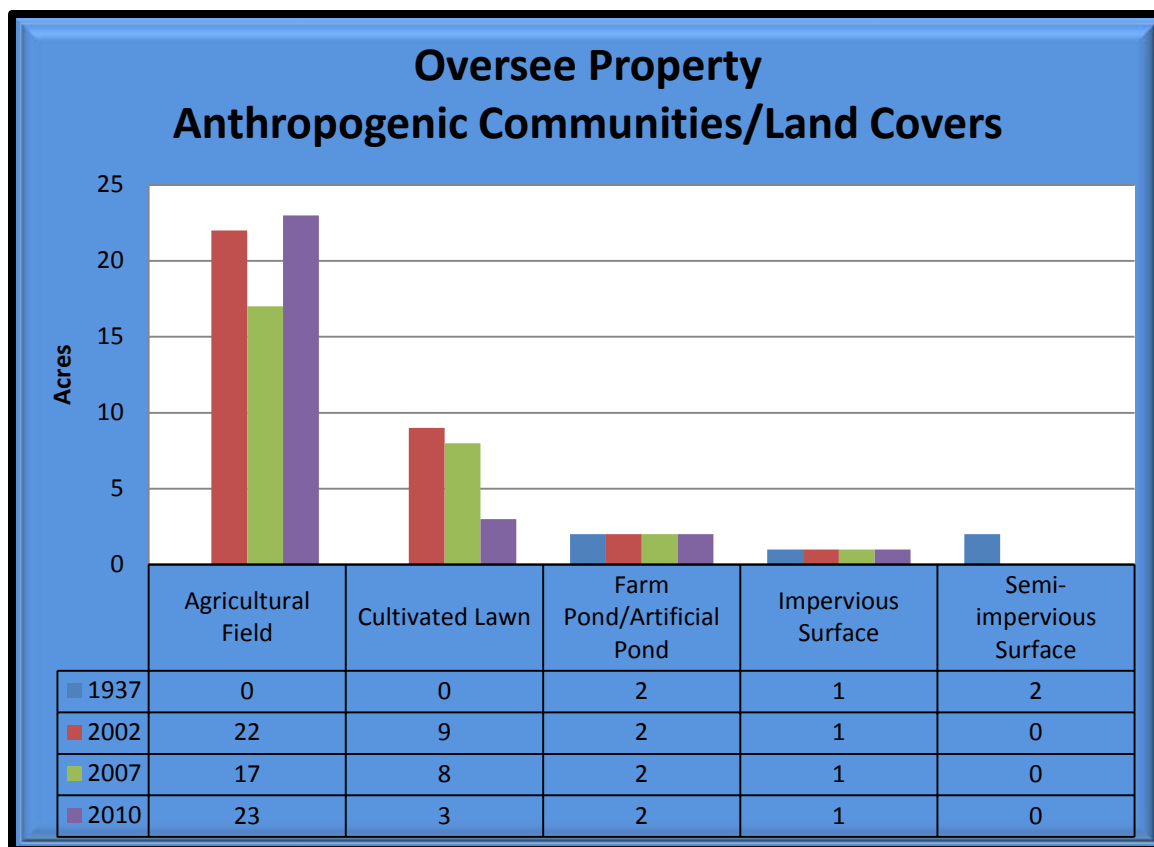


Figure 3.10. Anthropogenic Communities/Land Covers at the Oversee Property (1937, 2002, 2007, and 2010)

Oversee Property Anthropogenic Communities/Land Covers (Figure 3.10): Agricultural field is the most common anthropogenic community/land cover in the Oversee Property. Cultivated lawn is a distant second.

Natural Capital (Table 3.5)

Agricultural field and farm ponds are the only anthropogenic communities/land covers with any natural capital value in the Oversee Property. Their capital has increased overall since 1937.

Table 3.5. Natural Capital of Oversee Property Anthropogenic Communities/Land Covers	
Year	Natural Capital (in 2012 dollars)
1937	\$10,670/year
2002	\$11,932/year
2007	\$11,645/year
2010	\$11,989/year

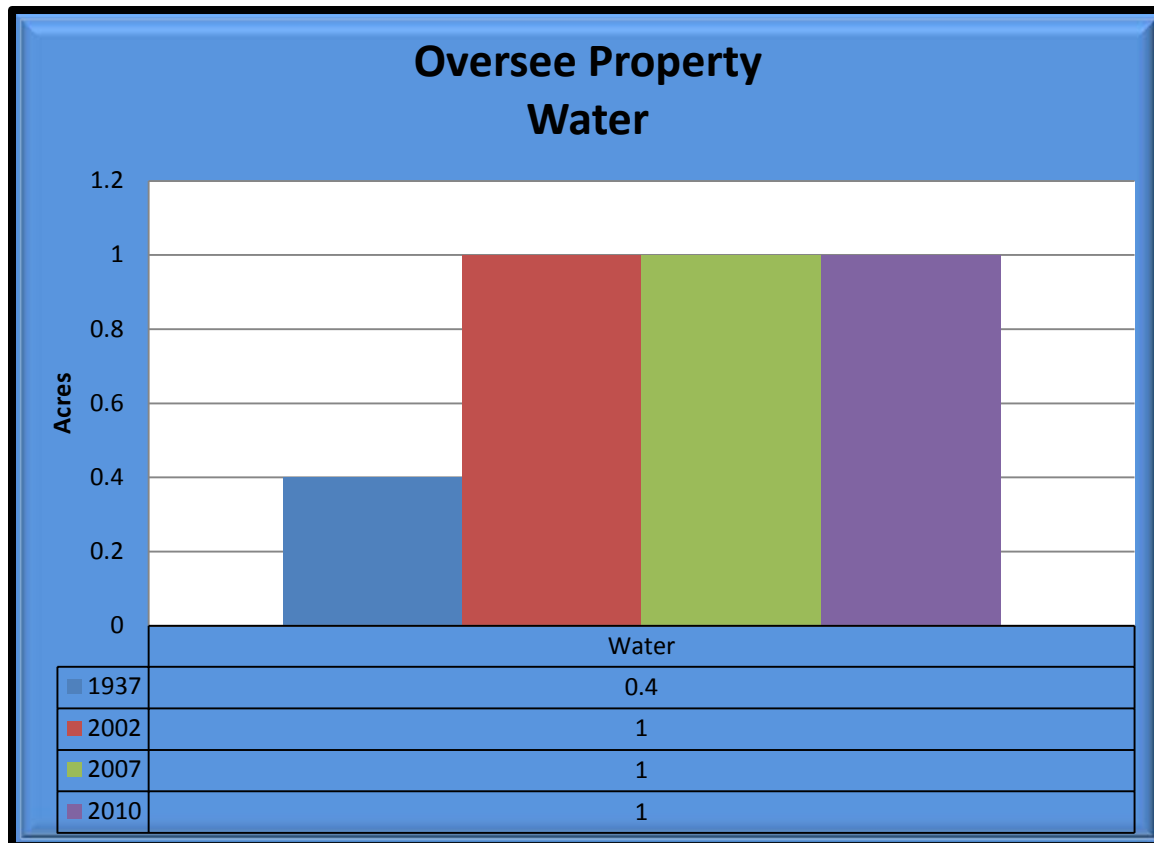


Figure 3.11. Water coverage at the Oversee Property (1937, 2002, 2007, and 2010)

Oversee Property Water Coverage (Figure 3.11): Water has increased since 1937 but has been stable in the 2002-2007 period. The increases appear to be due to erosion in Red Clay Creek Creek.

Natural Capital (Table 3.6)

Capital of water has increased since 1937 and has been stable in the 2002-2010 period.

Table 3.6. Natural Capital of Oversee Property Water	
Year	Natural Capital (in 2012 dollars)
1937	\$2,134/year
2002	\$5,335/year
2007	\$5,335/year
2010	\$5,335/year

CHAPTER 4: DESCRIPTIONS AND ANALYSIS OF THE VEGETATION COMMUNITIES

Thirteen vegetation communities and four land covers were noted in the survey (Figures 3.1-3.4). Below is a list of the vegetation communities present in 2010 and historical in previous years and descriptions. The National Vegetation Classification (NVC) Association number is given with the vegetation community and their approximate acreage in the project area. Names of communities correspond with the common names as given in the NVC and the Guide to Delaware Vegetation Communities.

The vegetation communities include:

1. Box -elder Floodplain Forest (CEGL005033)—1 acre
2. Cultivated Lawn (CEGL006486)—3 acres
3. Eastern Reed Marsh (CEGL004141)—0.09 acres
4. Golden Bamboo Shrubland (CEGL008560)—0.1 acres
5. Northeastern Modified Successional Forest (CEGL006599)—30 acres
6. Northeastern Old Field (CEGL006107)—19 acres
7. Northeastern Successional Shrubland (CEGL006451)—4 acres
8. Northern Piedmont Mesic Oak-Beech Forest (CEGL006921)—36 acres
9. Norway Spruce Planted Forest (CEGL007167)—0.3 acres
10. Skunk Cabbage-Orange Jewelweed Seep (CEGL006567)—1 acre
11. Successional Sweetgum Forest (CEGL007216)—0.4 acres
12. Successional Tuliptree Forest (CEGL007220)—3 acres
13. White Pine Plantation (CEGL007178)—0.5 acres

The land covers include:

1. Agricultural Field—23 acres
2. Farm Pond/Artificial Pond—2 acres
3. Impervious Surface—1 acre
4. Water—1 acre

**DEWAP: Forested Floodplains and Riparian Swamps
NHC: Central Appalachian River Floodplain**

Description

This community is located on the floodplain of Red Clay Creek on the Oversee Property and is common on larger floodplains of the creek. At the Oversee Property this community is dominated by box-elder (*Acer negundo*) and associated by sycamore (*Platanus occidentalis*), black willow (*Salix nigra*) and green ash (*Fraxinus pennsylvanica*) in the canopy. The understory is composed of spicebush (*Lindera benzoin*), American hornbeam (*Carpinus caroliniana*), American elm (*Ulmus americana*), black walnut (*Juglans nigra*) and white walnut (*Juglans cinerea*). Multiflora rose (*Rosa multiflora*) and elderberry (*Sambucus canadensis*) are the common shrubs and poison ivy (*Toxicodendron radicans*) and Oriental bittersweet (*Celastrus orbiculatus*) are common in the vine layer. Common herbs include yellow daylily (*Hemerocallis*



fulva), Japanese stiltgrass (*Microstegium vimineum*), orange-spotted jewelweed (*Impatiens capensis*), American gromwell (*Lithospermum latifolium*), stinging nettle (*Urtica dioica*), spring beauty (*Claytonia virginica*), yellow trout-lily (*Erythronium americanum*) and garlic mustard (*Alliaria petiolata*).

This community is in the late successional to early mature stage and contains a thick understory and a dense herb layer of stinging nettle.

Figure 4.1. Box-elder Floodplain Forest

Analysis of Condition at the Oversee Property

Box-elder Floodplain Forest was not present in 1937 and has since grown into 1 acre of Northeastern Old Field, 0.04 acres of Semi-impervious Surface, and 0.01 acres of water (Table 5.1).

Table 4.1. Box-elder Floodplain Forest has grown into X or remained since 1937	
X	Acreage
Northeastern Old Field	1 acre
Semi-impervious Surface	0.04 acres
Water	0.01 acres

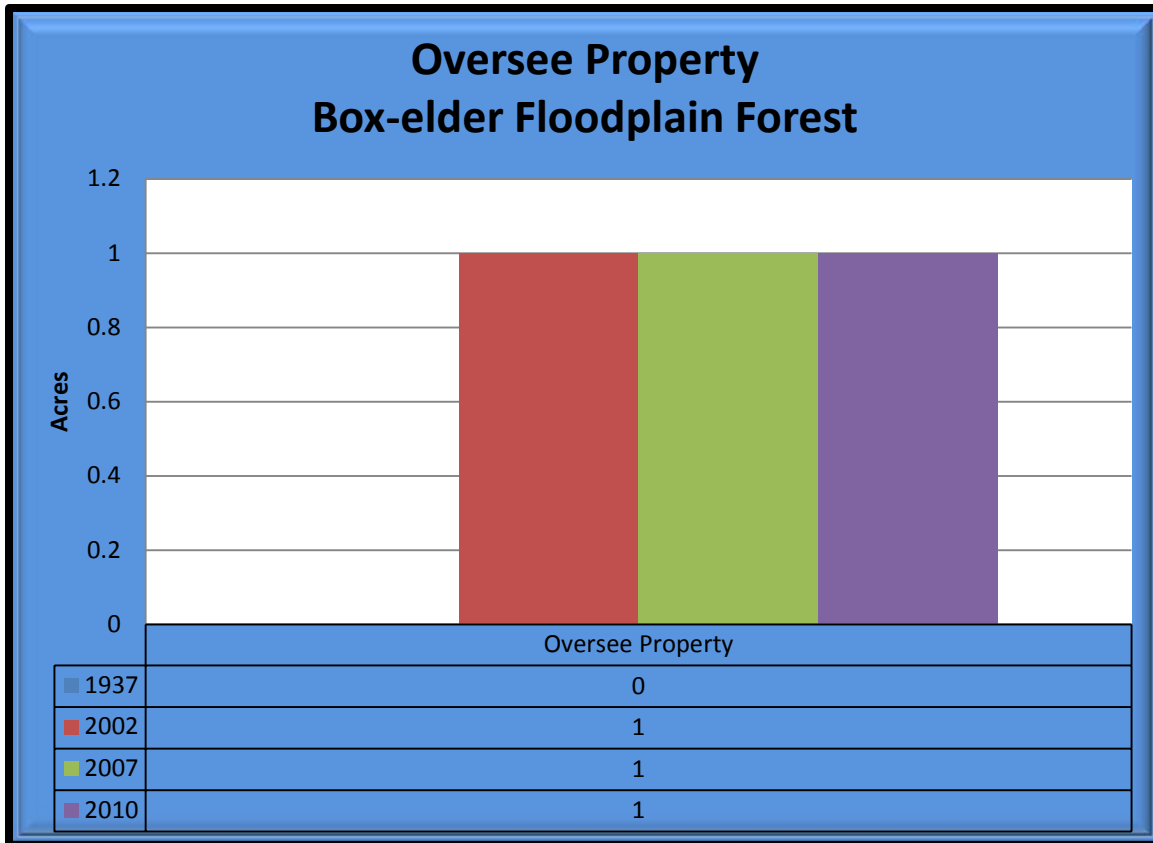


Figure 4.2. Box-elder Floodplain Forest at the Oversee Property (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.2)

Box-elder Floodplain Forest has grown to \$12,292 of capital on the Oversee Property. It has remained at this amount since 2002 and will likely be stable in the future.

Table 4.2. Natural Capital of Box-elder Floodplain Forest	
Year	Natural Capital (in 2012 dollars)
1937	\$0/year (not present)
2002	\$12,292/year
2007	\$12,292/year
2010	\$12,292/year

Cultivated Lawn [3 acres (Figure 4.3, Table 4.3)]

GNA SNA

DEWAP: No Equivalent Classification
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

This community is located around a residence and along roadsides on the property. It is composed mostly of tall fescue (*Festuca arundinacea*) and other ornamental plants.

Analysis of Condition at the Oversee Property

Cultivated lawn was not present in 1937 and has since been developed on 3 acres of Northeastern Old Field, 0.2 acres of Impervious Surface, 0.1 acres of Semi-impervious Surface, and 0.02 acres of Northeastern Successional Shrubland (Table 4.3).

Table 4.3. Cultivated Lawn has been developed into X or remained since 1937	
X	Acreage
Northeastern Old Field	3 acres
Impervious Surface	0.2 acres
Semi-impervious Surface	0.1 acres
Northeastern Successional Shrubland	0.02 acres

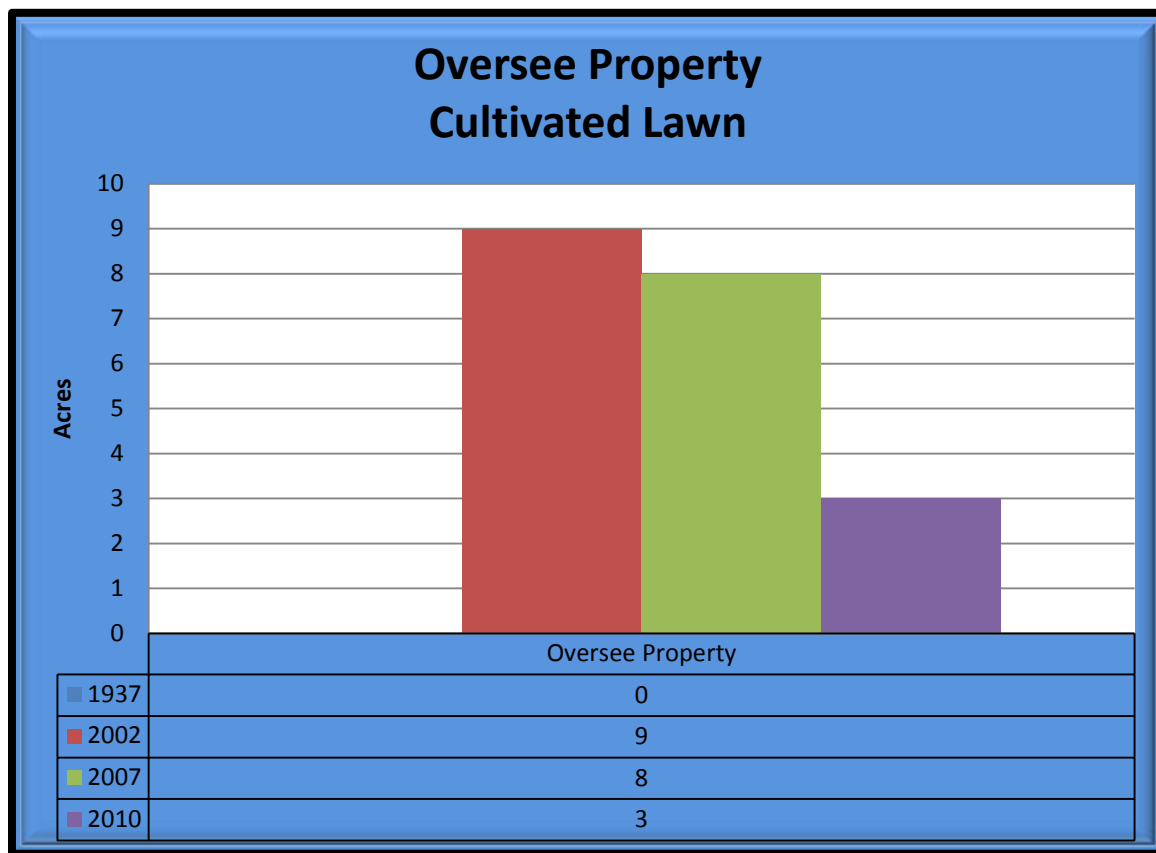


Figure 4.3. Cultivated Lawn at the Oversee Property (1937, 2002, 2007, and 2010)

Natural Capital

Cultivated lawn does not have any natural capital value.

Eastern Reed Marsh [0.09 acres (Figure 4.4, Tables 4.4)]

GNA SNA

DEWAP: Streamside Herbaceous Wetlands
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

This wetland community is totally covered by common reed (*Phragmites australis*).

Analysis of Condition at the Oversee Property

All of the area now covered by Eastern Reed Marsh was Northeastern Successional Shrubland in 1937.

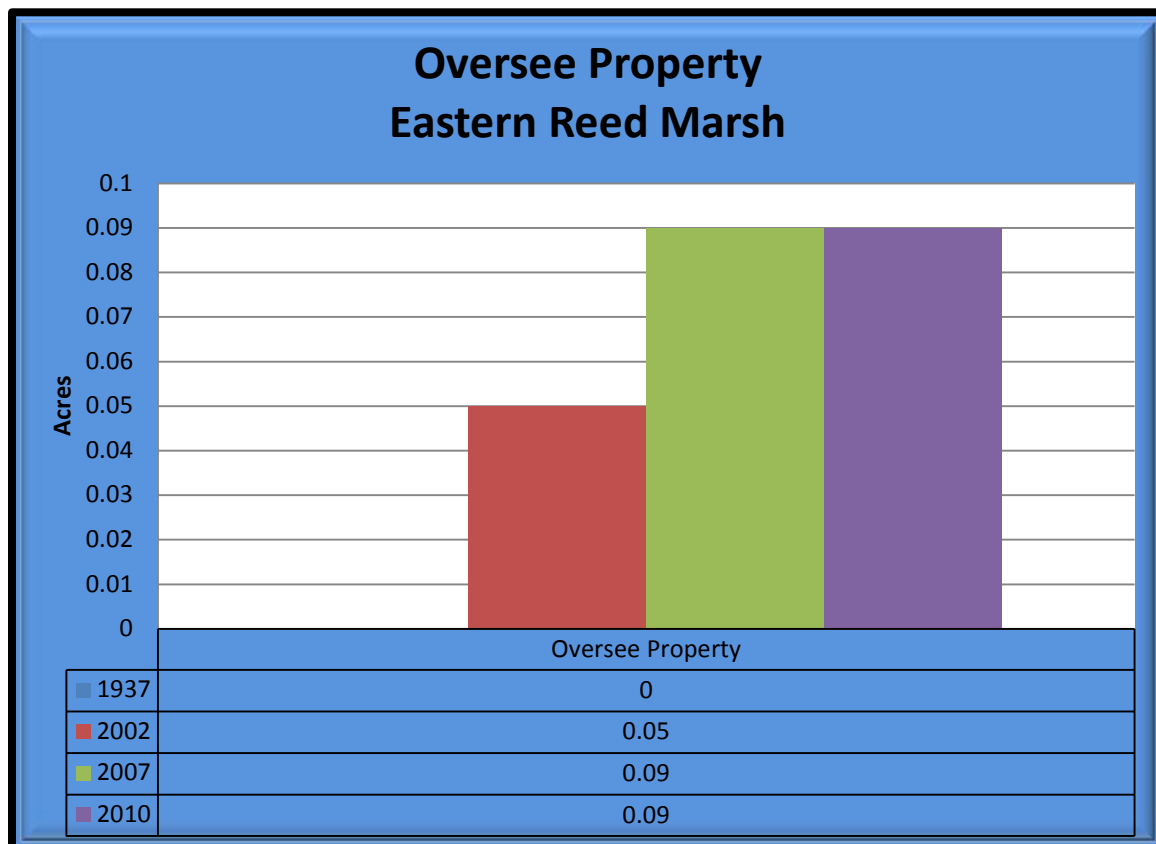


Figure 4.4. Eastern Reed Marsh at the Oversee Property (1937, 2002, 2007, 2010)

Natural Capital (Table 4.4)

Natural capital of Eastern Reed Marsh has increased since 2002 and was not present in 1937. The capital may continue to increase with the acreage.

Table 4.4. Natural Capital of Eastern Reed Marsh	
Year	Natural Capital (in 2012 dollars)
1937	\$0/year (not present)
2002	\$464/year
2007	\$835/year
2010	\$835/year

DEWAP: No Equivalent Classification
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

This shrubland is composed of golden bamboo (*Phyllostachys* sp.) in a dense shrubland. It is located just below a pond on the property.



Figure 4.5. Golden Bamboo Shrubland

Analysis of Condition at the Oversee Property

All of the current acreage of Golden Bamboo Shrubland came from Northeastern Old Field in 1937.

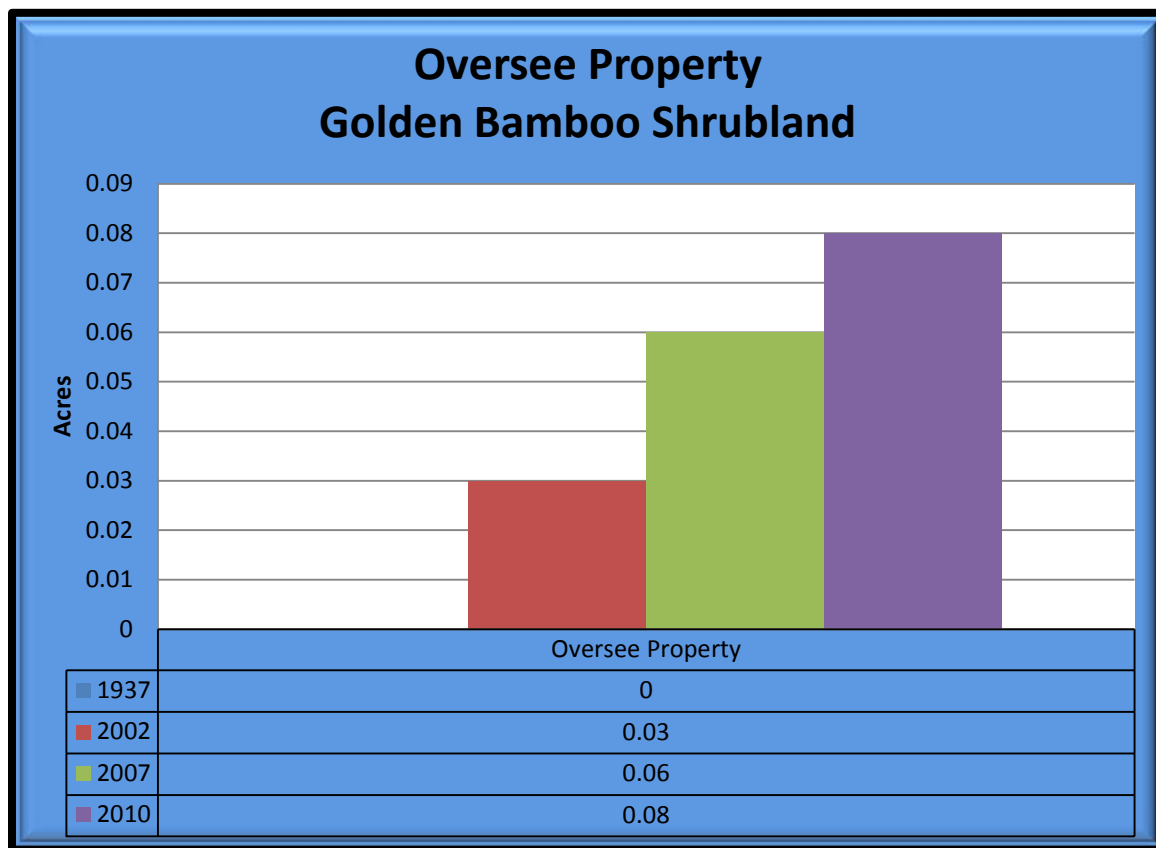


Figure 4.6. Golden Bamboo Shrubland at the Oversee Property (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.5)

Golden Bamboo Shrubland has gradually increased capital as it spreads.

Table 4.5. Natural Capital of Golden Bamboo Shrubland	
Year	Natural Capital (in 2012 dollars)
1937	\$0/year (not present)
2002	\$4/year
2007	\$9/year
2010	\$12/year

**Northeastern Modified Successional Forest [38 acres (Figures 4.7-4.8, Tables 4.6-4.7)] GNA
SNA**

**DEWAP: Piedmont Upland Forests
NHC: Semi-natural/Altered Vegetation and Conifer Plantations**

Description

This community is one of the more common ones throughout the Red Clay Creek and White Clay Creek watersheds and is the result of the myriad of human disturbances and plant introductions through history. It most often presents as a degraded example of a Tuliptree Forest that has been invaded by exotic invasive species and has reached a static situation. In other cases it is a forest that has regenerated from an abandoned field and has been invaded by exotic plant species.

The canopy of this community is dominated by a combination of tuliptree (*Liriodendron tulipifera*), red maple (*Acer rubrum*), black walnut (*Juglans nigra*) and black locust (*Robinia pseudoacacia*). The understories have smaller members of the canopy plus sassafras (*Sassafras albidum*), wild black cherry (*Prunus serotina*) and spicebush (*Lindera benzoin*). The shrub and vine layers are often quite dense and include multiflora rose (*Rosa multiflora*), Oriental bittersweet (*Celastrus orbiculatus*), Chinese privet (*Ligustrum sinense*) and Japanese honeysuckle (*Lonicera japonica*). Common herbs include garlic mustard (*Alliaria petiolata*) and Japanese stiltgrass (*Microstegium vimineum*) to almost the exclusion of all else.



Figure 4.7. Northeastern Modified Successional Forest (in background)

Analysis of Condition at the Oversee Property

Northeastern Modified Successional Forest was not present in 1937 and has since grown into 24 acres of Northeastern Old Field, invaded 11 acres of Northern Piedmont Mesic Oak-Beech Forest, grown from 4 acres of Northeastern Successional Shrubland, and 0.04 acres of Semi-impervious Surface (Table 4.6).

Table 4.6. Northeastern Modified Successional Forest has grown into X or remained since 1937	
X	Acreage
Northeastern Old Field	23 acres
Northeastern Successional Shrubland	4 acres
Northern Piedmont Mesic Oak Beech Forest	3 acres
Semi-impervious Surface	0.04 acres

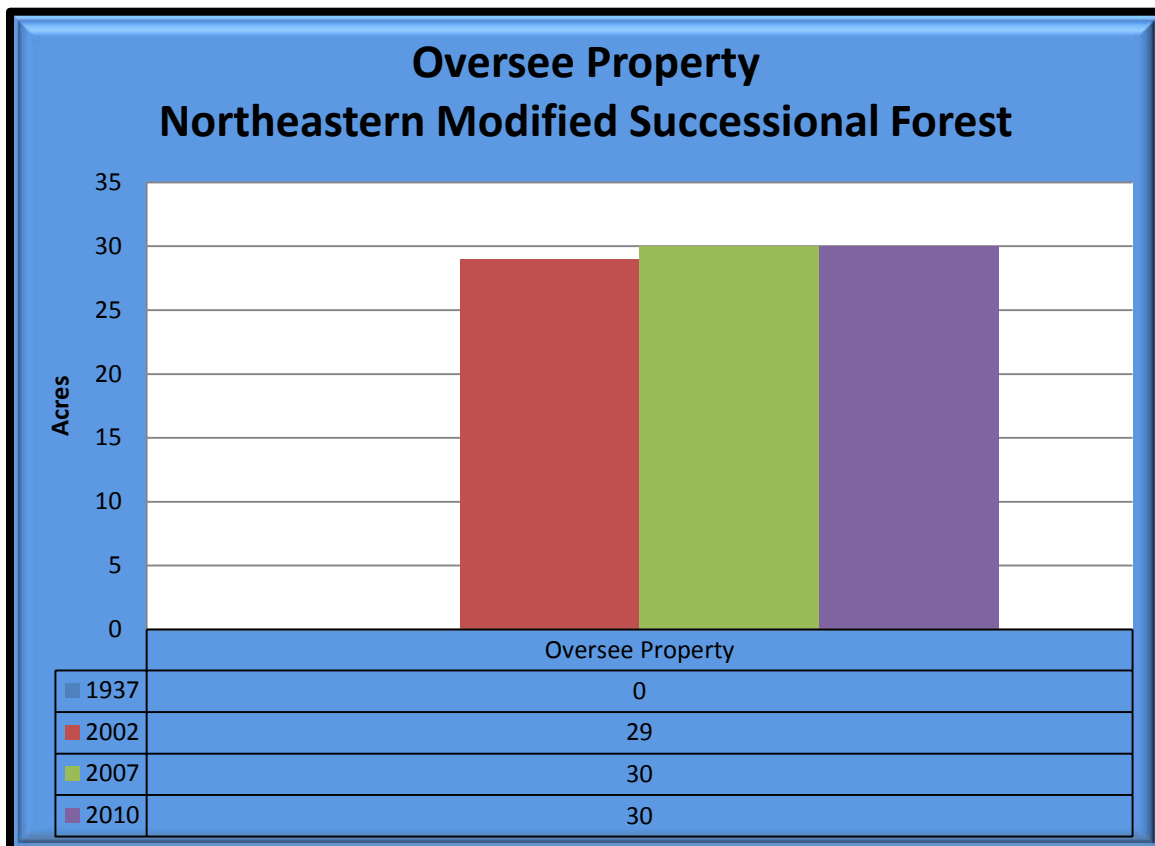


Figure 4.8. Northeastern Modified Successional Forest at the Oversee Property (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.7)

Northeastern Modified Successional Forest was not present in 1937 and has since gained or transferred \$5,673 in capital.

Table 4.7. Natural Capital of Northeastern Modified Successional Forest	
Year	Natural Capital (in 2012 dollars)
1937	\$0/year (not present)
2002	\$5,483/year
2007	\$5,673/year
2010	\$5,673/year

**DEWAP: Early Successional Upland Habitats
NHC: Semi-natural/Altered Vegetation and Conifer Plantations**

Description



Figure 4.9. Northeastern Old Field

This community is present in the higher elevation areas of the site. Most of the fields in the Red Clay Creek valley are maintained perpetually in this state by annual mowing and haying. Kentucky fescue (*Festuca arundinacea*) is the typical dominant species of this community. Other associates may be white clover (*Trifolium pratense*), queen anne's lace (*Daucus carota*), sweet vernal grass (*Anthoxanthum odoratum*), orchard grass (*Dactylis glomerata*), common velvet grass (*Holcus lanatus*) and redtop panicgrass (*Panicum rigidulum* var. *rigidulum*).

Analysis of Condition at the Oversee Property

Only 15 acres of the 94 acres present in 1937 were still present in 2010. The rest of the fields became 26 acres of agricultural field, 24 acres of Northeastern Modified Successional Forest, 17 acres of Northern Piedmont Mesic Oak-Beech Forest, and 3 acres of Northeastern Successional Shrubland (Table 4.8). Since 1937, Northeastern Old Field has developed on 1 acre of Semi-impervious Surface (Table 4.9) resulting in a loss for the community.

Table 4.8. What was Northeastern Old Field in 1937 has become X or remained in 2010	
X	Acreage
Northeastern Modified Successional Forest	23 acres
Agricultural Field	22 acres
Northeastern Old Field	18 acres
Northern Piedmont Mesic Oak-Beech Forest	18 acres
Northeastern Successional Shrubland	4 acres
Other communities/land covers	9 acres

Table 4.9. Northeastern Old Field has migrated into X or remained since 1937	
X	Acreage
Northeastern Old Field	18 acres
Semi-impervious Surface	1 acre

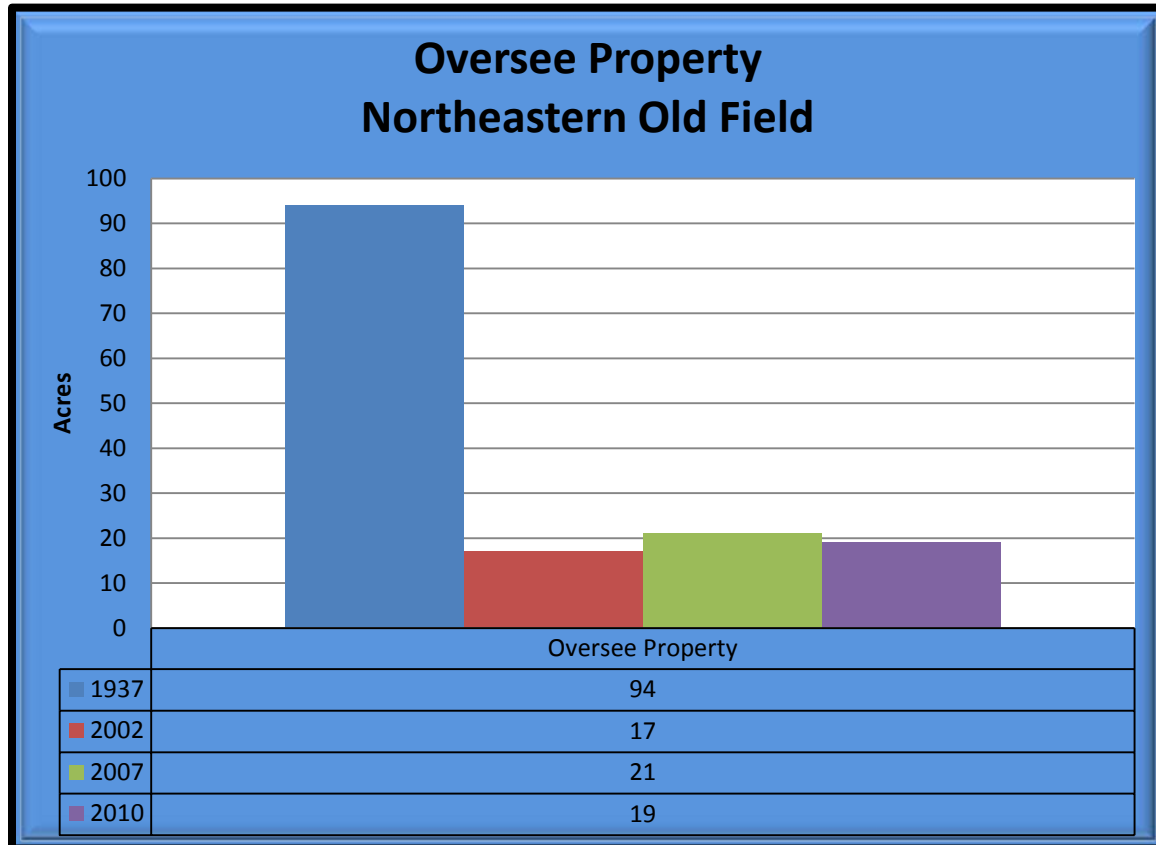


Figure 4.10. Northeastern Old Field at the Oversee Property (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.10)

Northeastern Old Field has lost capital since 1937 as the fields have grown into forest or have been converted to agricultural fields or cultivated lawn.

Table 4.10. Natural Capital of Northeastern Old Field	
Year	Natural Capital (in 2012 dollars)
1937	\$13,696/year
2002	\$2,477/year
2007	\$3,060/year
2010	\$2,768/year

Northeastern Successional Shrubland [3 acres (Figure 4.11, Tables 4.11-4.13)] GNA SNA

**DEWAP: Early Successional Upland Habitats
NHC: Semi-natural/Altered Vegetation and Conifer Plantations**

Description

This community is essentially the same as the Northeastern Modified Successional Forest excepting the canopy. It contains a similar assortment of species in both the shrub and herb layers. One area just north of the ponds on the property is dominated by smooth alder (*Alnus serrulata*), which suggests a Smooth Alder Swamp (a rare community). However, because of the artificial nature of the setting and the lack of a typical understory for this community it is placed in Northeastern Successional Shrubland for now.

Analysis of Condition at the Oversee Property

None of the Northeastern Successional Shrubland from 1937 was still present in 2010. All of the shrubland had become 4 acres of Northeastern Modified Successional Forest, 0.09 acres of Eastern Reed Marsh, 0.09 acres of agricultural field, 0.02 acres of cultivated lawn, and 0.01 acres of impervious surface (Table 4.10). Since 1937, 3 acres of Northeastern Old Field and 0.1 acres of Impervious Surface have become Northeastern Successional Shrubland (Table 4.11).

Table 4.11. What was Northeastern Successional Shrubland in 1937 has become X or remained in 2010	
X	Acreage
Northeastern Modified Successional Forest	4 acres
Eastern Reed Marsh	0.1 acres
Agricultural Field	0.1 acres
Cultivated Lawn	0.02 acres
Impervious Surface	0.01 acres

Table 4.12. Northeastern Successional Shrubland has migrated into X or remained since 1937	
X	Acreage
Northeastern Old Field	3 acres
Impervious Surface	0.1 acres

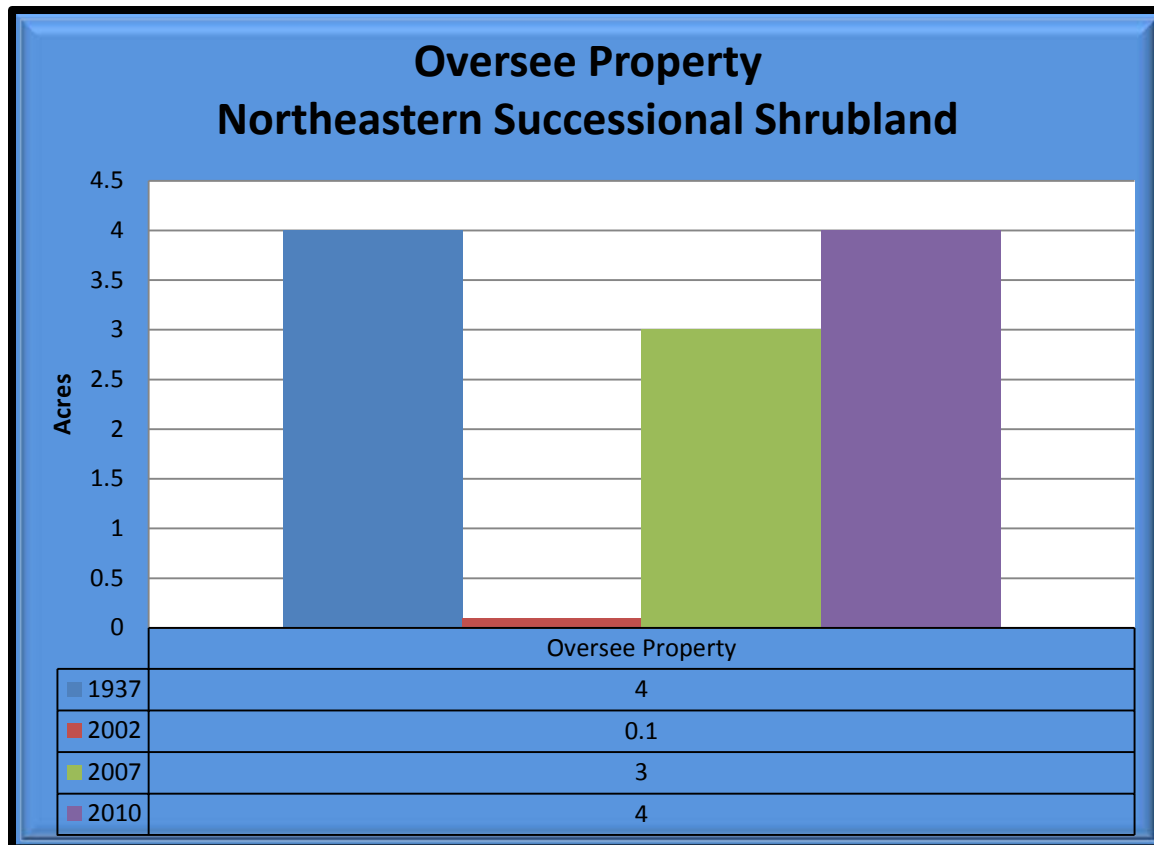


Figure 4.11. Northeastern Successional Shrubland at the Oversee Property (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.13)

Capital of Northeastern Successional Shrubland has been roughly the same since 1937, with some dips in value as it matures to forest and then regenerates. It reached its lowest capital in 2002.

Table 4.13. Natural Capital of Northeastern Successional Shrubland	
Year	Natural Capital (in 2012 dollars)
1937	\$583/year
2002	\$15/year
2007	\$437/year
2010	\$583/year

Northern Piedmont Mesic Oak-Beech Forest [28 acres (Figures 4.12-4.13, Tables 4.14-4.16)]

G5 S5

DEWAP: Piedmont Upland Forests
NHC: Central Appalachian Dry Oak-Pine Forest

Description

Northern Piedmont Mesic Oak-Beech Forest is the most common natural type forest community in the Red Clay Creek watershed. American beech (*Fagus grandifolia*), tuliptree (*Liriodendron tulipifera*) compose the canopy in about equal amounts and are associated by white oak (*Quercus alba*), black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), and red maple (*Acer rubrum*). Understory species include pignut hickory (*Carya glabra*), witch-hazel (*Hamamelis virginiana*), flowering dogwood (*Cornus florida*), sassafras (*Sassafras albidum*), and American hornbeam (*Carpinus caroliniana*). Common shrubs include strawberry bush (*Euonymus americana*), maple-leaf viburnum (*Viburnum acerifolium*), pinxter flower (*Rhododendron periclymenoides*) and mountain laurel (*Kalmia latifolia*) on steeper slopes. New



York fern (*Thelypteris noveboracensis*), sessile bellwort (*Uvularia sessilifolia*), bearded short husk (*Brachylyletrum erectum*), lady fern (*Athyrium felix-femina*), white wood aster (*Eurybia divaricata*) and broad-beech fern (*Phegopteris hexagonoptera*) are common herbs.

All of the examples on the Overseer Property are mature with diameters of canopy trees ranging from 1 to 1.5 feet and good layering.

Figure 4.12. Northern Piedmont Mesic Oak-Beech Forest

Analysis of Condition at the Overseer Property

About 18 acres of the 21 acres present in 1937 were still present in 2010. The rest of the acreage had become 3 acres of Northeastern Modified Successional Forest from invasion of exotic invasive plants, 0.1 acres of Farm Pond/Artificial Pond, and 0.01 acres of impervious surface (Table 4.14). Since 1937, this community has grown from 18 acres of Northeastern Old Field, and 0.3 acres of Semi-impervious Surface (Table 4.15).

Table 4.14. What was Northern Piedmont Mesic Oak-Beech Forest in 1937 has become X or remained in 2010	
X	Acreage
Northern Piedmont Mesic Oak-Beech Forest	18 acres
Northeastern Modified Successional Forest	3 acres
Farm Pond/Artificial Pond	0.1 acres
Impervious Surface	0.1 acres

Table 4.15. Northern Piedmont Mesic Oak-Beech Forest has migrated into X or remained since 1937	
X	Acreage
Northern Piedmont Mesic Oak-Beech Forest	18 acres
Northeastern Old Field	18 acres
Semi-impervious Surface	0.3 acres

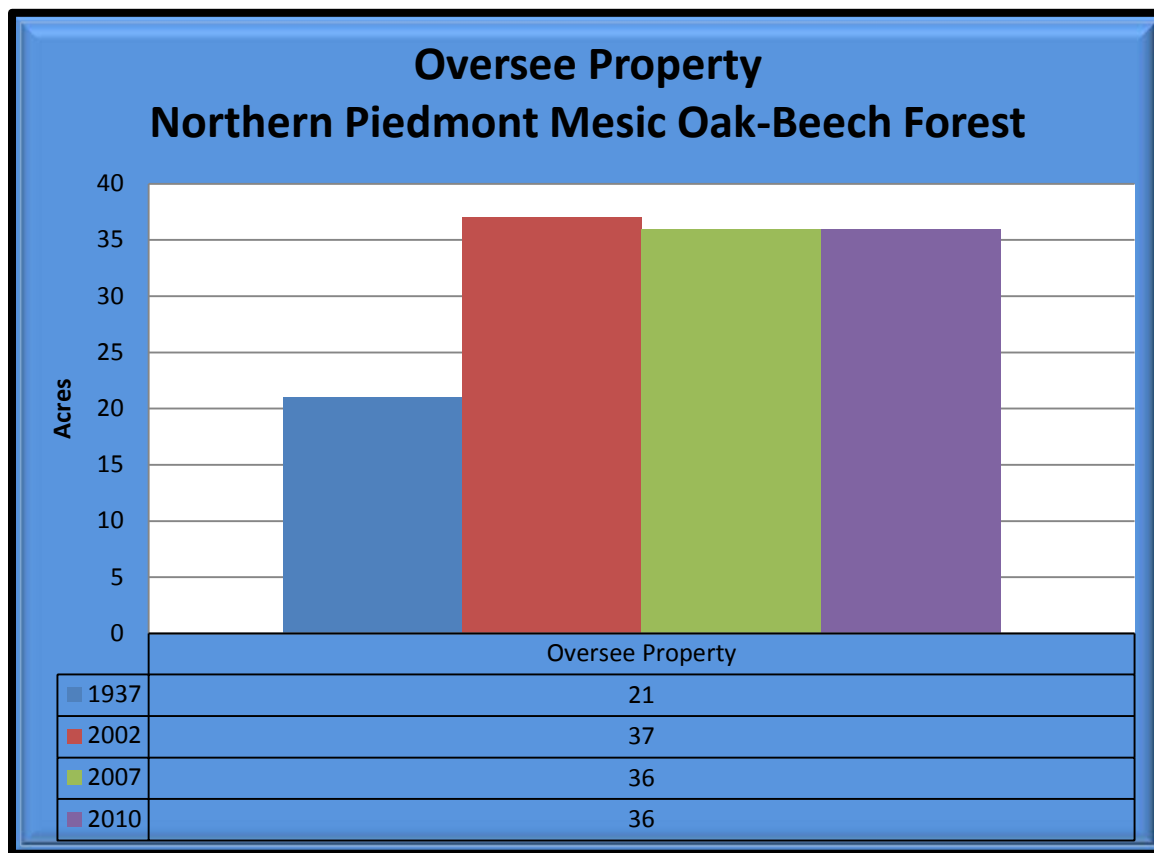


Figure 4.13. Northern Piedmont Mesic Oak-Beech Forest at the Oversee Property (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.16)

Despite losses due to invasion of exotic invasive plants, Northern Piedmont Mesic Oak-Beech Forest managed to increase its capital since 1937 through transfers from Northeastern Old Field.

Table 4.16. Natural Capital of Northern Piedmont Mesic Oak-Beech Forest	
Year	Natural Capital (in 2012 dollars)
1937	\$3,971/year
2002	\$6,997/year
2007	\$6,808/year
2010	\$6,808/year

Norway Spruce Planted Forest [0.3 acres (Figure 4.14-4.15, Table 4.17)] G5 S5

**DEWAP: Piedmont Upland Forests
NHC: Central Appalachian Dry Oak-Pine Forest**

Description



This community consists of planted Norway Spruce (*Picea abies*) with no understory.

Figure 4.14. Norway Spruce Planted Forest

Analysis of Condition at the Oversee Property

All of the current acreage of Norway Spruce Planted Forest came from Northeastern Old Field in 1937.

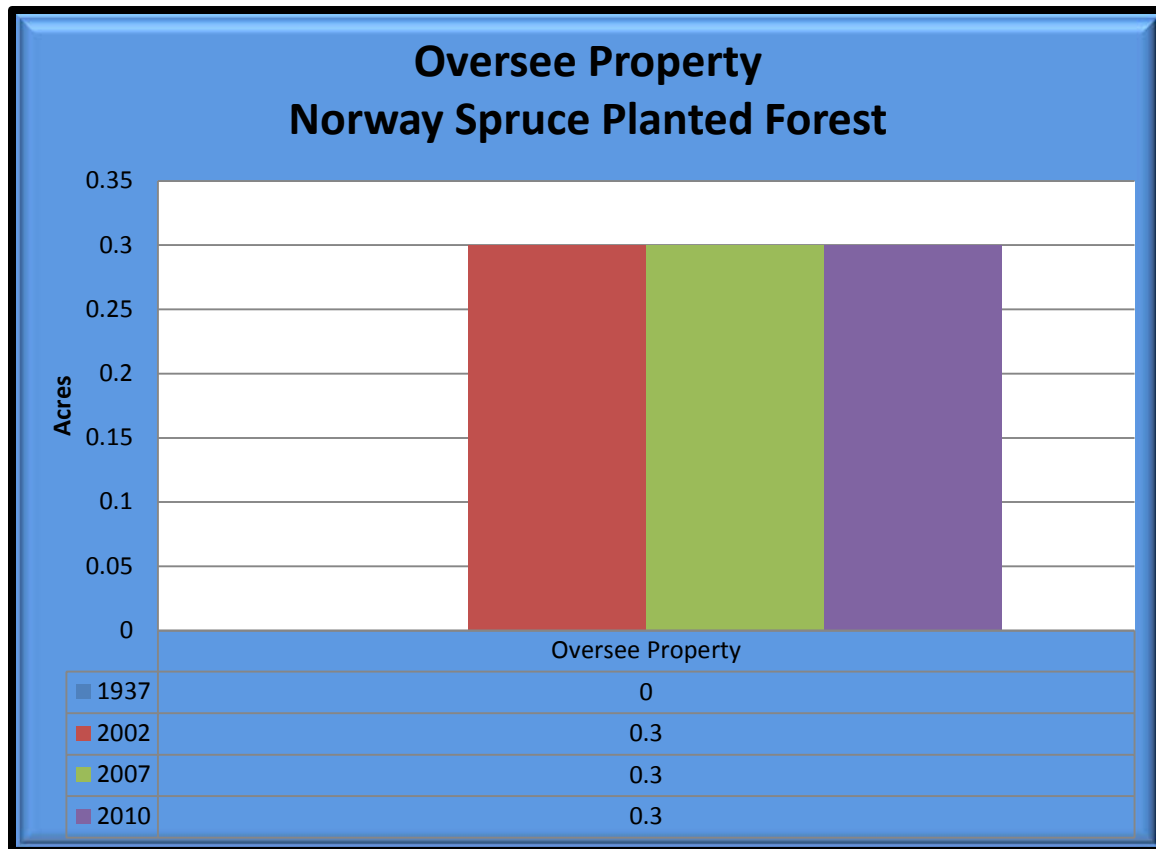


Figure 4.15. Norway Spruce Planted Forest at the Oversee Property (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.17)

Norway Spruce Planted Forest has remained at the same capital since it appeared in 2002.

Table 4.17. Natural Capital of Northern Piedmont Mesic Oak-Beech Forest	
Year	Natural Capital (in 2012 dollars)
1937	\$0/year (not present)
2002	\$57/year
2007	\$57/year
2010	\$57/year

DEWAP: Piedmont Stream Valley Wetlands
NHC: No Equivalent Classification

Description

This seepage community is located near the headwaters of a small tributary of Red Clay Creek that flows through the property. It is dominated by skunk cabbage (*Symplocarpus*



foetidus). A few scattered woody plants are within the community including green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*), winterberry (*Ilex verticillata*), spicebush (*Lindera benzoin*) and elderberry (*Sambucus canadensis*). Other herbs include Canadian clearweed (*Pilea pumila*), cinnamon fern (*Osmunda cinnamomea*), orange-spotted jewelweed (*Impatiens capensis*), golden saxifrage (*Chrysosplenium americanum*) and log wood-fern (*Dryopteris celsa*).

Figure 4.16. Skunk Cabbage-Orange
Jewelweed Seep

Analysis of Condition at the Oversee Property

Skunk Cabbage-Orange Jewelweed Seep has not changed in acreage or extent since 1937, therefore an analysis was not completed.

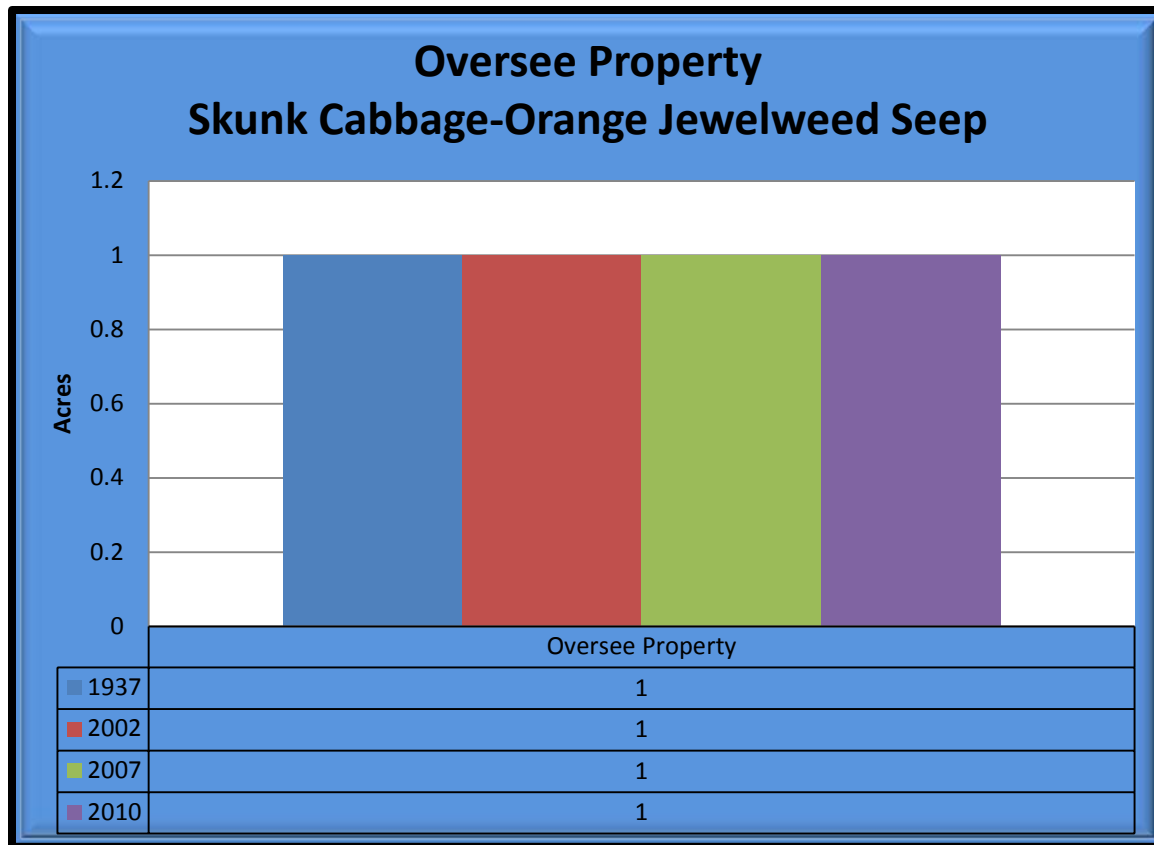


Figure 4.17. Skunk Cabbage-Orange Jewelweed Seep at the Oversee Property (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.18)

This wetland community has remained at the same acreage and capital since 1937.

Table 4.18. Natural Capital of Skunk Cabbage-Orange Jewelweed Seep	
Year	Natural Capital (in 2012 dollars)
1937	\$9,281/year
2002	\$9,281/year
2007	\$9,281/year
2010	\$9,281/year

DEWAP: Piedmont Upland Forests
NHC: Central Appalachian Dry Oak-Pine Forest

Description

This community is composed of successional sweetgum (*Liquidambar styraciflua*) that dominates the canopy. The shrub and vine layer is composed of Japanese honeysuckle (*Lonicera japonica*), and blackberry (*Rubus* sp.). Herbs in this community include horseweed (*Conyza canadensis*), spikerush (*Juncus* sp.), Japanese stiltgrass (*Microstegium vimineum*), deer tongue grass (*Dichanthelium clandestinum*), goldenrod (*Solidago* sp.), and daisy fleabane (*Erigeron strigosus*).

Analysis of Condition at the Oversee Property

All of the current acreage of Successional Sweetgum Forest came from Northeastern Old Field in 1937.

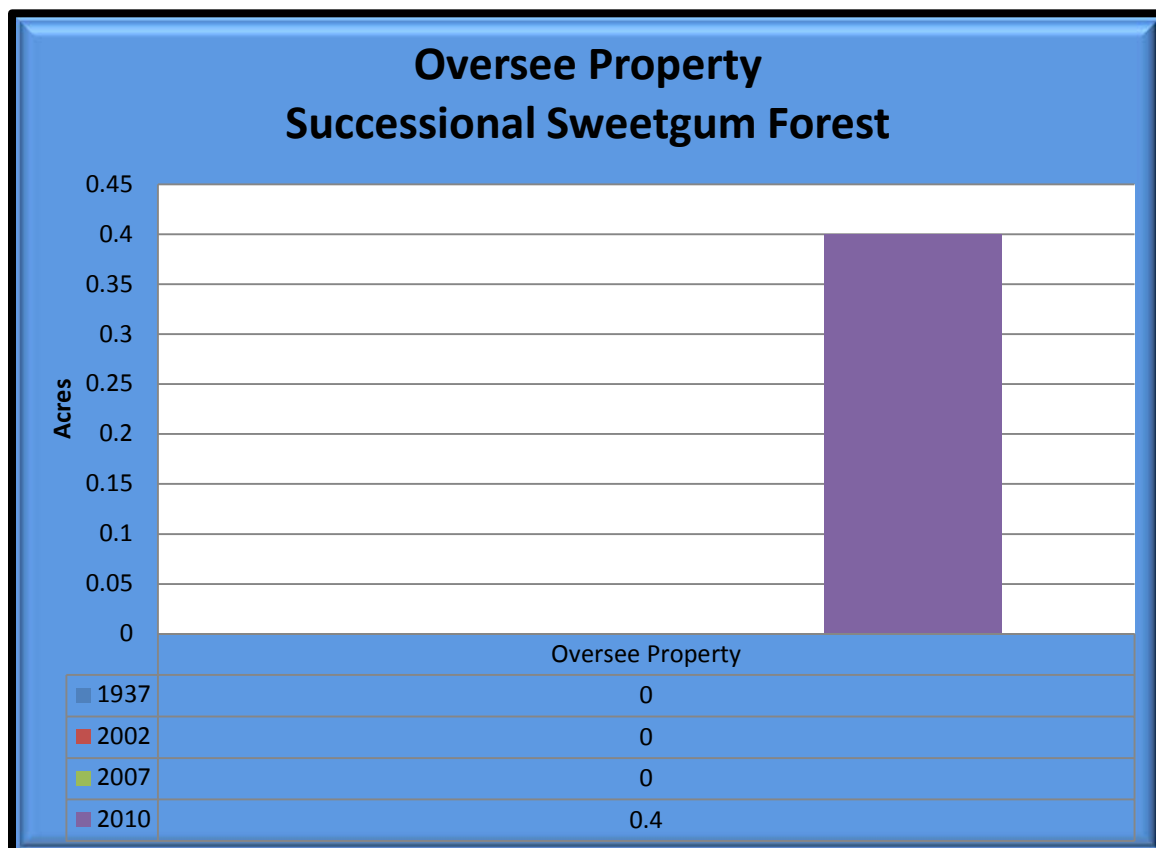


Figure 4.18. Successional Sweetgum Forest at the Oversee Property (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.19)

Successional Sweetgum Forest has a value of \$76 in capital.

Table 4.19. Natural Capital of Successional Sweetgum Forest	
Year	Natural Capital (in 2012 dollars)
1937	\$0/year (not present)
2002	\$0/year (not present)
2007	\$0/year (not present)
2010	\$76/year

Successional Tuliptree Forest [3 acres (Figures 4.19-4.20, Table 4.20)] GNA SNA

**DEWAP: Piedmont Upland Forests
NHC: Semi-natural/Altered Vegetation and Conifer Plantations**

Description

This forested community is distinguished by the dominance of tuliptree (*Liriodendron tulipifera*) with an association of red maple (*Acer rubrum*). Understory species include spicebush (*Lindera benzoin*), mockernut hickory (*Carya alba*), American beech (*Fagus grandifolia*) and black gum (*Nyssa sylvatica*). Multiflora rose (*Rosa multiflora*), privet (*Ligustrum vulgare*) and



raspberry (*Rubus* spp.) are common shrubs, while poison ivy (*Toxicodendron radicans*), oriental bittersweet (*Celastrus orbiculatus*) and summer grape (*Vitis aestivalis*) are common vines. The rich herb layer contains numerous species including horsebalm (*Collinsonia canadensis*), common blue violet (*Viola sororia*), white wood aster (*Eurybia divaricata*), garlic mustard (*Alliaria petiolata*), enchanter's nightshade (*Circaea lutetiana*), wild ginger (*Asarum canadense*) and American lopseed (*Phyrma leptostachya*).

Figure 4.19. Successional Tuliptree Forest

Analysis of Condition at the Oversee Property

All of the Successional Tuliptree Forest present in the Oversee Property has grown from 3 acres of Northeastern Old Field that was present in 1937.

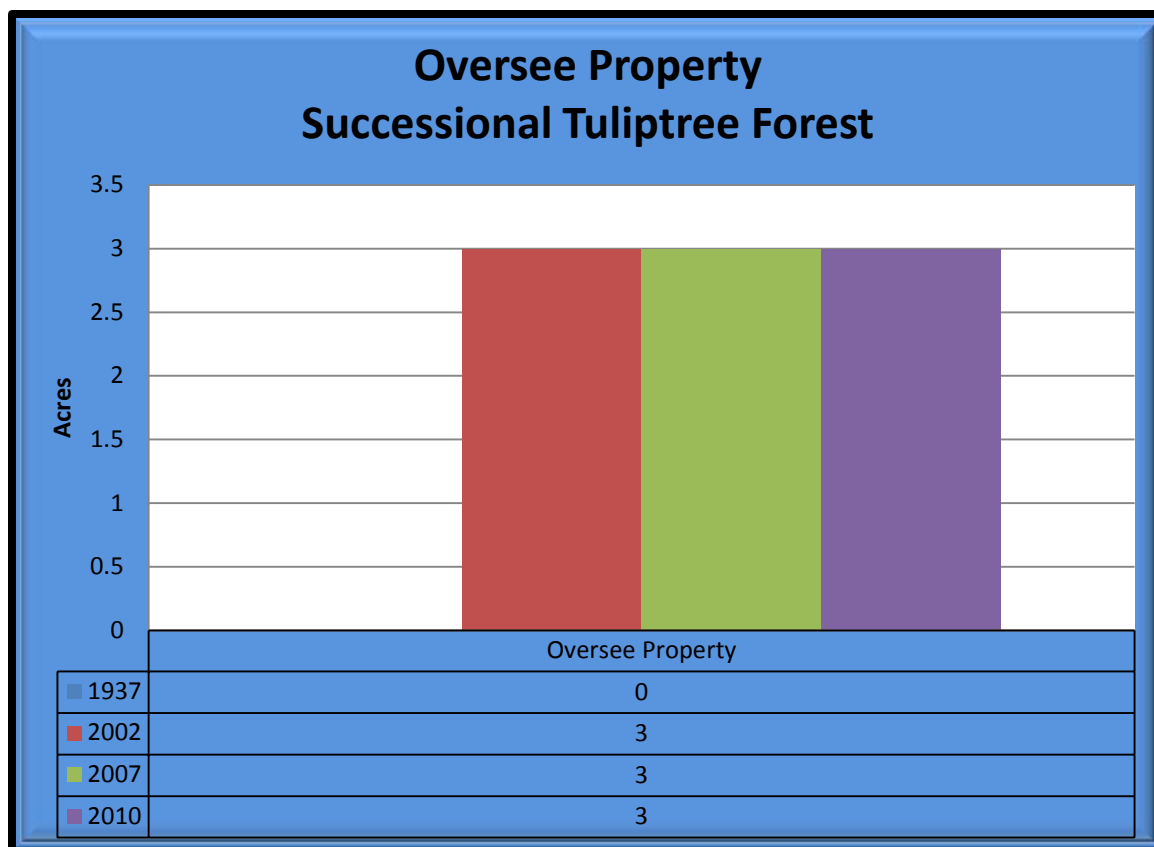


Figure 4.20. Successional Tuliptree Forest at the Oversee Property (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.20)

This community has gained \$567 in capital since 1937 by transfers and increases from Northeastern Old Field.

Table 4.20. Natural Capital of Successional Tuliptree Forest	
Year	Natural Capital (in 2012 dollars)
1937	\$0/year (not present)
2002	\$567/year
2007	\$567/year
2010	\$567/year

White Pine Planted Forest [0.5 acres (Figure 4.21, Tables 4.21-4.22)] GNA SNA

**DEWAP: Piedmont Upland Forests
NHC: Semi-natural/Altered Vegetation and Conifer Plantations**

Description

This community is artificial in nature and is composed of planted white pine (*Pinus strobus*) with no other layers beneath it.

Analysis of Condition at the Oversee Property

White Pine Planted Forest was not present in 1937 and has since come up in 0.4 acres of Northeastern Old Field and 0.1 acres of Semi-impervious Surface (Table 4.21).

Table 4.21. White Pine Planted Forest has migrated into X or remained since 1937	
X	Acreage
Northeastern Old Field	0.4 acres
Semi-impervious Surface	0.1 acres

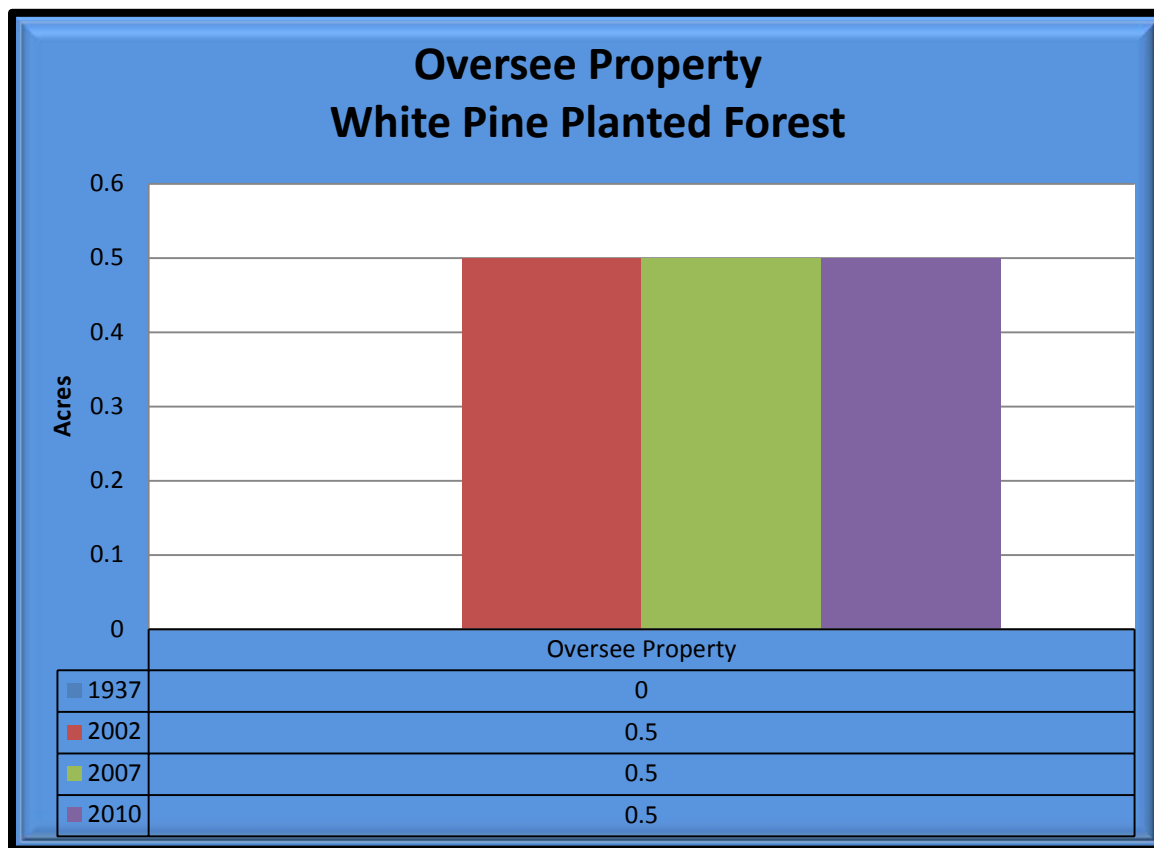


Figure 4.21. White Pine Planted Forest at the Oversee Property (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.22)

This community has gained \$95 from transfers and increases since 1937.

Table 4.22. Natural Capital of White Pine Planted Forest	
Year	Natural Capital (in 2012 dollars)
1937	\$0/year (not present)
2002	\$95/year
2007	\$95/year
2010	\$95/year

CHAPTER 5: DESCRIPTIONS AND ANALYSIS OF THE LAND COVERS

Land covers are those areas such as agricultural fields or places that do not contain vegetation communities but still cover ground surface. In terms of sea-level rise, water is most important but its effects can also be seen in the impoundments.

The land covers include:

1. Agricultural Field—27 acres
2. Farm Pond/Artificial Pond—1 acre
3. Impervious Surface—1 acre

Agricultural Field [27 acres, (Figure 5.1, Tables 5.1-5.2)]

DEWAP: No Equivalent Classification

NHC: No Equivalent Classification

Description

Agricultural field includes those areas that are in agricultural production via a row crop or truck crop.

Analysis of Condition at the Oversee Property

Agricultural field was not present in 1937 and has since developed on 26 acres of Northeastern Old Field, 0.2 acres of Semi-impervious Surface, and 0.1 acres of Northeastern Successional Shrubland (Table 5.1).

Table 5.1. Agricultural Field has migrated into X or remained since 1937	
X	Acreage
Northeastern Old Field	22 acres
Semi-impervious Surface	0.1 acres
Northeastern Successional Shrubland	0.1 acres

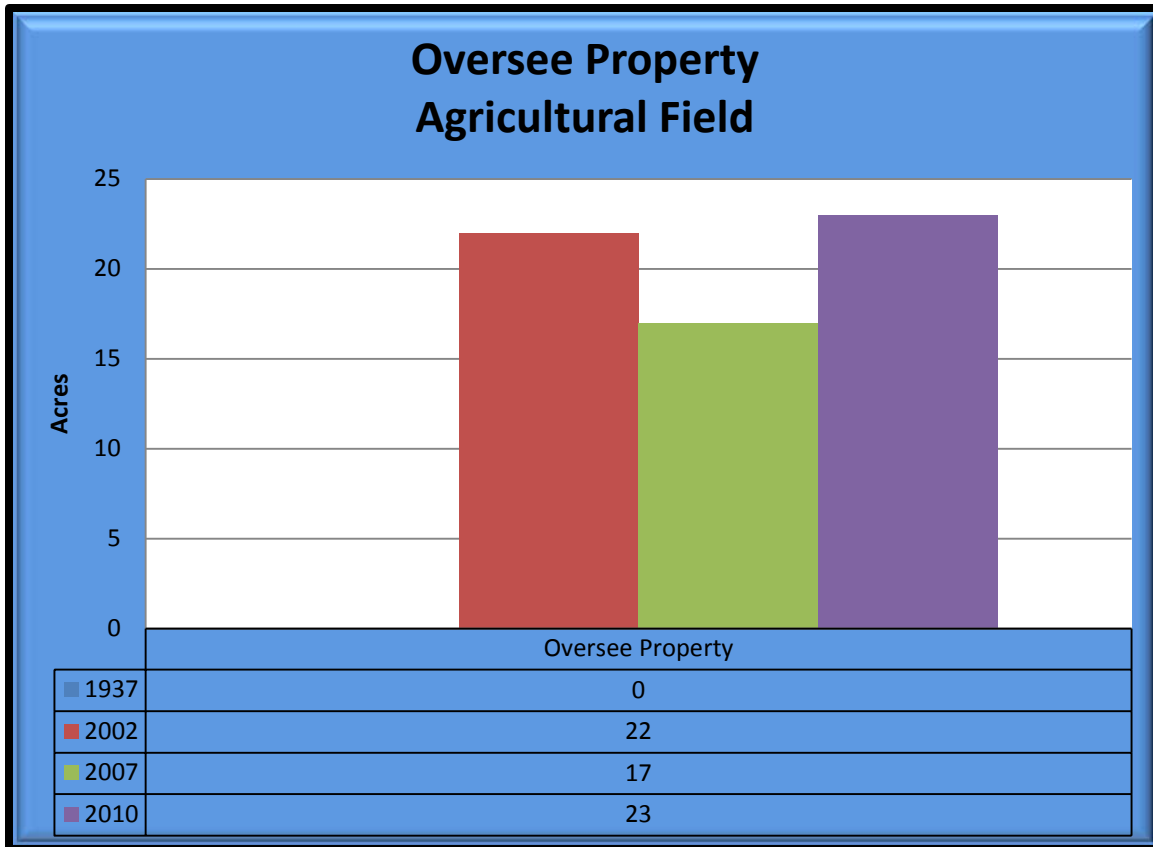


Figure 5.1. Agricultural Field at the Oversee Property (1937, 2002, 2007, and 2010)

Natural Capital (Table 5.2)

Agricultural Field has oscillated in value as it is abandoned and then reused.

Table 5.2. Natural Capital of Agricultural Field	
Year	Natural Capital (in 2012 dollars)
1937	\$0/year (not present)
2002	\$1,262/year
2007	\$975/year
2010	\$1,319/year

Farm Pond/Artificial Pond [1 acre, (Figure 5.2, Table 5.3)]

DEWAP: Impoundment
NHC: No Equivalent Classification

Description

Farm Pond/Artificial Pond includes water bodies that are less than 5 acres in size.

Analysis of Condition at the Overseer Property

The farm pond located on the Overseer Property has not changed in size or extent since 1937.

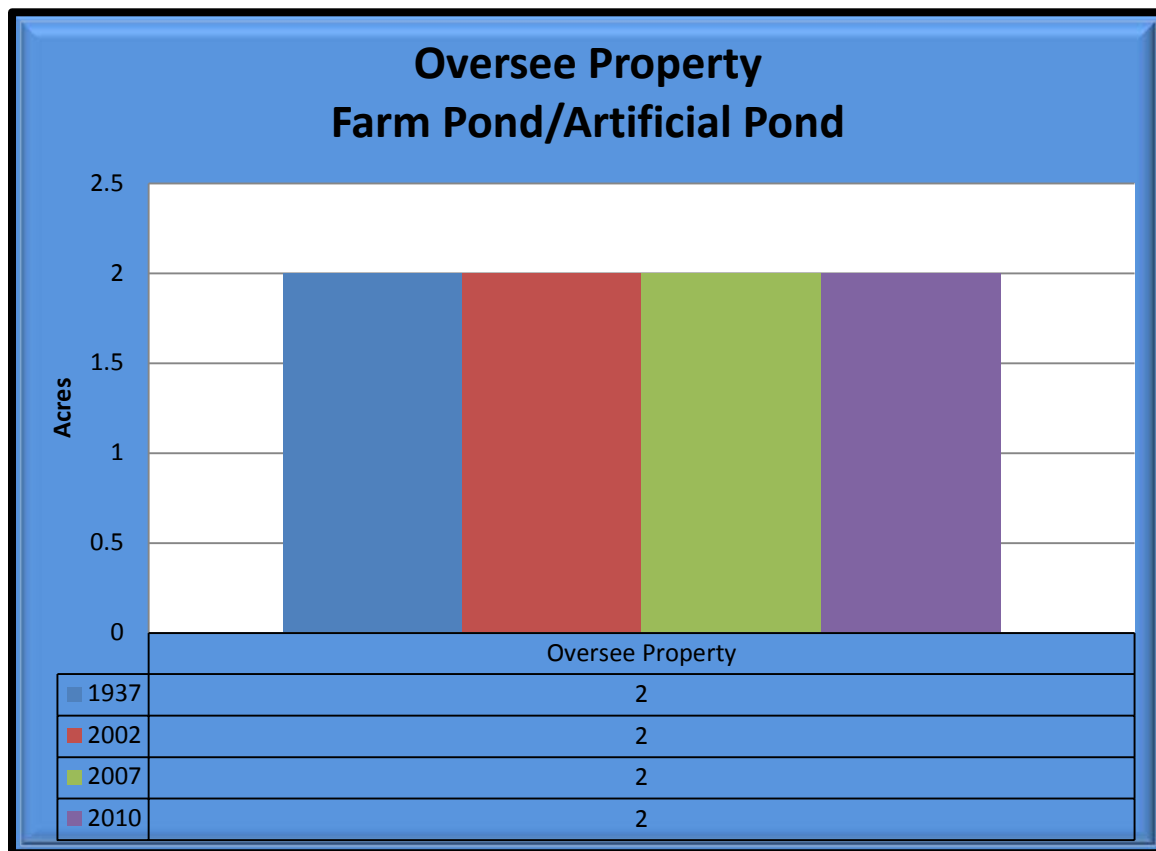


Figure 5.2. Farm Pond/Artificial Pond at the Overseer Property (1937, 2002, 2007, and 2010)

Natural Capital (Table 5.3)

Farm Pond/Artificial Pond has stayed at the same capital value since 1937.

Table 5.3. Natural Capital of Farm Pond/Artificial Pond	
Year	Natural Capital (in 2012 dollars)
1937	\$10,670/year
2002	\$10,670/year
2007	\$10,670/year
2010	\$10,670/year

Impervious Surface [1 acre, (Figure 5.3, Tables 5.4-5.5)]

DEWAP: No Equivalent Classification

NHC: No Equivalent Classification

Description

Impervious Surface includes those places that impervious to the passage of water such as roads and buildings.

Analysis of Condition at the Oversee Property

A little less than half (0.4 acres) of the impervious surface present in 1937 was still present in 2010. The rest had become 0.2 acres of cultivated lawn and 0.1 acres of Northeastern Successional Shrubland (Table 5.4). Impervious surface has been developed in 1 acre of Northeastern Old Field, 0.1 acres of Northern Piedmont Mesic Oak-Beech Forest, and 0.1 acres of Northeastern Successional Shrubland since 1937 (Table 5.5).

Table 5.4. What was Impervious Surface in 1937 has become X or remained in 2010	
X	Acreage
Impervious Surface	0.4 acres
Cultivated Lawn	0.2 acres
Northeastern Successional Shrubland	0.1 acres

Table 5.5. Impervious Surface has migrated into X or remained since 1937	
X	Acreage
Northeastern Old Field	1 acre
Impervious Surface	0.4 acres
Northern Piedmont Mesic Oak-Beech Forest	0.1 acres
Northeastern Successional Shrubland	0.1 acres

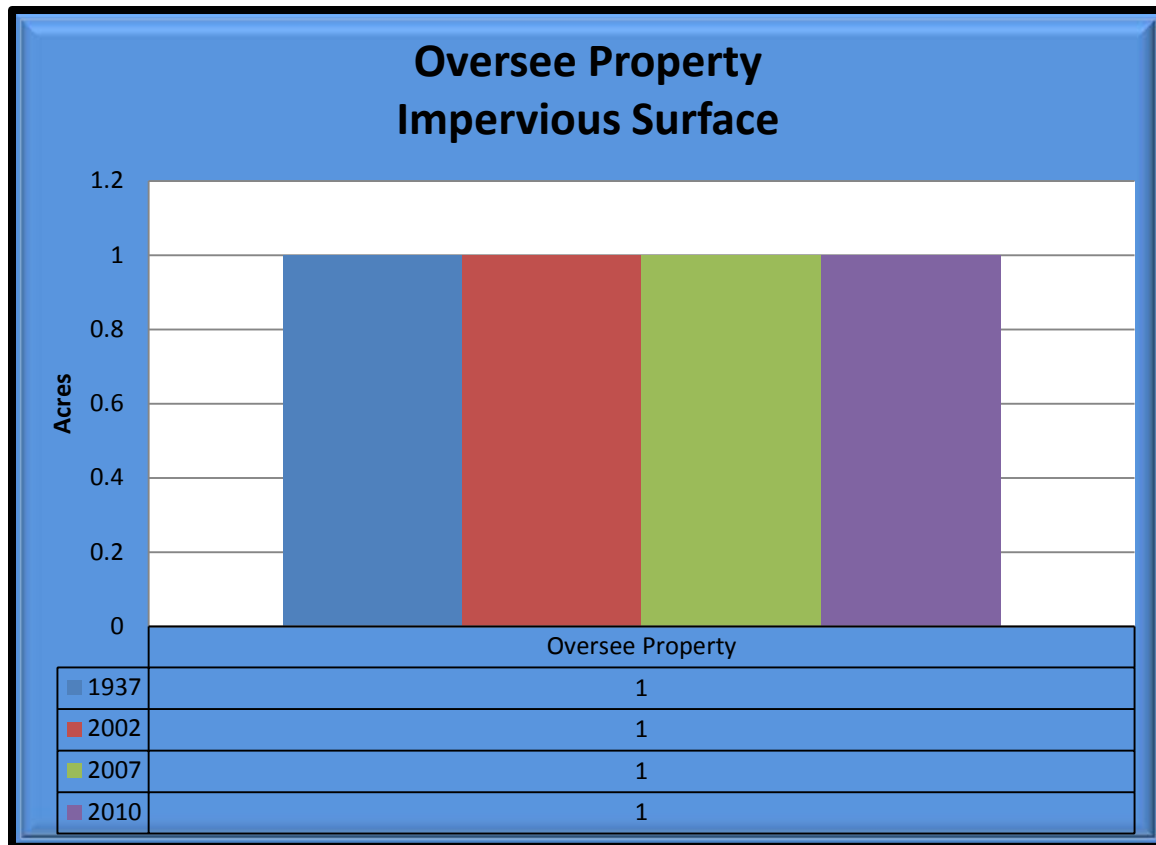


Figure 5.3. Impervious Surface at the Oversee Property (1937, 2002, 2007, and 2010)

Natural Capital

Impervious surface does not have any natural capital value.

Semi-impervious Surface [0 acres, (Figure 5.4, Table 5.6)]

DEWAP: No Equivalent Classification

NHC: No Equivalent Classification

Description

Impervious Surface includes those places that impervious to the passage of water such as roads and buildings.

Analysis of Condition at the Oversee Property

Semi-impervious Surface is no longer present on the Oversee Property. What was Semi-impervious surface has become 1 acre of Northeastern Old Field, 0.3 acres of Northern Piedmont Mesic Oak-Beech Forest, 0.2 acres of Agricultural Field, 0.1 acres of Impervious Surface, and 0.1 acres of cultivated lawn (Table 5.6).

Table 5.6. What was Semi-impervious Surface in 1937 has become X or remained in 2010	
X	Acreage
Northeastern Old Field	1 acre
Northern Piedmont Mesic Oak-Beech Forest	0.3 acres
Agricultural Field	0.2 acres
Impervious Surface	0.1 acres
Cultivated Lawn	0.1 acres
Other communities/land covers	0.1 acres

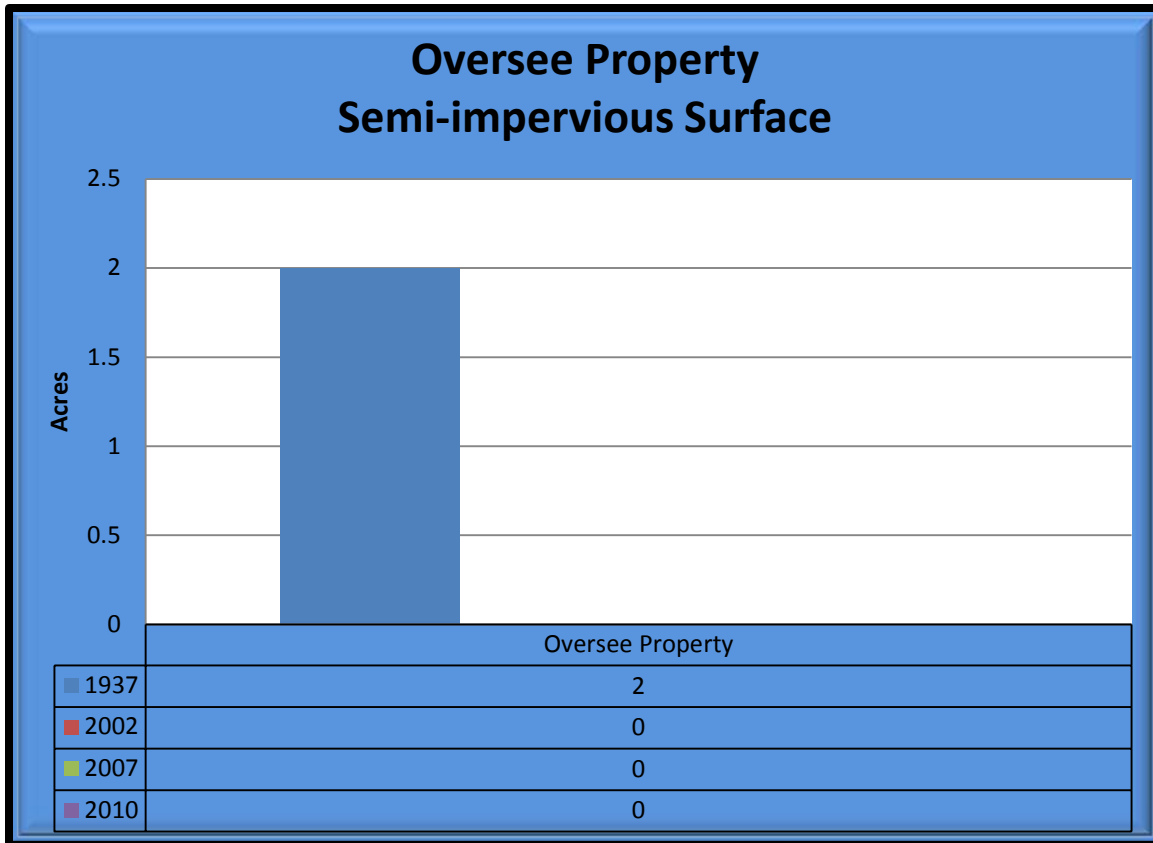


Figure 5.4. Semi-impervious Surface at the Oversee Property (1937, 2002, 2007, and 2010)

Natural Capital

Semi-impervious surface does not have any natural capital value.

APPENDIX I: STATE RARE VEGETATION RANKING CRITERIA

Ranks are based on a system developed by The Nature Conservancy and Natureserve to measure the relative rarity of vegetation communities within a given state. State rarity ranks are used to prioritize conservation and protection efforts so that the rarest of vegetation communities receive immediate attention. The primary criteria for ranking vegetation communities are the total number of documented occurrences with consideration given to the total number of occurrences and total amount of acreage in the state. Ranks for vegetation communities are updated annually and are based on current knowledge and mapping being done for the Guide to Delaware Vegetation Communities.

State Rank

- S1** Extremely rare (i.e., typically 5 or fewer occurrences statewide), or may be susceptible to extirpation because of other threats to its existence.
- S1.1** Only a single occurrence or population of the species is known to occur. (this rank is only applied to plants.)
- S2** Very rare, (i.e., typically 6 to 20 occurrences statewide), or may be susceptible to extirpation because other threats to its existence.
- S3** Rare to uncommon, not yet susceptible to extirpation but may be if additional populations are destroyed. Approximately 21 to 100 occurrences statewide.
- S4** Common, apparently secure in the state under present conditions.
- S5** Very common, secure in the state under present conditions.
- SH** Historically known, but not verified for an extended period (usually 15+ years); there are expectations that the species may be rediscovered.
- SX** Extirpated or presumed extirpated from the state. All historical locations and/or potential habitat have been surveyed.
- SU** Status uncertain within the state. Usually an uncommon species which is believed to be of conservation concern, but there is inadequate data to determine the degree of rarity.
- SNR** Unranked
- SNA** Not Applicable
- SW** Weedy vegetation or vegetation dominated by invasive alien species (this rank is only applied to natural communities).
- SM** Vegetation resulting from management or modification of natural vegetation. It is readily restorable by management or time and/or the restoration of original ecological processes (this rank is only applied to natural communities).

APPENDIX II: SGCN SPECIES EXPECTED FOR KEY WILDLIFE HABITATS

SGCN Species expected in Early Successional Upland Habitats			
Species	Common Name	Class	Tier
<i>Nicrophorus americanus</i>	American burying beetle	Insect	1
<i>Callophrys irus</i>	frosted elfin	Insect	1
<i>Papaipema maritima</i>	maritime sunflower borer moth	Insect	1
<i>Terrapene carolina</i>	Eastern box turtle	Reptile	1
<i>Lampropeltis triangulum</i>	milk snake	Reptile	1
<i>Branta canadensis</i>	Canada goose (migratory)	Bird	1
<i>Circus cyaneus</i>	Northern harrier	Bird	1
<i>Bartramia longicauda</i>	upland sandpiper	Bird	1
<i>Scolopax minor</i>	American woodcock	Bird	1
<i>Asio flammeus</i>	short-eared Owl	Bird	1
<i>Chordeiles minor</i>	common nighthawk	Bird	1
<i>Lanius ludovicianus</i>	loggerhead shrike	Bird	1
<i>Dendroica discolor</i>	prairie warbler	Bird	1
<i>Ammodramus henslowii</i>	Henslow's sparrow	Bird	1
<i>Cincindela scutellaris</i>	festive tiger beetle	Insect	2
<i>Atrytonopsis hianna</i>	dusted skipper	Insect	2
<i>Satyrrium liparops</i>	striped hairstreak	Insect	2
<i>Satyrrium liparops strigosum</i>	stiped hairstreak	Insect	2
<i>Callophrys gryneus</i>	juniper hairstreak	Insect	2
<i>Speyeria aphrodite</i>	aphrodite fritillary	Insect	2
<i>Speyeria idalia</i>	regal fritillary	Insect	2
<i>Boloria bellona</i>	meadow fritillary	Insect	2
<i>Paratrea plebeja</i>	trumpet vine sphinx	Insect	2
<i>Calyptra canadensis</i>	Canadian owlet	Insect	2
<i>Acronicta rubricoma</i>	a dagger moth	Insect	2
<i>Papaipema rigida</i>	rigid sunflower borer moth	Insect	2
<i>Cirrhophanus triangulifer</i>	a noctuid moth	Insect	2
<i>Schima septentrionalis</i>	a noctuid moth	Insect	2
<i>Plegadis falcinellus</i>	glossy ibis	Bird	2
<i>Cygnus columbianus</i>	tundra swan	Bird	2
<i>Coragyps atratus</i>	black vulture	Bird	2
<i>Colinus virginianus</i>	Northern bobwhite	Bird	2
<i>Pluvialis squatarola</i>	black-bellied plover	Bird	2
<i>Coccyzus erythrophthalmus</i>	black-billed cuckoo	Bird	2
<i>Chaetura pelagica</i>	chimney swift	Bird	2
<i>Colaptes auratus</i>	Northern flicker	Bird	2
<i>Empidonax minimus</i>	least flycatcher	Bird	2
<i>Tyrannus tyrannus</i>	Eastern kingbird	Bird	2
<i>Toxostoma rufum</i>	Brown thrasher	Bird	2
<i>Dendroica pensylvanica</i>	Chestnut-sided warbler	Bird	2
<i>Icteria virens</i>	Yellow-breasted chat	Bird	2
<i>Pipilo erythrophthalmus</i>	Eastern towhee	Bird	2
<i>Spizella pusilla</i>	field sparrow	Bird	2
<i>Pooecetes gramineus</i>	vesper sparrow	Bird	2

<i>Passerculus sandwichensis</i>	savannah sparrow	Bird	2
<i>Ammodramus savannarum</i>	grasshopper sparrow	Bird	2
<i>Dolichonyx oryzivorus</i>	bobolink	Bird	2
<i>Cryptotis parva</i>	least shrew	Bird	2

SGCN Species expected in Impoundments			
Species	Common Name	Class	Tier
<i>Podilymbus podiceps</i>	Pied-billed grebe	Bird	1
<i>Branta canadensis</i>	Canada goose (migratory)	Bird	1
<i>Anas rubripes</i>	American black duck	Bird	1
<i>Pandion haliaetus</i>	osprey	Bird	1
<i>Actitis macularia</i>	Spotted sandpiper	Bird	1
<i>Cygnus columbianus</i>	Tundra swan	Bird	2
<i>Anas platyrhynchos</i>	mallard	Bird	2
<i>Anas clypeata</i>	Northern shoveler	Bird	2
<i>Aythya valisneria</i>	canvasback	Bird	2
<i>Aythya marila</i>	Greater scaup	Bird	2
<i>Aythya affinis</i>	Lesser scaup	Bird	2
<i>Bucephala albeola</i>	bufflehead	Bird	2
<i>Lophodytes cucullatus</i>	Hooded merganser	Bird	2
<i>Pluvialis squatarola</i>	Black-bellied plover	Bird	2
<i>Himantopus mexicanus</i>	Black-necked stilt	Bird	2
<i>Catoptrophorus semipalmatus</i>	willet	Bird	2
<i>Calidris pusilla</i>	Semipalmated sandpiper	Bird	2
<i>Calidris alpina</i>	dunlin	Bird	2

SGCN Species expected in Piedmont Forested Floodplains and Riparian Swamps			
Species	Common Name	Class	Tier
<i>Satyrium kingi</i>	King's hairstreak	Insect	1
<i>Clemmys guttata</i>	Spotted turtle	Reptile	1
<i>Terrapene carolina</i>	Eastern box turtle	Reptile	1
<i>Nerodia erythrogaster</i>	Plainbelly water snake	Reptile	1
<i>Nycticorax nycticorax</i>	Black crowned night-heron	Bird	1
<i>Nyctanassa violacea</i>	yellow-crowned night-heron	Bird	1
<i>Buteo platypterus</i>	Broad-winged hawk	Bird	1
<i>Melanerpes erythrocephalus</i>	Red-headed woodpecker	Bird	1
<i>Hylocichla mustelina</i>	Wood thrush	Bird	1
<i>Parula americana</i>	Northern parula	Bird	1
<i>Setophaga ruticella</i>	American redstart	Bird	1
<i>Limnothlypis swainsonii</i>	Swainson's warbler	Bird	1
<i>Amblyscirtes aesculapius</i>	Lace-winged roadside-skipper	Insect	2
<i>Libytheana carinenta</i>	American snout	Insect	2
<i>Anacamptodes pergracilis</i>	Cypress looper	Insect	2
<i>Chloropteryx tepperaria</i>	Angle winged emerald moth	Insect	2
<i>Manduca jasmineearum</i>	Ash sphinx	Insect	2

<i>Dolba hyloeus</i>	Black alder or pawpaw sphinx	Insect	2
<i>Haploa colona</i>	A tiger moth	Insect	2
<i>Orgyia detrita</i>	A tussock moth	Insect	2
<i>Catocala unijuga</i>	Once-married underwing	Insect	2
<i>Catocala praeclara</i>	Praeclara underwing	Insect	2
<i>Parapamea buffaloensis</i>	A borer moth	Insect	2
<i>Papaipema stenocelis</i>	Chain fern borer moth	Insect	2
<i>Gomphaeschna antilope</i>	Taper-tailed darner	Insect	2
<i>Gomphaeschna furcillata</i>	Harlequin darner	Insect	2
<i>Sympetrum ambiguum</i>	Blue-faced meadowhawk	Insect	2
<i>Enallagma weewa</i>	Blackwater bluet	Insect	2
<i>Hemidactylum scutatum</i>	Four-toed salamander	Amphibian	2
<i>Pseudotriton montanus montanus</i>	Mud salamander	Amphibian	2
<i>Hyla chrysoscelis</i>	Cope's gray treefrog	Amphibian	2
<i>Rana virgatipes</i>	Carpenter frog	Amphibian	2
<i>Opheodrys aestivus</i>	Rough green snake	Reptile	2
<i>Thamnophis sauritus</i>	Eastern ribbon snake	Reptile	2
<i>Agkistrodon contortix</i>	copperhead	Reptile	2
<i>Ardea herodias</i>	Great blue heron	Bird	2
<i>Casmerodius albus</i>	Great egret	Bird	2
<i>Egretta thula</i>	Snowy egret	Bird	2
<i>Egretta caerulea</i>	Little blue heron	Bird	2
<i>Egretta tricolor</i>	Tricolored heron	Bird	2
<i>Bubulcus ibis</i>	Cattle egret	Bird	2
<i>Plegadis falcinellus</i>	Glossy ibis	Bird	2
<i>Buteo lineatus</i>	Red-shouldered hawk	Bird	2
<i>Strix varia</i>	Barred owl	Bird	2
<i>Vireo flavifrons</i>	Yellow-throated vireo	Bird	2
<i>Protonotaria citrea</i>	Prothonotary warbler	Bird	2
<i>Helmitheros vermivorus</i>	Worm-eating warbler	Bird	2
<i>Oporornis formosus</i>	Kentucky warbler	Bird	2
<i>Piranga olivacea</i>	Scarlet tanager	Bird	2
<i>Icterus galbula</i>	Baltimore oriole	Bird	2
<i>Lasionycteris noctivagans</i>	Silver-haired bat	Mammal	2
<i>Nycticeius humeralis</i>	Evening bat	Mammal	2

SGCN Species expected in Piedmont Stream Valley Wetlands			
Species	Common Name	Class	Tier
<i>Poanes massasoit</i>	Mulberry wing	Insects	1
<i>Euphyes conspicua</i>	Black dash	Insects	1
<i>Papaipema eupatorii</i>	Eupatorium borer moth	Insects	1
<i>Glyptemys muhlenbergii</i>	Bog turtle	Reptiles	1
<i>Euphyes dion</i>	Dion skipper	Insects	2
<i>Boloria selene</i>	Silver-bordered fritillary	Insects	2
<i>Boloria selene myrina</i>	Myrina fritillary	Insects	2
<i>Euphydryas phaeton</i>	Baltimore checkerspot	Insects	2
<i>Satyrodes eurydice</i>	Eyed brown	Insects	2

<i>Arctonicta connecta</i>	A noctuid moth	Insects	2
<i>Parapamea buffaloensis</i>	A borer moth	Insects	2
<i>Cordulegaster erronea</i>	Tiger spiketail	Insects	2
<i>Cordulegaster bilineata</i>	Brown spiketail	Insects	2
<i>Libellula flava</i>	Yellow-sided skimmer	Insects	2
<i>Sympetrum semicinctum</i>	Band-winged meadowhawk	Insects	2
<i>Eurycea longicauda</i>	Longtail salamander	Amphibians	2
<i>Regina septemvittata</i>	Queen Snake	Reptiles	2
<i>Thamnophis sauritus</i>	Eastern Ribbon Snake	Reptiles	2