

Historical Analysis and Map of Vegetation Communities, Land Covers, and Habitats of Alapocas Run State Park New Castle County, Delaware

Brandywine Creek Watershed

Submitted to:

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Table of Contents

Chapter 1: Introduction and Methods	3
Setting of Alapocas Run State Park	3
Soils and Geology of Alapocas Run State Park.....	5
Discussion of vegetation communities in general and why they are important in management	6
Purpose of the Study	8
Vegetation Community and Land Cover Surveys	9
Analysis of Historical Imagery	9
Ecological Integrity Assessment (EIA)	9
Forest Block Analysis	9
Natural Capital Analysis	10
Chapter 2: EIAs, Forest Blocks, and General Observations	11
Summary of Findings from this study	11
1. Vegetation Communities:.....	11
2. Rare Plants:	11
3. Rare Animals:.....	11
Forest Block Analysis.....	12
Analysis of Forest Blocks at Alapocas Run State Park	13
Chapter 3: Broad Trends at Alapocas Run State Park	16
Chapter 4: Descriptions and Analysis of the Vegetation Communities	30
Chapter 5: Descriptions and Analysis of the Land Covers	54
Appendix I: State rare vegetation ranking criteria.....	66
Appendix II: SGCN Species expected for Key Wildlife Habitats	67

CHAPTER 1: INTRODUCTION AND METHODS

Setting of Alapocas Run State Park

Alapocas Run State Park is located in northern New Castle County, Delaware on the north side of Wilmington (Figure 1.1). The park totals 369 acres and is wholly within the Brandywine Creek watershed. Alapocas Run State Park is important as a large green space in the middle of an urban watershed.

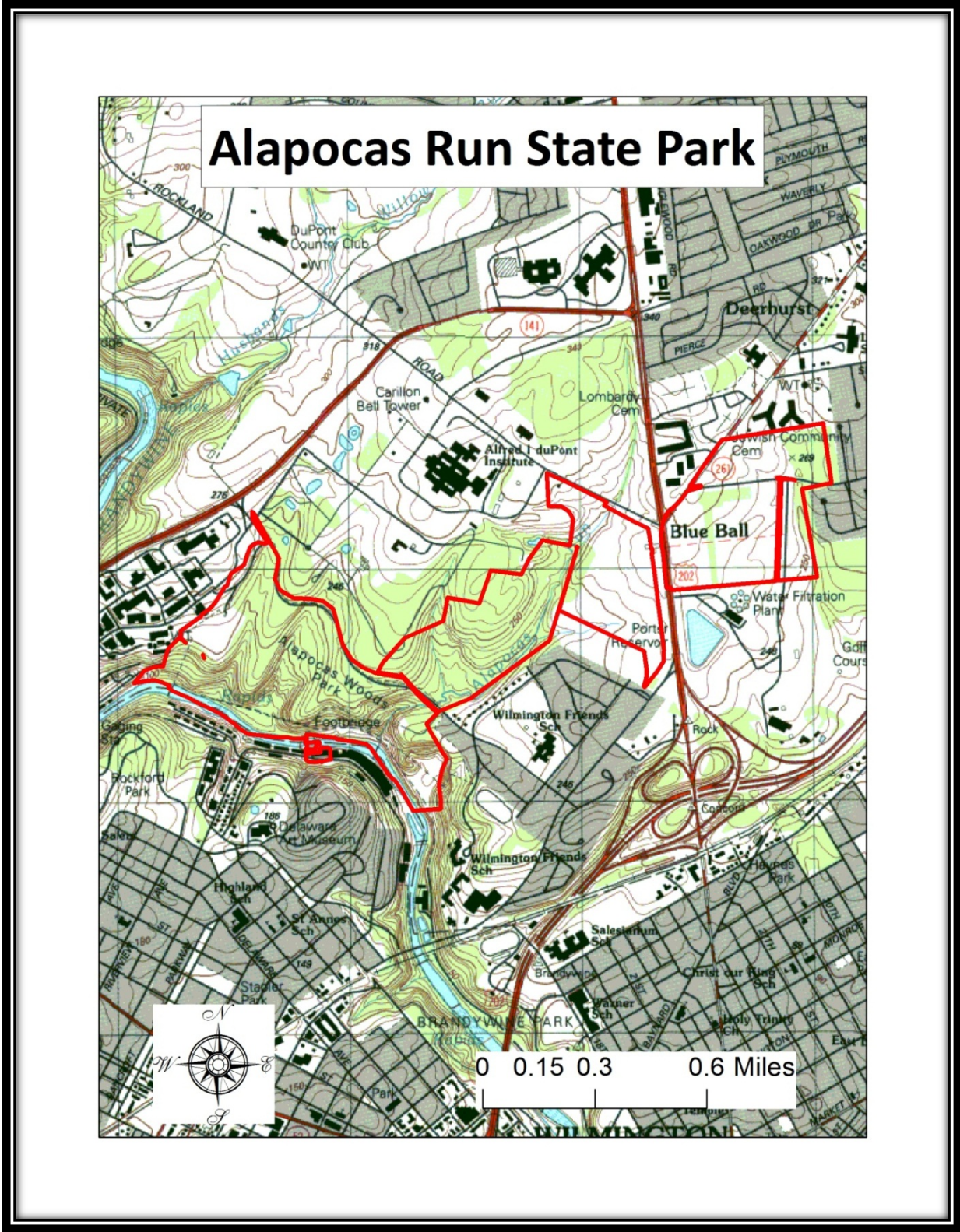


Figure 1.1. Location of Alapocas Run State Park

Soils and Geology of Alapocas Run State Park¹

Underlying Geology

Alapocas Run State Park is located in the Piedmont physiographic province of Delaware. Most of the park is underlain by Brandywine Blue Gneiss, which is present in the outcrops of an old quarry in the park. Isolated areas of Rockford Park Gneiss are present near Brandywine Creek. A very small amount of the Bryn Mawr Formation is located in the northeastern part of the park.

Brandywine Blue Gneiss is described as “medium to coarse grained granulites and gneisses composed of plagioclase, quartz, orthopyroxene, clinopyroxene, brown-green hornblende, magnetite, and ilmenite.” This gneiss is often called the blue rocks and is the name of the Wilmington, DE baseball team. Rockford Park Gneiss is described as “fine-grained mafic to fine- to medium grained felsic gneisses interlayered on the decimeter scale.” The Bryn Mawr Formation is a Coastal Plain Formation from the Miocene Period that in small amount is located in the northeastern part of the park. It is described as “reddish-brown to yellowish-brown silty quartz sand to sandy silt that interfingers with medium to coarse clayey sand with gravel.”

Soils

One soil, Neshaminy-Montalto Silt Loam, is prominent in the park and covers 172 acres. Other minor soils include Udorthents (64 acres), Glenville Silt Loam (47 acres), and Talleyville Silt Loam (41 acres) (Figure 1.2).

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

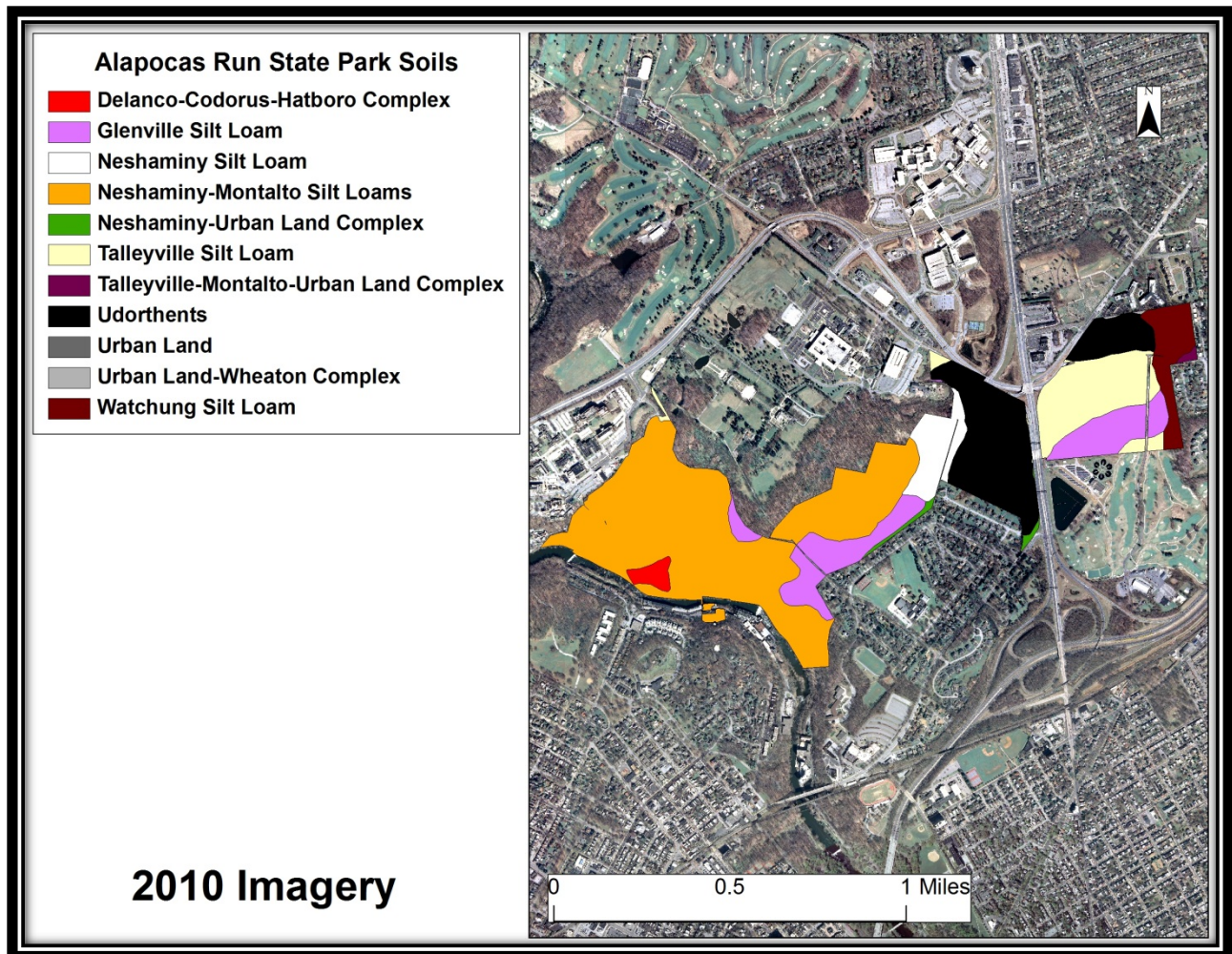


Figure 1.2. Alapocas Run State Park Soils

Elevation

Elevations at Alapocas Run State Park range from about 30 feet where Brandywine Creek flows out of the park to 300 feet near Blue Ball. Alapocas Run State Park is located in the “Fall Line Zone” of Delaware.

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 Alapocas Run State Park 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 state park.
4. Produce Ecological Integrity Assessments (EIAs) for vegetation communities that are ranked S2 or higher.

Surveys were conducted during 2006 and 2007 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 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 vegetation communities are provided in Chapter 4 and of the land covers in Chapter 5. A crosswalk to the Delaware Wildlife Action Plan (DEWAP) and the Northeast Habitat Classification (NHC) is provided at the top of each individual description.

Analysis of Historical Imagery

Historical imagery of Alapocas Run State Park 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 state park discussion. There is more imagery available but these were not used due to registration problems in the image tiles.

Ecological Integrity Assessment (EIA)

An EIA was conducted for those communities in the park 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 Alapocas Run State Park that are included in the EIA analysis are listed in Table 2.3.

Forest Block Analysis

Current forest blocks within or partially within the park 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, powerline 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 Coxe, Robert. 2010. Guide to Delaware Vegetation Communities-Fall 2012 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:** Ten vegetation communities and four land covers were found at Alapocas Run State Park. Northern Piedmont Mesic Oak-Beech Forest (160 acres) is the largest vegetation community, followed by Successional Tuliptree Forest with 32 acres. Impervious Surface (28 acres) is the largest land cover.
2. **Rare Plants:** Ten rare plants are known to exist in Alapocas Run State Park (Table 2.1).

Scientific Name	Common Name	Rank	Last Observed
<i>Agrimonia rostellata</i>	Woodland Agrimony	S3	1992
<i>Arabis canadensis</i>	Sicklepod	S2	1989
<i>Bromus pubescens</i>	Hairy Wood Brome Grass	S2	2003
<i>Carex grisea</i>	A Sedge	S1	???
<i>Conophilus americana</i>	Squaw-root	S2	1991
<i>Dichanthelium yadkinense</i>	A Panic Grass	S1	???
<i>Muhlenbergia tenuiflora</i>	Slender Muhly	S2	1992
<i>Conophilus americana</i>	Squaw-root	S2	1997
<i>Quercus michauxii</i>	Swamp Chestnut Oak	P1	2007
<i>Woodwardia areolata</i>	Netted Chain Fern	P1	2007



Table 2.1 Rare Plants at Alapocas Run State Park

3. **Rare Animals:** Six rare animals are known to exist in Alapocas Run State Park (Table 2.2).

Scientific Name	Common Name	Rank	Last Observed
<i>Agkistrodon contortix</i>	Copperhead	S1	2002
<i>Ambystoma maculatum</i>	Spotted Salamander	S2	1991
<i>Chordeiles minor</i>	Common Nighthawk	S2B	1988
<i>Eurycea longicauda</i>	Longtail Salamander	S1	1988
<i>Lampropeltis triangulum</i>	Milk Snake	S1	1988
<i>Sphinx franckii</i>	Franck's Sphinx	SH	???

Table 2.2 Rare Animals at Alapocas Run State Park

Table 2.3. EIA Vegetation Communities located in Alapocas Run State Park

Community Map	Community Name/EIA Score	Description
	<p>Alapocas 1</p> <p>Central Appalachian/Piedmont Bedrock Floodplain Woodland (0.6 acres)</p> <p>EIA = 4.16 (B rank)</p>	<p>This woodland is located on a scour sandbar of Brandywine Creek.</p>
	<p>Alapocas 2</p> <p>Central Appalachian/Northern Piedmont Chestnut Oak Forest (4.7 acres)</p> <p>EIA = 3.94 (B rank)</p>	<p>This dry forest community is located on a bluff overlooking Brandywine Creek.</p>

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.

Management of state parks has traditionally favored recreational uses, which require cultivated lawns and edges running counter to the habitat needed for forest interior birds. Protecting forest

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

interior bird species runs contrary to the idea that artificially created edges creates more diversity. While this technique creates more diversity of some aggressive species it diminishes the populations of other species.



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 Alapocas Run State Park

Two forest blocks are present that are more than 100 acres in size and are located in whole or part in the state park (Table 2.4 and Figure 2.1). 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 Alapocas Run State Park

Forest Block Map	Block Name/Acreage	Description
	<p>Alapocas Run A</p> <p>Current Block = 139 acres (18 acres interior)</p> <p>Potential Block = 164 acres (43 acres interior)</p>	<p>Alapocas Run A covers the wooded area between Alapocas Drive and Brandywine Creek. It is bounded by Alapocas Drive on the north, development on the east, Brandywine Creek on the south, and development on the west. Six vegetation communities are located within this block and include Box Elder Floodplain Forest, Central Appalachian/Northern Piedmont Chestnut Oak Forest, Central Appalachian/Piedmont Bedrock Floodplain Woodland, Northeastern Modified Successional Forest, Northern Coastal Plain/Piedmont Basic Mesic Hardwood Forest, and Northern Piedmont Mesic Oak-Beech Forest. Brandywine Creek and Alapocas Run drain this block. Currently this block contains 18 acres of interior habitat. Potentially this block could be 164 acres in size and contain 43 acres of interior habitat.</p>
	<p>Alapocas Run B</p> <p>Current Block = 142 acres (55 acres interior)</p> <p>Potential Block = 235 acres (83 acres interior)</p>	<p>Alapocas Run B covers the wooded area north of Alapocas Drive. It is bounded by development on the north, development on the east, Alapocas Drive on the south, and development on the west. Two vegetation communities are located within this block and include Northern Piedmont Mesic Oak-Beech Forest and Successional Tuliptree Forest. Brandywine Creek and Alapocas Run drain this block. Currently this block contains 55 acres of interior habitat. Potentially this block could be 235 acres in size and contain 83 acres of interior habitat.</p>

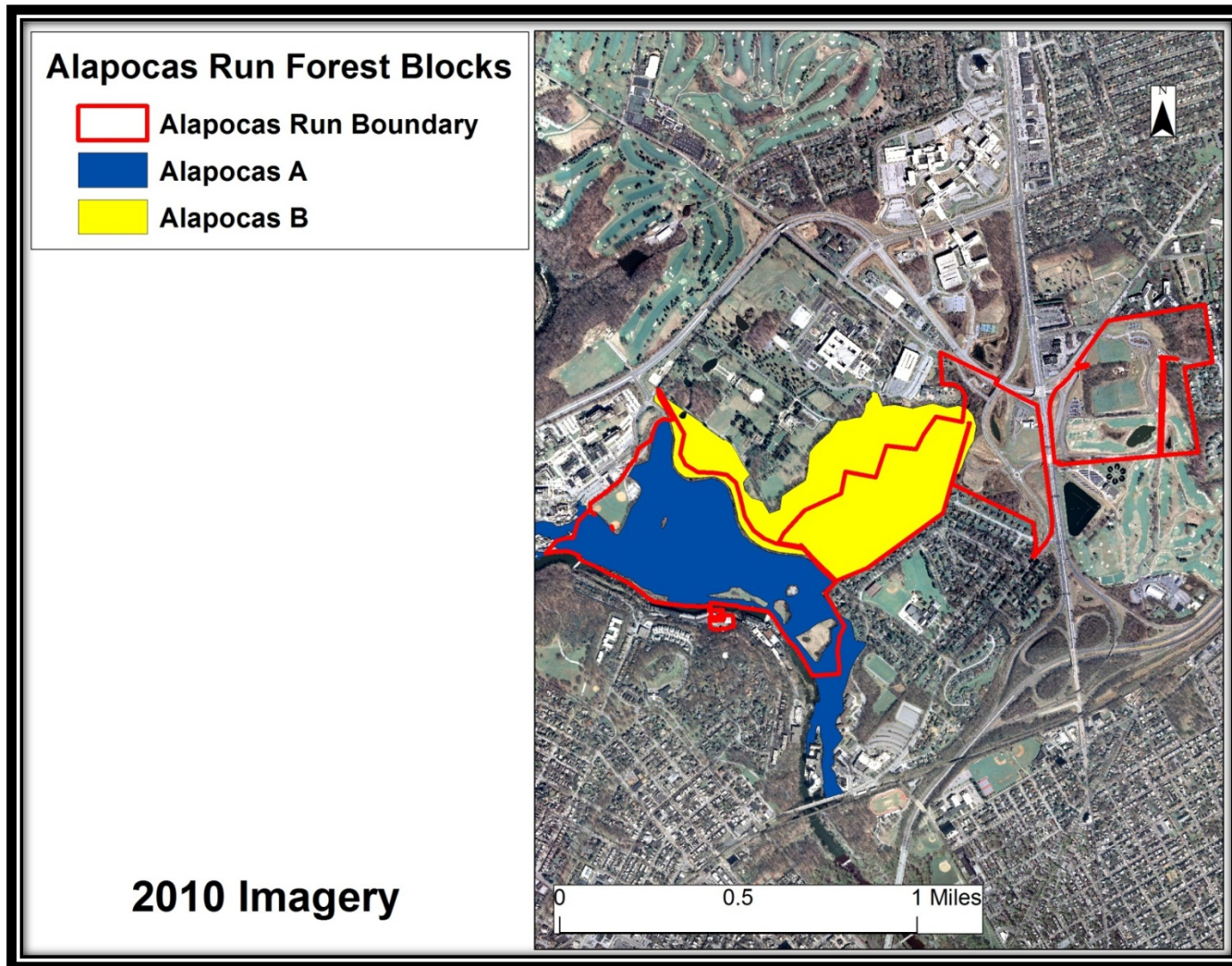


Figure 2.1. Alapocas Run State Park Forest Blocks

CHAPTER 3: BROAD TRENDS AT ALAPOCAS RUN STATE PARK

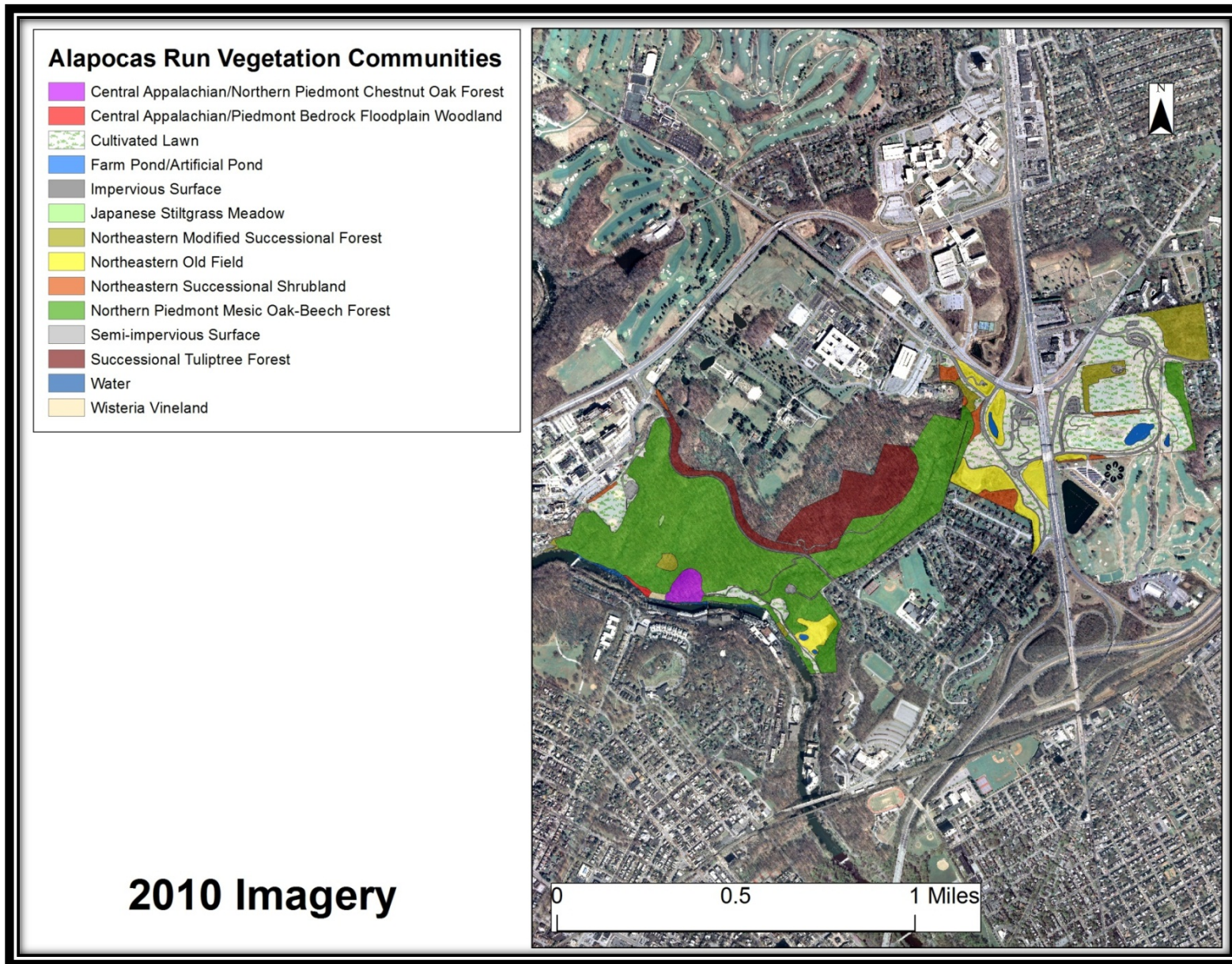


Figure 3.1. 2010 Vegetation Community Map of Alapocas Run State Park

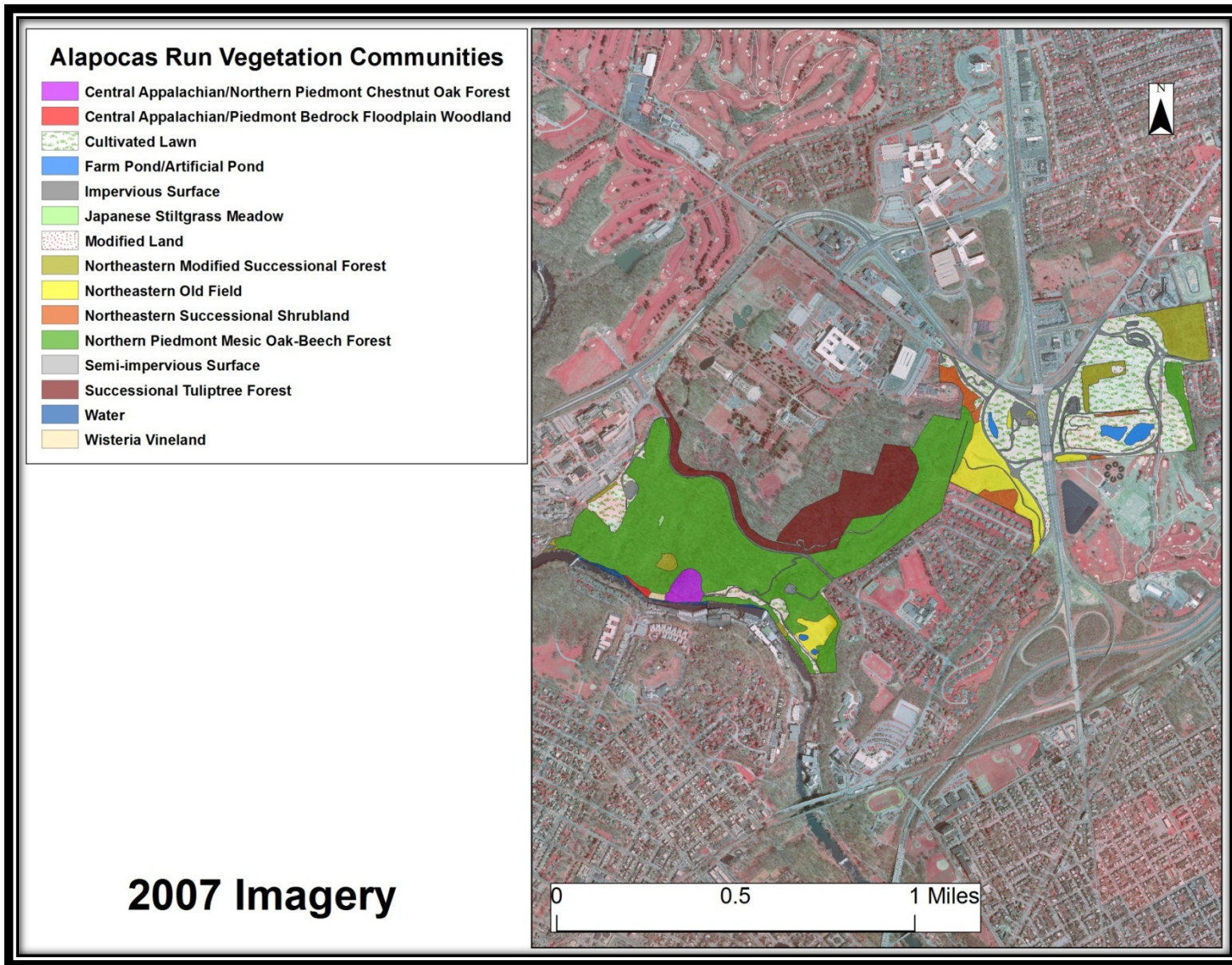


Figure 3.2. 2007 Vegetation Community Map of Alapocas Run State Park

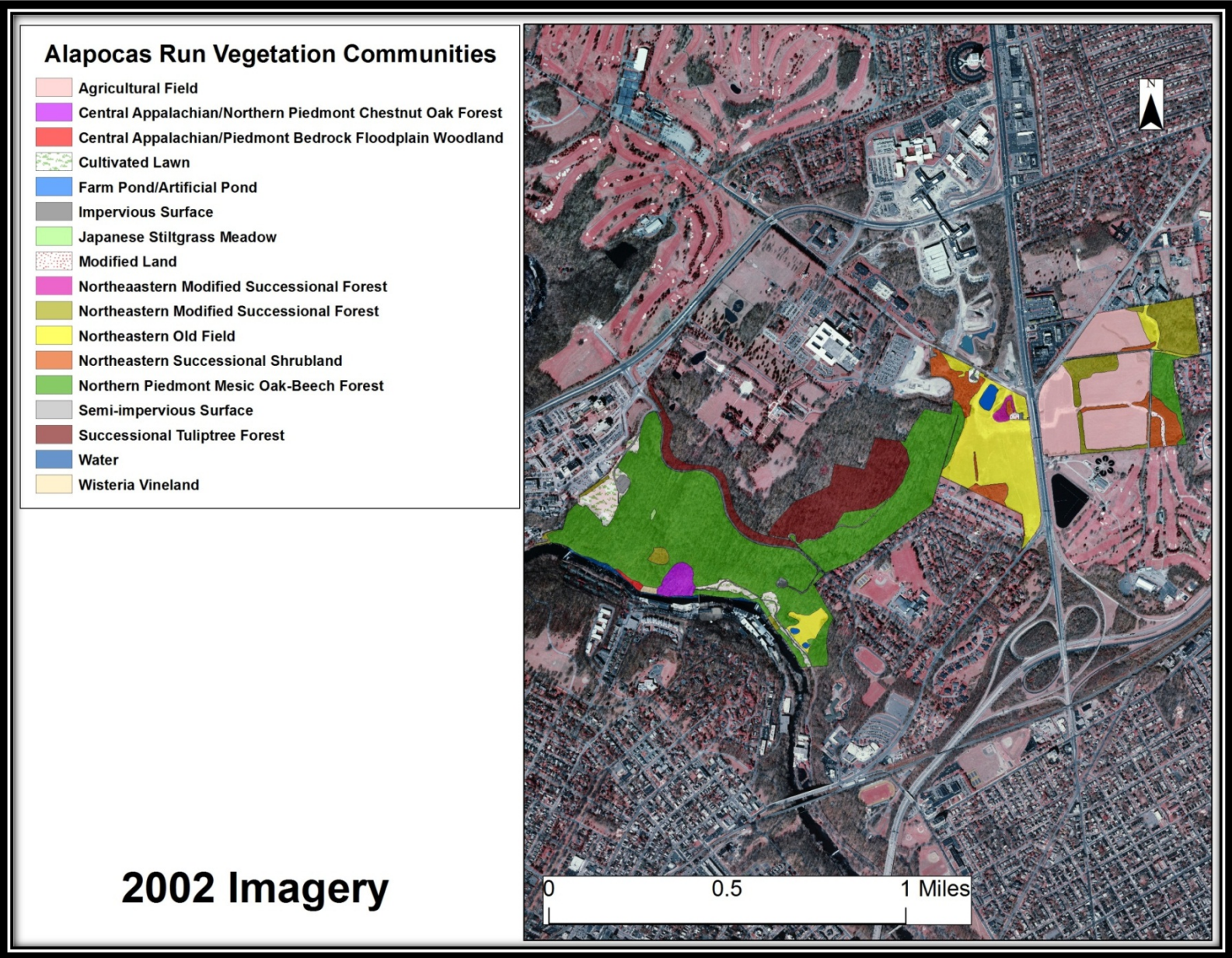


Figure 3.3. 2002 Vegetation Community Map of Alapocas Run State Park

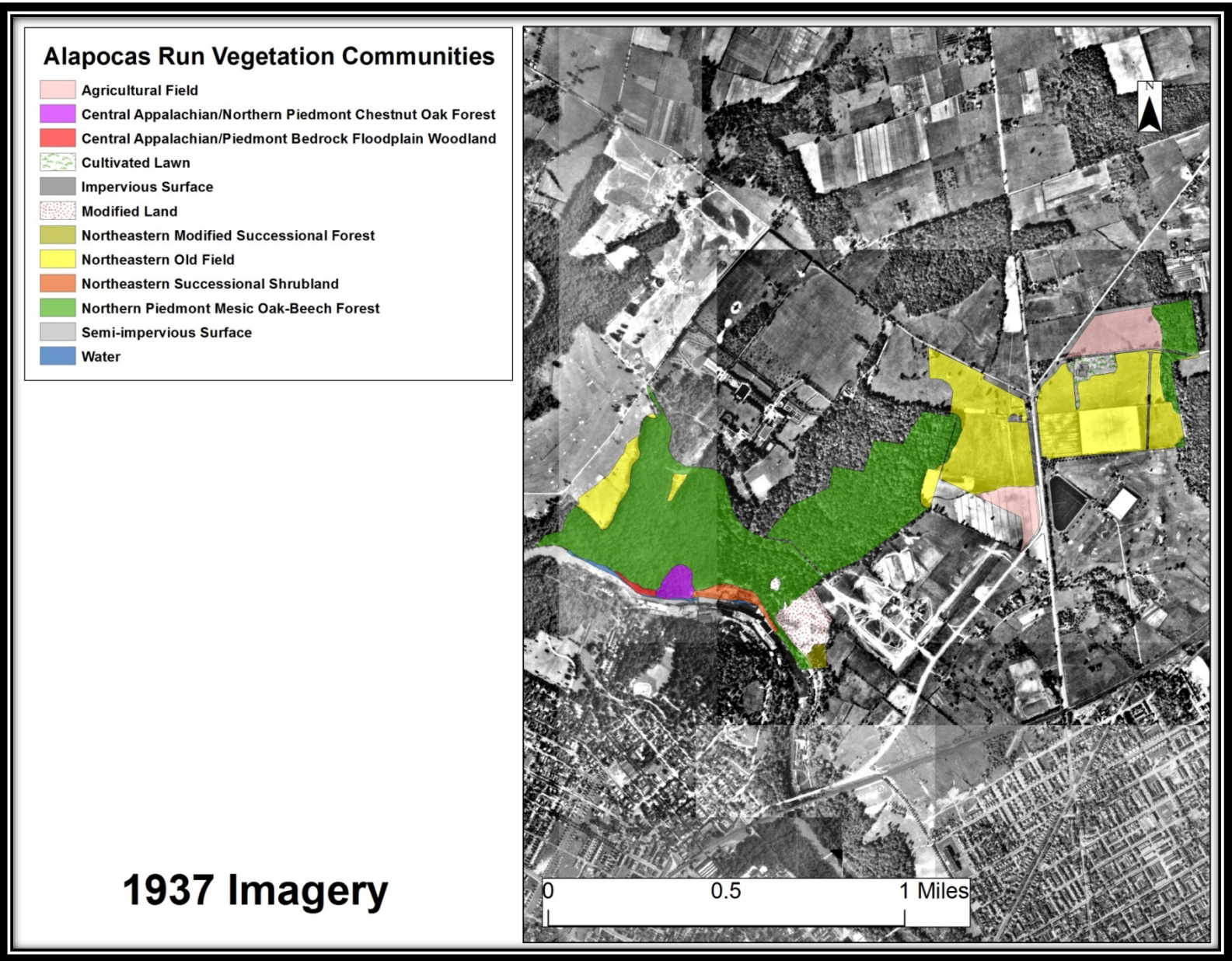


Figure 3.4. 1937 Vegetation Community Map of Alapocas Run State Park

Alapocas Run State Park Vegetation Community/Land Cover Categories

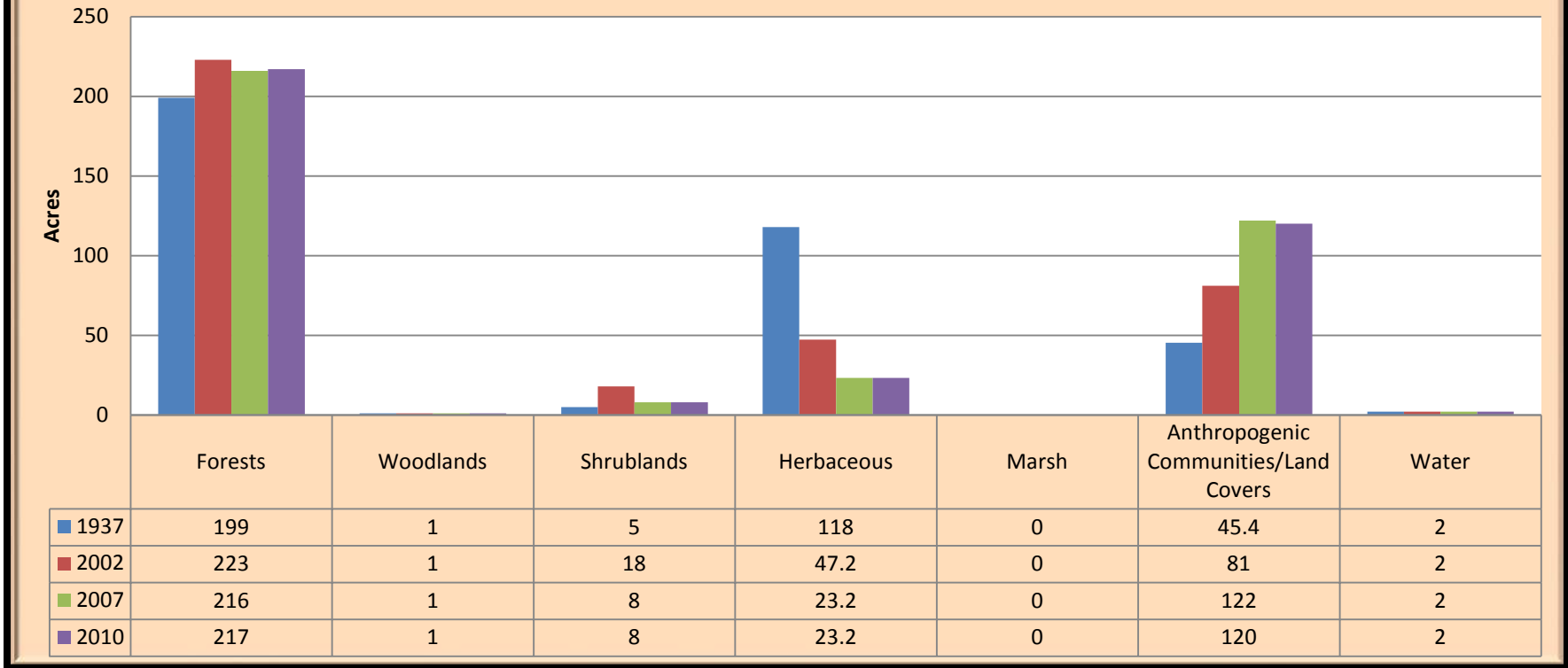


Figure 3.5. Alapocas Run State Park Vegetation Categories/Land Covers (1937, 2002, 2007, and 2010)

Alapocas Run State Park Broad Trends (Figure 3.5): Forestland and Anthropogenic communities/land covers are the major vegetation community/land cover categories present in Alapocas Run State Park.

Natural Capital (Table 3.1)

Natural capital of Alapocas Run State Park has increased since 1937, but has declined in the 2007-2010 period because of development around the Blue Ball Barn area.

Table 3.1. Natural Capital of Alapocas Run State Park	
Year	Natural Capital (in 2012 dollars)
1937	\$67,845/year
2002	\$76,353/year
2007	\$77,591/year
2010	\$72,356/year

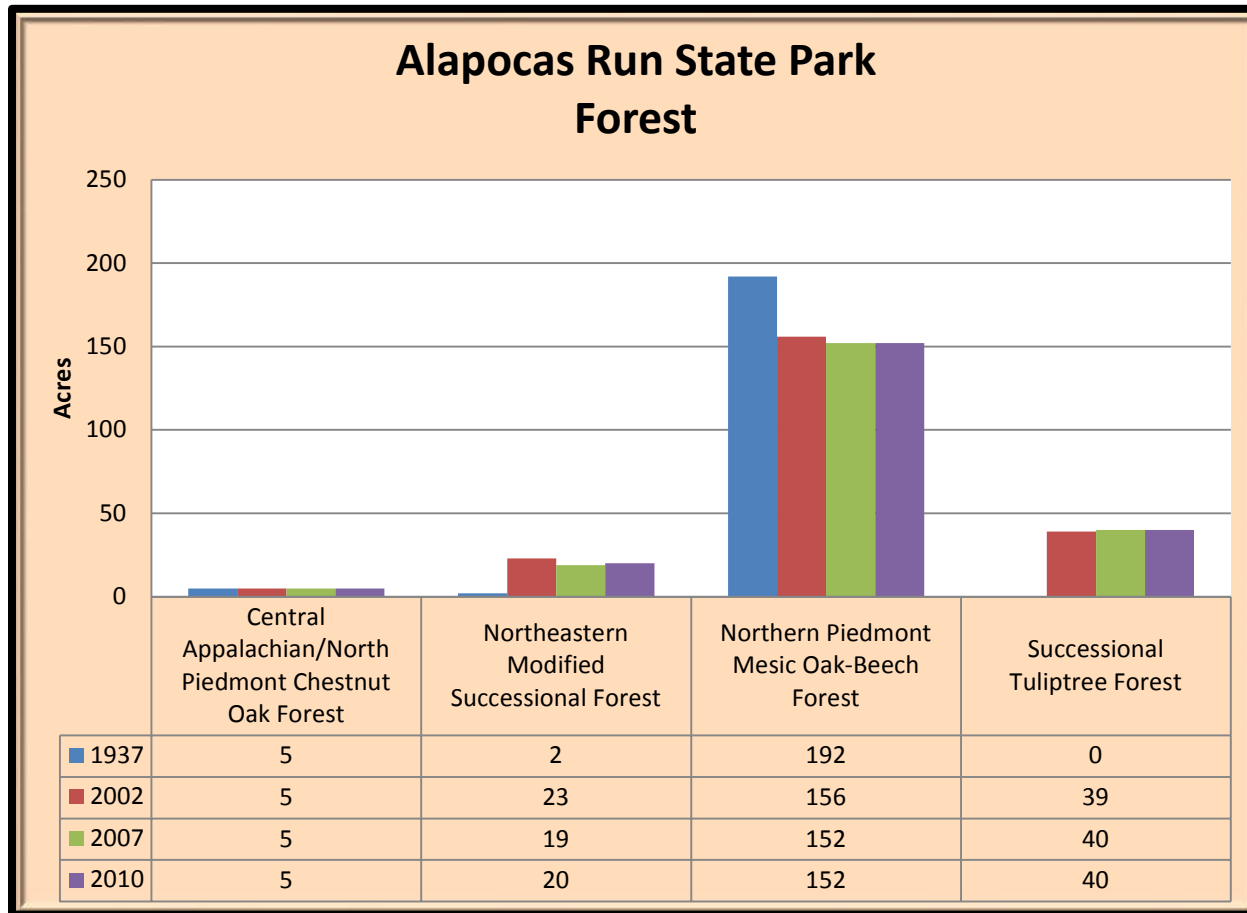


Figure 3.6. Forest at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Alapocas Run State Park Forest (Figure 3.6): Northern Piedmont Mesic Oak-Beech Forest is the most common forest community in Alapocas Run State Park. Successional Tuliptree Forest follows a distant second.

Natural Capital (Table 3.2)

Capital of forest at Alapocas Run State Park has increased since 1937, but has declined from its 2002 high.

Table 3.2. Natural Capital of Alapocas Run State Park Forest	
Year	Natural Capital (in 2012 dollars)
1937	\$37,631/year
2002	\$42,169/year
2007	\$40,846/year
2010	\$41,035/year

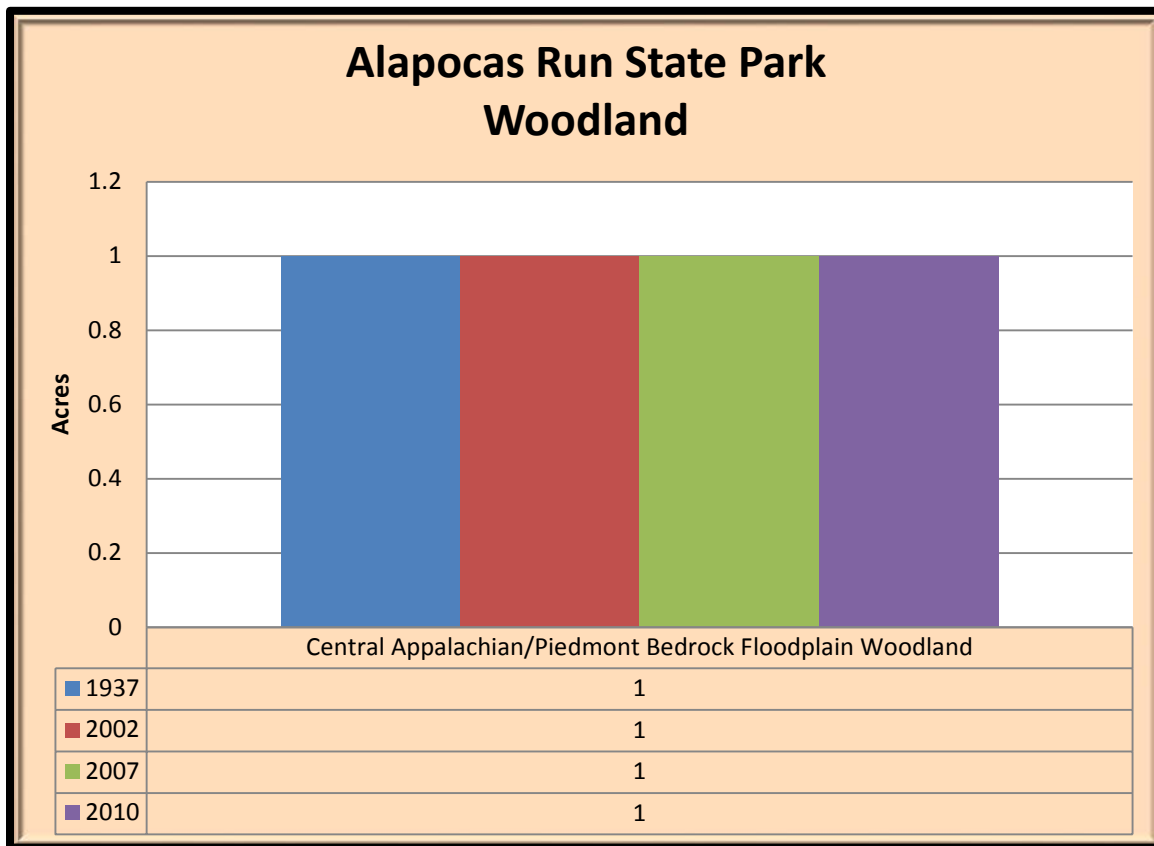


Figure 3.7. Woodland at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Alapocas Run State Park Woodland (Figure 3.7): Central Appalachian/Piedmont Bedrock Floodplain Woodland is the only woodland present in Alapocas Run State Park. It has stayed at the same acreage throughout the study period.

Natural Capital (Table 3.3)

Capital of woodland at Alapocas Run State has remained the same throughout the study period.

Table 3.3. Natural Capital of Alapocas Run State Park Woodland	
Year	Natural Capital (in 2012 dollars)
1937	\$189/year
2002	\$189/year
2007	\$189/year
2010	\$189/year

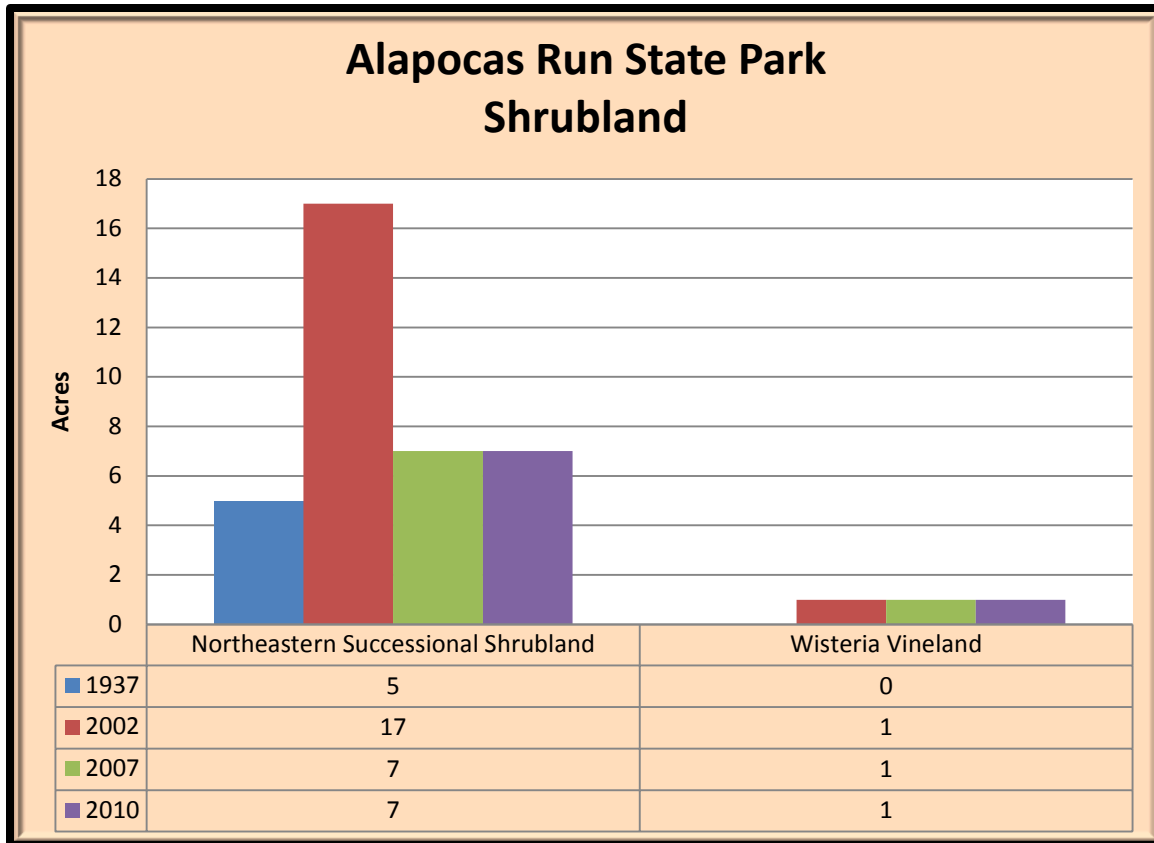


Figure 3.8. Shrubland at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Alapocas Run State Park Shrubland (Figure 3.8): Northeastern Successional Shrubland is the most common shrubland in the park, followed by one of the few occurrences of Wisteria Vineland in the state.

Natural Capital (Table 3.4)

Shrubland capital in Alapocas Run State Park has declined from its 2002 high with conversion of Northeastern Successional Shrubland.

Table 3.4. Natural Capital of Alapocas Run State Park Shrubland	
Year	Natural Capital (in 2012 dollars)
1937	\$729/year
2002	\$2,623/year
2007	\$1,166/year
2010	\$1,166/year

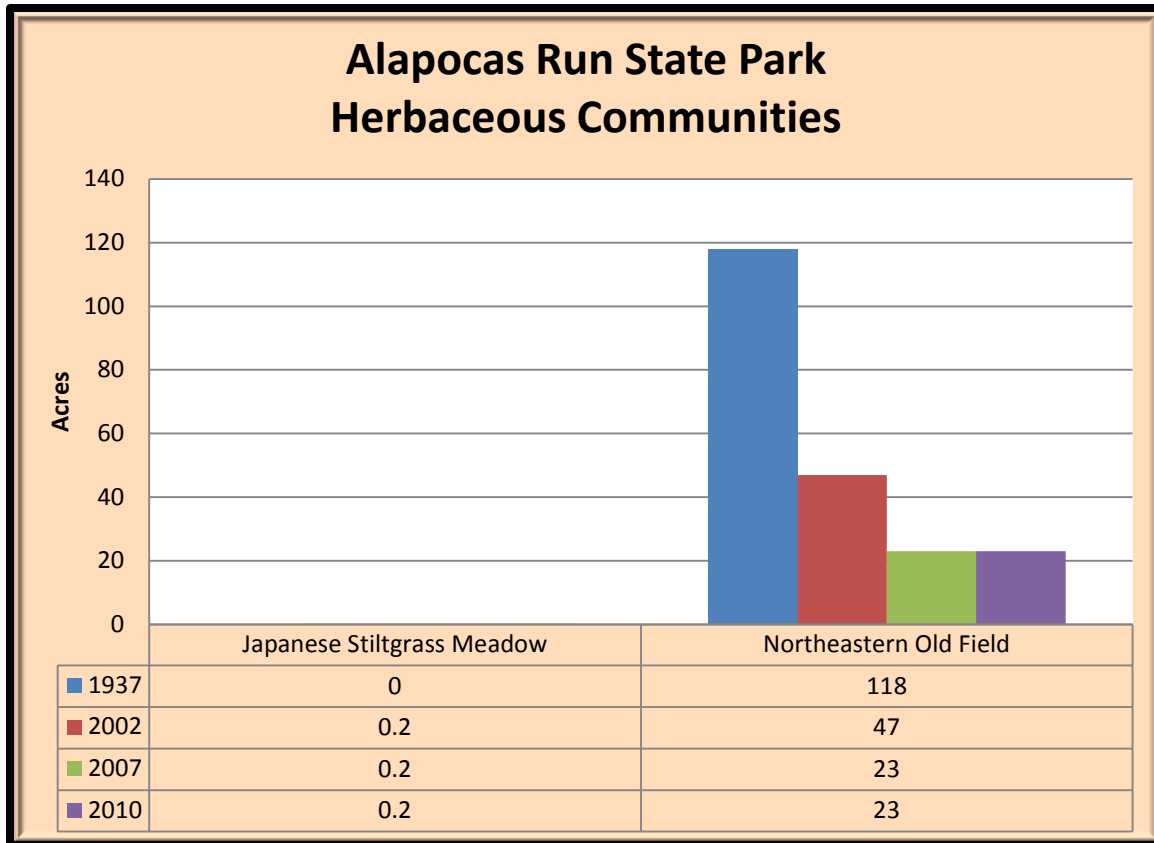


Figure 3.9. Herbaceous Communities at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Alapocas Run State Park Herbaceous Communities (Figure 3.9): Northeastern Old Field is the most common herbaceous community in the park. Its amount has been declining through time. Japanese Stiltgrass Meadow has appeared since 2002 in the park.

Natural Capital (Table 3.5)

Herbaceous community capital has decreased since 1937 with maturation of Northeastern Old Fields.

Table 3.5. Natural Capital of Alapocas Run State Park Herbaceous Communities	
Year	Natural Capital (in 2012 dollars)
1937	\$17,193/year
2002	\$6,877/year
2007	\$3,380/year
2010	\$3,380/year

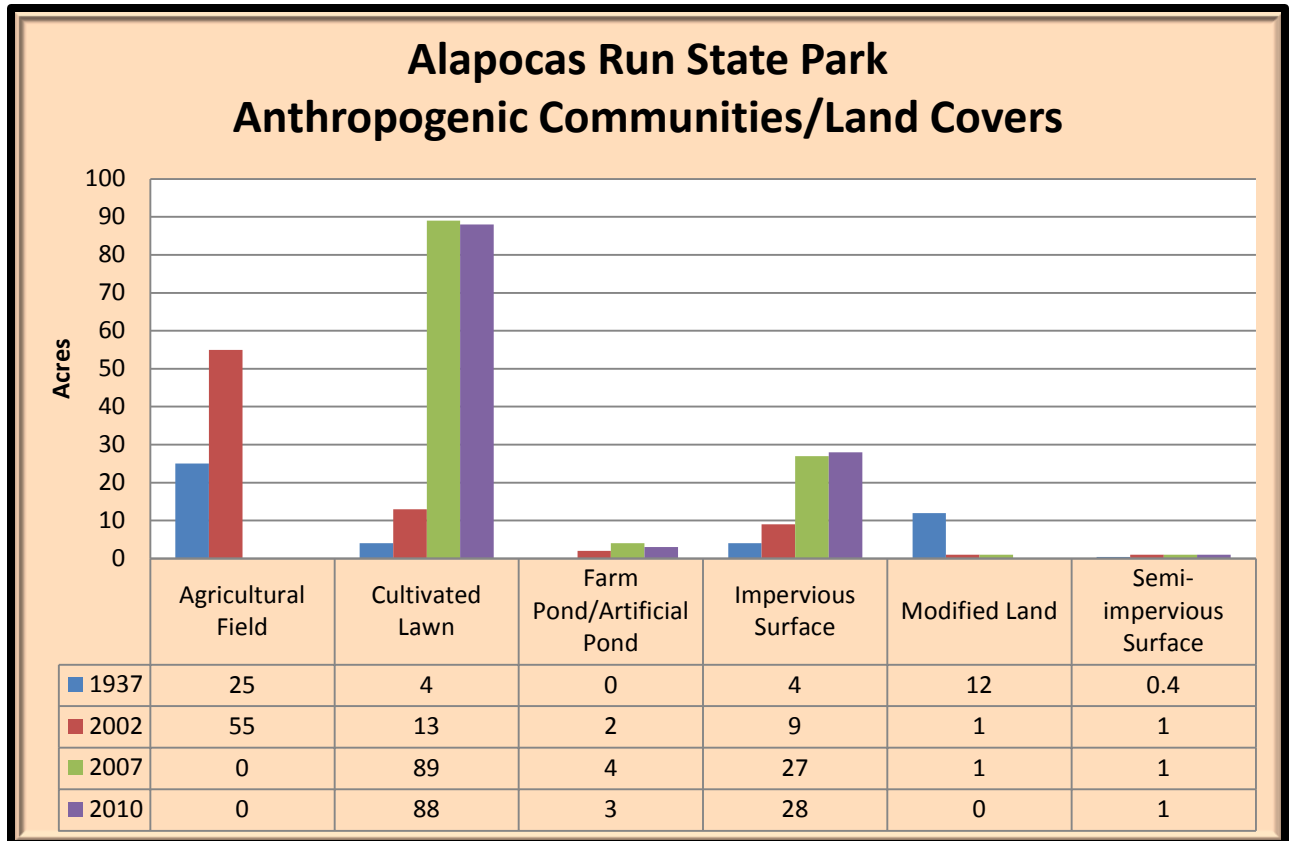


Figure 3.10. Anthropogenic Communities/Land Covers at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Alapocas Run State Park Anthropogenic Communities/Land Covers (Figure 3.10): Cultivated lawn is the most common anthropogenic community/land cover, followed by impervious surface.

Natural Capital (Table 3.6)

Agricultural fields and farm pond/artificial pond are the only anthropogenic communities/land covers with natural capital value. They have increased since 1937, being driven by impoundment capital.

Table 3.6. Natural Capital of Alapocas Run State Park Anthropogenic Communities/Land Covers	
Year	Natural Capital (in 2012 dollars)
1937	\$1,434/year
2002	\$13,824/year
2007	\$21,340/year
2010	\$16,005/year

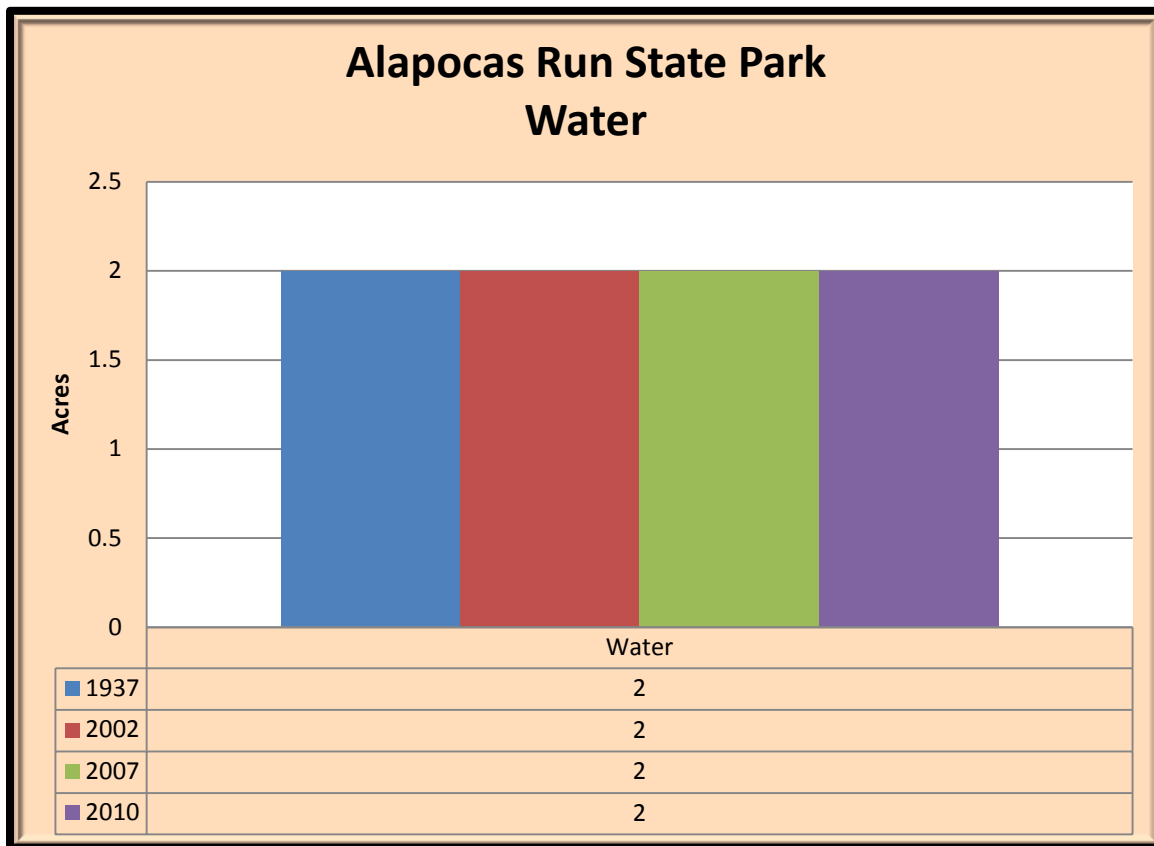


Figure 3.11. Water at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Alapocas Run State Park Water (Figure 3.11): Water has remained at the same acreage throughout the study period.

Natural Capital (Table 3.7)

Capital of water (main stem of Brandywine Creek) has remained steady during the study period.

Table 3.7. Natural Capital of Alapocas Run State Park Water	
Year	Natural Capital (in 2012 dollars)
1937	\$10,670/year
2002	\$10,670/year
2007	\$10,670/year
2010	\$10,670/year

CHAPTER 4: DESCRIPTIONS AND ANALYSIS OF THE VEGETATION COMMUNITIES

Ten 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. Central Appalachian/Northern Piedmont Chestnut Oak Forest (CEGL006299)—5 acres
2. Central Appalachian/Piedmont Bedrock Floodplain Woodland (CEGL006476)—1 acre
3. Cultivated Lawn (CEGL008462)—88 acres
4. Japanese Stiltgrass Meadow (No NVC classification)—0.2 acres
5. Northeastern Modified Successional Forest (CEGL006599)—20 acres
6. Northeastern Old Field (CEGL006107)—23 acres
7. Northeastern Successional Shrubland (CEGL006451)—7 acres
8. Northern Piedmont Mesic Oak-Beech Forest-(CEGL006921)—160 acres
9. Successional Tuliptree Forest (CEGL007220)—32 acres
10. Wisteria Vineland (CEGL008568)—1 acre

Central Appalachian/Northern Piedmont Chestnut Oak Forest [5 acres (Figures 4.1-4.2, Table 4.1)] G5 S2

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

Description

This community is located on steep slopes above Brandywine Creek and is characterized by an often dense understory of mountain laurel (*Kalmia latifolia*). Canopy species include chestnut oak (*Quercus prinus*), red maple (*Acer rubrum*), and American beech (*Fagus grandifolia*). The understory is dominated by mountain laurel, and weakly associated by witch



hazel (*Hamamelis virginiana*). The shrub layer is composed of low-bush blueberry (*Vaccinium pallidum*), arrowwood (*Viburnum dentatum*), and black huckleberry (*Gaylussacia baccata*), and a few white-leaf greenbrier (*Smilax glauca*). Pennsylvania sedge (*Carex pennsylvanica*) is often the only herb present in this community.

All examples of this community are in mature condition in the park.

Figure 4.1. Central Appalachian/Northern Piedmont Chestnut Oak Forest

Analysis of Condition at Alapocas Run State Park

All of the Central Appalachian Chestnut Oak Forest from 1937 was still present in 2010 and it has not migrated into any other communities since 1937. The acreage has been stable throughout the study period.

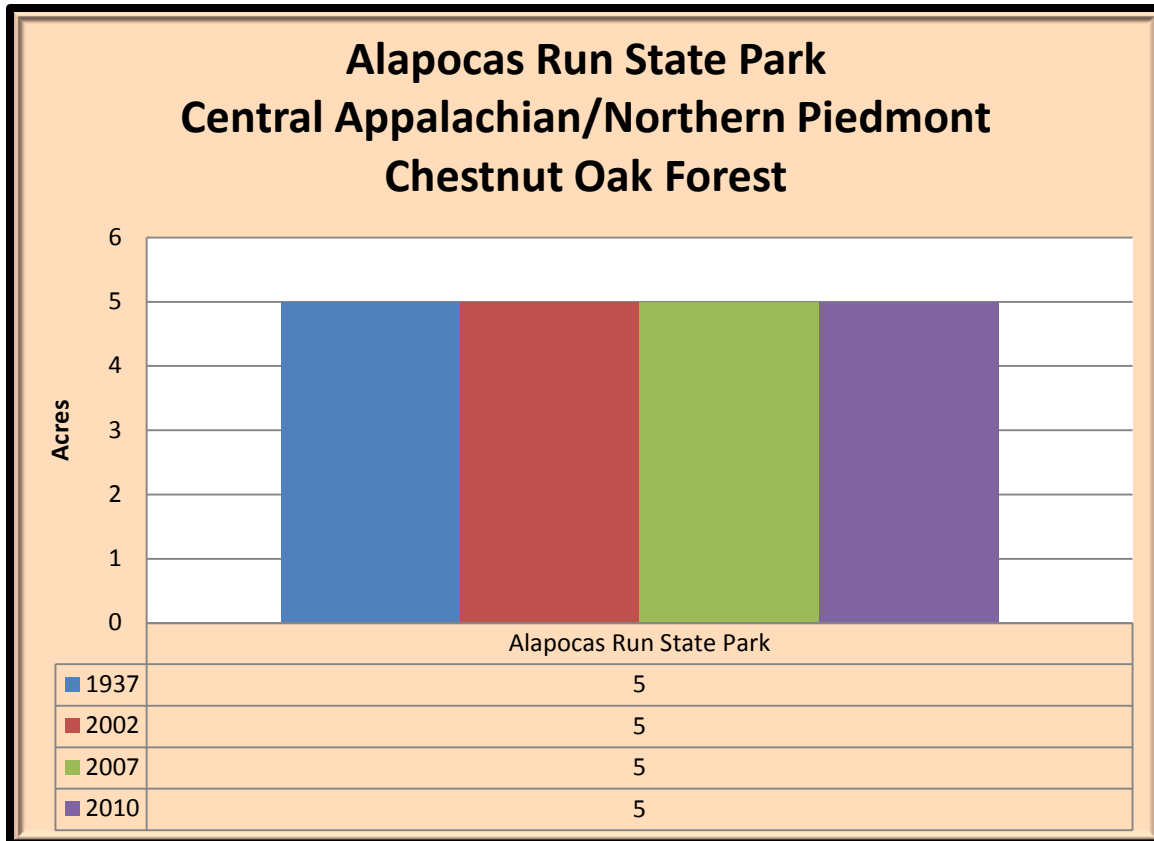


Figure 4.2. Central Appalachian/Northern Piedmont Chestnut Oak Forest at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.1)

The natural capital of Central Appalachian/Northern Piedmont Chestnut Oak Forest has remained stable along with its acreage throughout the study period.

Table 4.1. Natural Capital of Central Appalachian Chestnut Oak Forest	
Year	Natural Capital (in 2012 dollars)
1937	\$946/year
2002	\$946/year
2007	\$946/year

Central Appalachian/Piedmont Bedrock Floodplain Woodland [1 acres (Figure 4.3, Tables 4.2-4.4)] G2 S1.1

**DEWAP: Piedmont Stream Valley Wetlands
NHC: Central Appalachian Stream and Riparian**

Description

The occurrence of this community is the only location in the state of Delaware. The next closest location is on the Susquehanna River in Maryland. Central Appalachian/Piedmont Bedrock Floodplain Woodland is located in a scour zone on the floodplain of Brandywine Creek and contains a low canopy that is interrupted by large debris that is brought by floods.

Common species in the low canopy include green ash (*Fraxinus pennsylvanica*), box elder (*Acer negundo*), red maple (*Acer rubrum*), silver maple (*Acer saccharinum*), and black willow (*Salix nigra*). Honey locust (*Gleditsia tricanthos*), persimmon (*Diospyros virginiana*), and white mulberry (*Morus alba*) make up the understory. Common shrubs and vines include false indigo (*Amorpha fruticosa*), silky dogwood (*Cornus amomum*), multiflora rose (*Rosa multiflora*), and summer grape (*Vitis aestivalis*). Many herbs are present in this community but some of the more common include green-head coneflower (*Rudbeckia laciniata*), blue vervain (*Verbena hastata*), deer-tongue grass (*Dichanthelium clandestinum*), reed canary grass (*Phalaris arundinacea*), Frank’s sedge (*Carex frankii*), path rush (*Juncus tenuis*), and three-nerved Joe-pye-weed (*Eupatorium dubium*).

Analysis of Condition at Alapocas Run State Park

Acreage of Central Appalachian/Piedmont Bedrock Floodplain Woodland has decreased slightly since 1937, but it is still within the rounding amount. A little less than half of the acreage has become Wisteria Vineland since 1937 (Table 4.2). In 2010, about 0.6 acres of the woodland from 1937 were still present (Table 4.3).

Table 4.2. What was Central Appalachian/Piedmont Bedrock Floodplain Woodland in 1937 has become X or remained in 2007	
X	Acreage
Central Appalachian/Piedmont Bedrock Floodplain Woodland	1 acre
Wisteria Vineland	1 acre

Table 4.3. Central Appalachian/Piedmont Bedrock Floodplain Woodland has migrated into X or remained since 1937	
X	Acreage
Central Appalachian/Piedmont Bedrock Floodplain Woodland	1 acre

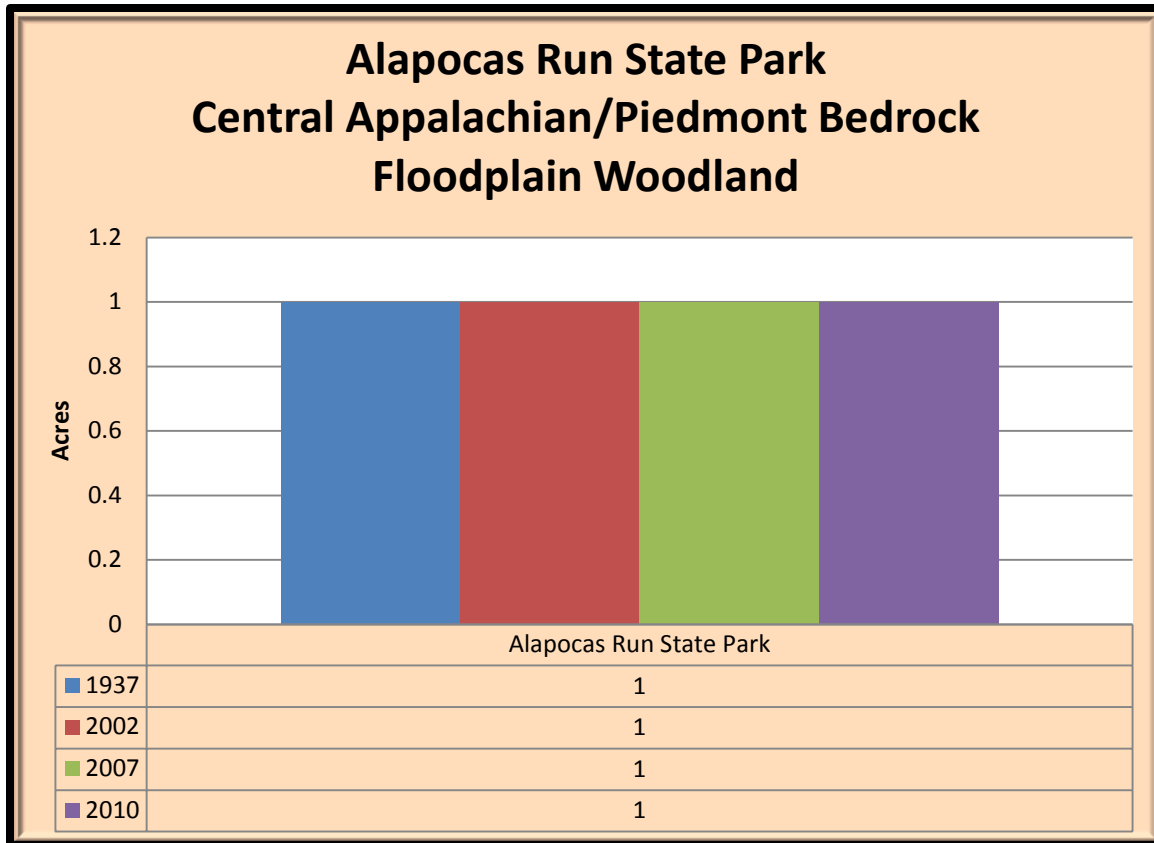


Figure 4.3. Central Appalachian/Piedmont Bedrock Floodplain Woodland at Alapocas Run State Park (1937, 2002, 2007, 2010)

Natural Capital (Table 4.4)

The natural capital of Central Appalachian/Piedmont Bedrock Floodplain Woodland has remained stable along with its acreage throughout the study period.

Table 4.4. Natural Capital of Central Appalachian/Northern Piedmont Bedrock Floodplain Woodland	
Year	Natural Capital (in 2012 dollars)
1937	\$189/year
2002	\$189/year
2007	\$189/year
2010	\$189/year

Cultivated Lawn [88 acres (Figure 4.4, Tables 4-5-4.6)] GNA SNA

DEWAP: No Equivalent Classification

NHC: No Equivalent Classification

Description

This community is located primarily along roadsides, and buildings in the park. It is composed mostly of tall fescue (*Festuca arundinacea*) and other ornamental plants. The grass in this community is mowed more than once per year.

Analysis of Condition at Alapocas Run State Park

Only 1 acre of the 4 acres present in 1937 was still present in 2010. The rest of the acreage had grown into 2 acres of Northeastern Modified Successional Forest and had been developed into 0.4 acres of impervious surface (Table 4.5). Since 1937, cultivated lawn has been developed considerably in the park. Communities that have become cultivated lawn include 66 acres of Northeastern Old Field, 13 acres of agricultural field, 3 acres of Northern Piedmont Mesic Oak-Beech Forest, and 2 acres of Northeastern Successional Shrubland (Table 4.6).

Table 4.5. What was Cultivated Lawn in 1937 has become X or remained in 2010	
X	Acreage
Northeastern Modified Successional Forest	2 acres
Cultivated Lawn	1 acre
Impervious Surface	0.4 acres

Table 4.6. Cultivated Lawn has migrated into X or remained since 1937	
X	Acreage
Northeastern Old Field	66 acres
Agricultural Field	13 acres
Northern Piedmont Mesic Oak-Beech Forest	3 acres
Northeastern Successional Shrubland	2 acres
Cultivated Lawn	1 acre
Other vegetation communities/land covers	1 acre

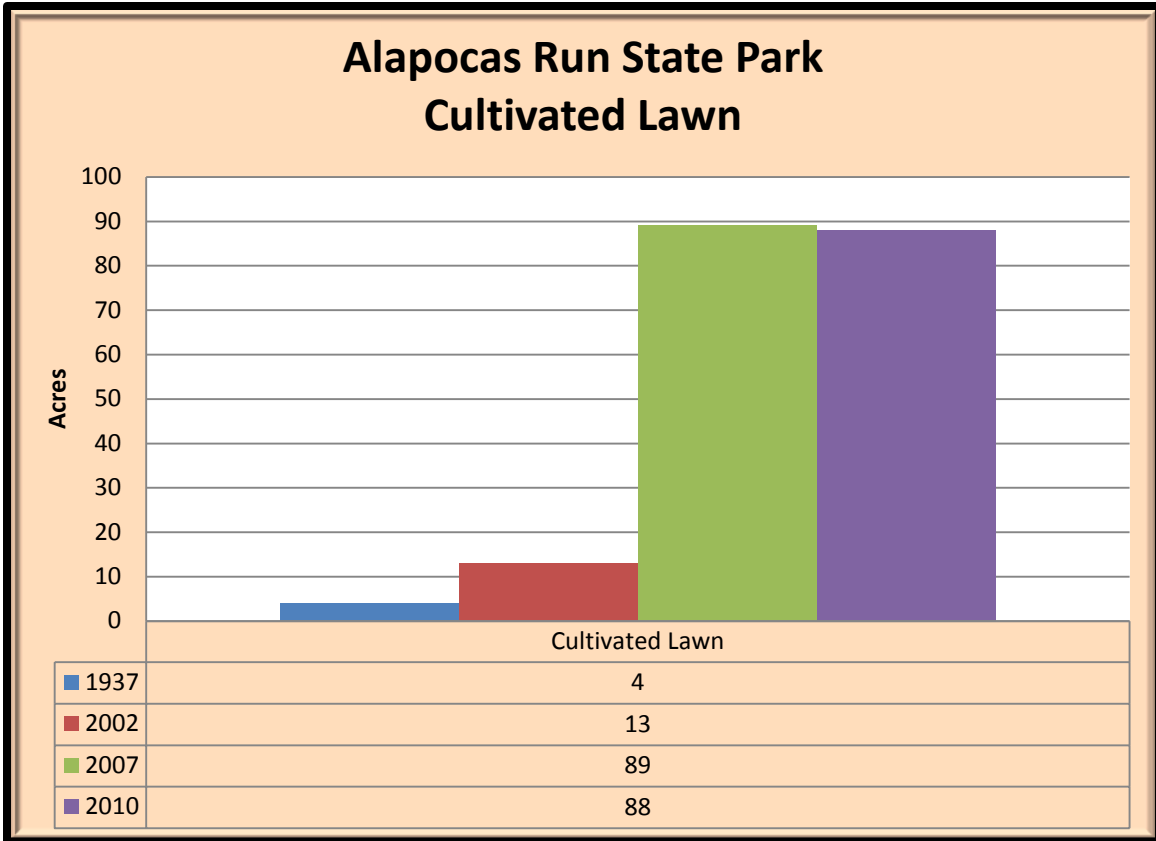


Figure 4.4. Cultivated Lawn at Brandywine Creek State Park (1937, 2002, 2007, and 2010)

Natural Capital

Cultivated lawn does not have any natural capital value.

Japanese Stiltgrass Meadow [0.2 acres, Figure 4.5, Tables 4.7-4.8] GNA SNA

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

Japanese Stiltgrass Meadows are found in places of disturbance such as trails and fields. Japanese stiltgrass (*Microstegium vimineum*) is nearly totally dominant in these areas, but may be joined in small amount by enchanter’s nightshade (*Circaea lutetiana*) and multiflora rose (*Rosa multiflora*).

Analysis of Condition at Alapocas Run State Park

As best as can be told this community was not present in 1937 and has since invaded 0.2 acres of Northern Piedmont Mesic Oak-Beech Forest (Table 4.7).

Table 4.7. Japanese Stiltgrass Meadow has migrated into X or remained since 1937	
X	Acreage
Northern Piedmont Mesic Oak-Beech Forest	0.2 acres

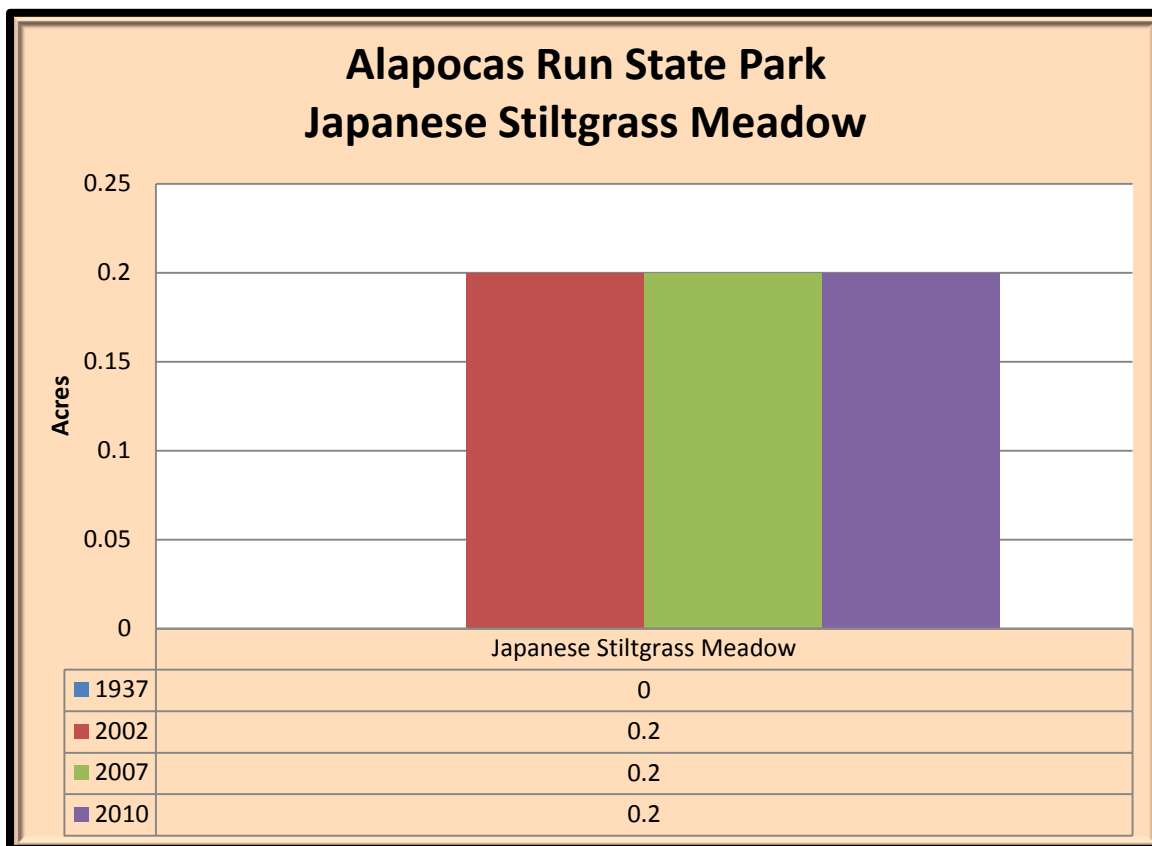


Figure 4.5. Cultivated Lawn at Brandywine Creek State Park (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.8)

Capital of Japanese Stiltgrass Meadow has remained the same since it appeared in 2002.

Table 4.8. Natural Capital of Japanese Stiltgrass Meadow	
Year	Natural Capital (in 2012 dollars)
1937	\$0/year (not present)
2002	\$29/year
2007	\$29/year
2010	\$29/year

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

Description

This community often contains a high amount of tuliptree (*Liriodendron tulipifera*) and can resemble a degraded example of a Successional Tuliptree Forest. Canopy species include tuliptree, sassafras (*Sassafras albidum*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*), and a few black locust (*Robinia pseudoacacia*). The understory is generally dominated by exotic invasive or native invasive plant species distinguishing this community from others. Understory associates include smaller members of the canopy plus Norway maple (*Acer plantanoides*), spicebush (*Lindera benzoin*), bitternut hickory (*Carya cordiformis*), and Chinese privet (*Ligustrum vulgare*). Shrubs may include multiflora rose (*Rosa multiflora*), Oriental bittersweet (*Celastrus orbiculatus*), Siebold’s viburnum (*Viburnum sieboldii*), and winged euonymus (*Euonymus alatus*). Common herbs include garlic mustard (*Alliaria petiolata*), lopseed (*Phyrma leptostachya*), Japanese stiltgrass (*Microstegium vimineum*), enchanter’s nightshade (*Circaea lutetiana*), Christmas fern (*Polystichum acrostichoides*), and herbaceous greenbrier (*Smilax herbacea*).

Generally all of the examples of this community are in the late successional stage, a point at which they remain because of the understory disturbance.

Analysis of Condition at Alapocas Run State Park

All of the former acreage of this community from 1937 has become Northern Piedmont Mesic Oak-Beech Forest (Table 4.9). Since 1937, this community has expanded into 11 acres of Northern Piedmont Mesic Oak-Beech Forest, 2 acres each of cultivated lawn, agricultural field, and Northeastern Old Field, and 1 acre of Impervious Surface (Table 4.10).

Table 4.9. What was Northeastern Modified Successional Forest in 1937 has become X or remained in 2010	
X	Acreage
Northern Piedmont Mesic Oak-Beech Forest	2 acres

Table 4.10. Northeastern Modified Successional Forest has migrated into X or remained since 1937	
X	Acreage
Northern Piedmont Mesic Oak-Beech Forest	11 acres
Cultivated Lawn	2 acres
Agricultural Field	2 acres
Northeastern Old Field	2 acres
Impervious Surface	1 acre
Other vegetation communities/land covers	1 acre

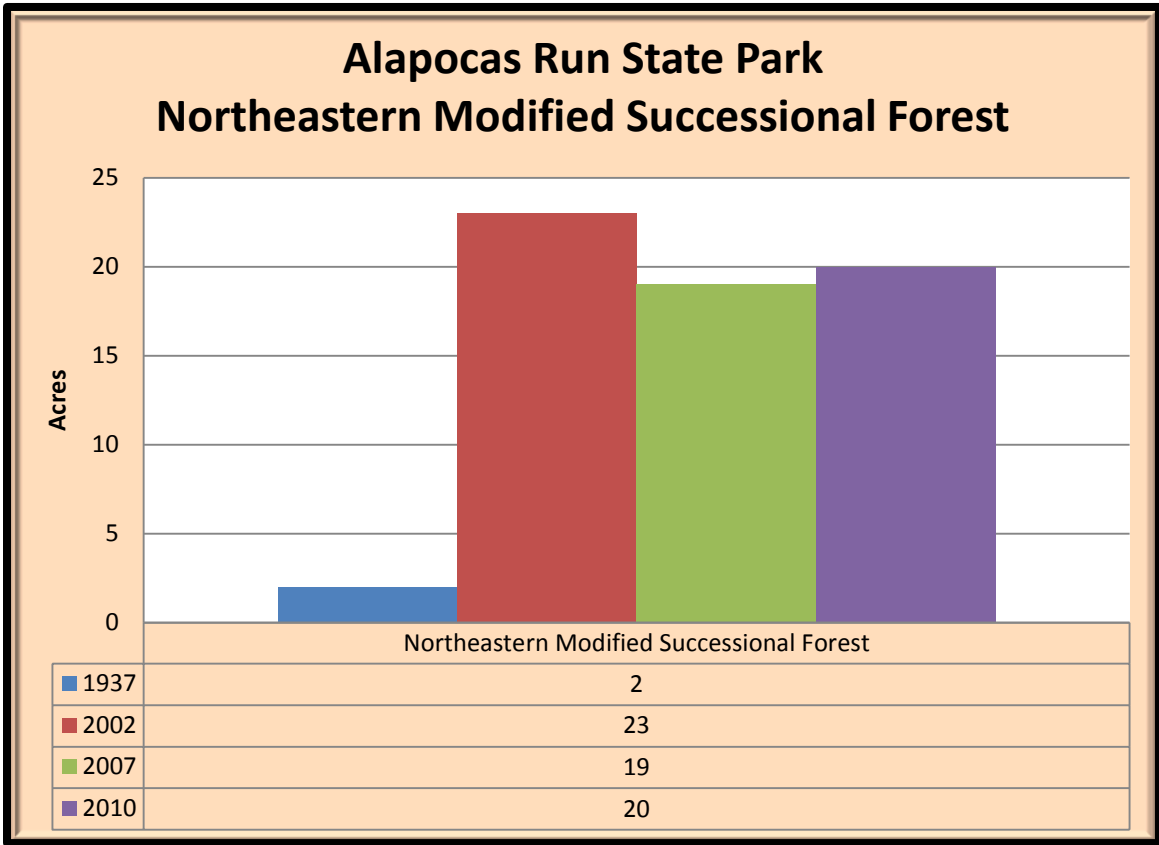


Figure 4.6. Northeastern Modified Successional Forest at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.11)

Natural capital of Northeastern Modified Successional Forest has oscillated with efforts to eradicate the invasive plant species from the forest. The eradication converts this community to a more native forest. Overall the capital for this community has increased since 1937 and has increased in the recent period (2007-2010) showing a resurgence of the invasive plant species.

Table 4.11. Natural Capital of Northeastern Modified Successional Forest	
Year	Natural Capital (in 2012 dollars)
1937	\$378/year
2002	\$4,349/year
2007	\$3,593/year
2010	\$3,782/year

Northeastern Old Field [23 acres (Figure 4.7, Tables 4.12-4.14)] GNA SNA

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

Description

Northeastern Old Fields are common in the upper parts of the Brandywine Creek watershed in Delaware. Alapocas Run State Park, however, is mostly wooded, and does have as many open areas. Most of the fields are located around the Blue Ball Barn. Species in these fields include tall fescue (*Festuca rubra*), sweet vernal grass (*Anthoxanthum odoratum*), orchard grass (*Dactylis glomerata*), common velvet grass (*Holcus lanatus*), and timothy (*Phleum pratense*). Other non-grass species may include Queen Anne’s lace (*Daucus carota*), red clover (*Trifolium pratense*), and daisy fleabane (*Erigeron strigosus*).

Analysis of Condition at Alapocas Run State Park

Only 16 acres of the 118 acres from 1937 still existed in 2010. The rest of the acreage had become 66 acres of cultivated lawn, 17 acres of impervious surface, and had grown into 9 acres of Northern Piedmont Mesic Oak-Beech Forest and 5 acres of Northeastern Successional Shrubland (Table 4.12). Since 1937, Northeastern Old Field has grown from 4 acres of modified land and 3 acres of agricultural field (Table 4.13).

Table 4.12. What was Northeastern Old Field in 1937 has become X or remained in 2010	
X	Acreage
Cultivated Lawn	66 acres
Impervious Surface	17 acres
Northeastern Old Field	16 acres
Northern Piedmont Mesic Oak-Beech Forest	9 acres
Northeastern Successional Shrubland	5 acres
Other vegetation communities/land covers	5 acres

Table 4.13. Northeastern Old Field has migrated into X or remained since 1937	
X	Acreage
Northeastern Old Field	16 acres
Modified Land	4 acres
Agricultural Field	3 acres

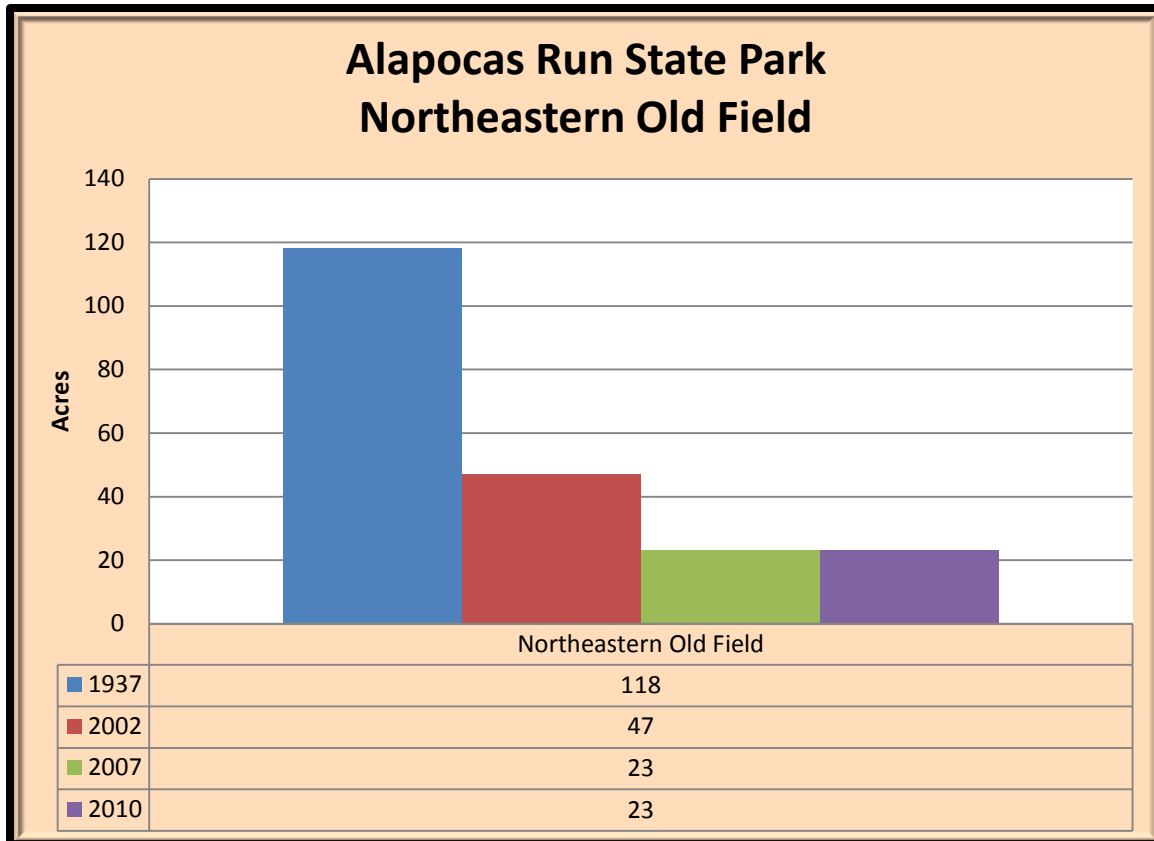


Figure 4.7. Northeastern Old Field at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.14)

Natural capital of Northeastern Old Field has declined as it has matured to shrubland and forest. All of the former agricultural land in the park has converted to another community, so unless a place is kept open it is likely that the rest of the fields will mature transferring their capital.

Table 4.14. Natural Capital of Northeastern Old Field	
Year	Natural Capital (in 2012 dollars)
1937	\$17,193/year
2002	\$6,848/year
2007	\$3,351/year
2010	\$3,351/year

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

Description

Northeastern Successional Shrubland is the intermediate successional community between Northeastern Old Field and Northeastern Modified Successional Forest. Common shrubs in this community include multiflora rose (*Rosa multiflora*), blackberry (*Rubus* sp.), common greenbrier (*Smilax rotundifolia*), Oriental bittersweet (*Celastrus orbiculatus*), and Japanese honeysuckle (*Lonicera japonica*).

Analysis of Condition at Alapocas Run State Park

None of the shrubland present in 1937 still existed in 2010. All of the shrubland had become 2 acres of Northern Piedmont Mesic Oak-Beech Forest, 2 acres of Cultivated Lawn, 0.4 acres of Impervious Surface, and 0.4 acres of Northeastern Modified Successional Forest (Table 4.15). Since 1937, Northeastern Successional Shrubland has appeared in 5 acres of Northeastern Old Field, 2 acres of agricultural field, and 0.4 acres of Northern Piedmont Mesic Oak-Beech Forest (Table 4.16).

Table 4.15. What was Northeastern Successional Shrubland in 1937 has become X or remained in 2010	
X	Acreage
Northern Piedmont Mesic Oak-Beech Forest	2 acres
Cultivated Lawn	2 acres
Impervious Surface	0.4 acres
Northeastern Modified Successional Forest	0.4 acres

Table 4.16. Northeastern Successional Shrubland has migrated into X or remained since 1937	
X	Acreage
Northeastern Old Field	5 acres
Agricultural Field	2 acres
Northern Piedmont Mesic Oak-Beech Forest	0.4 acres

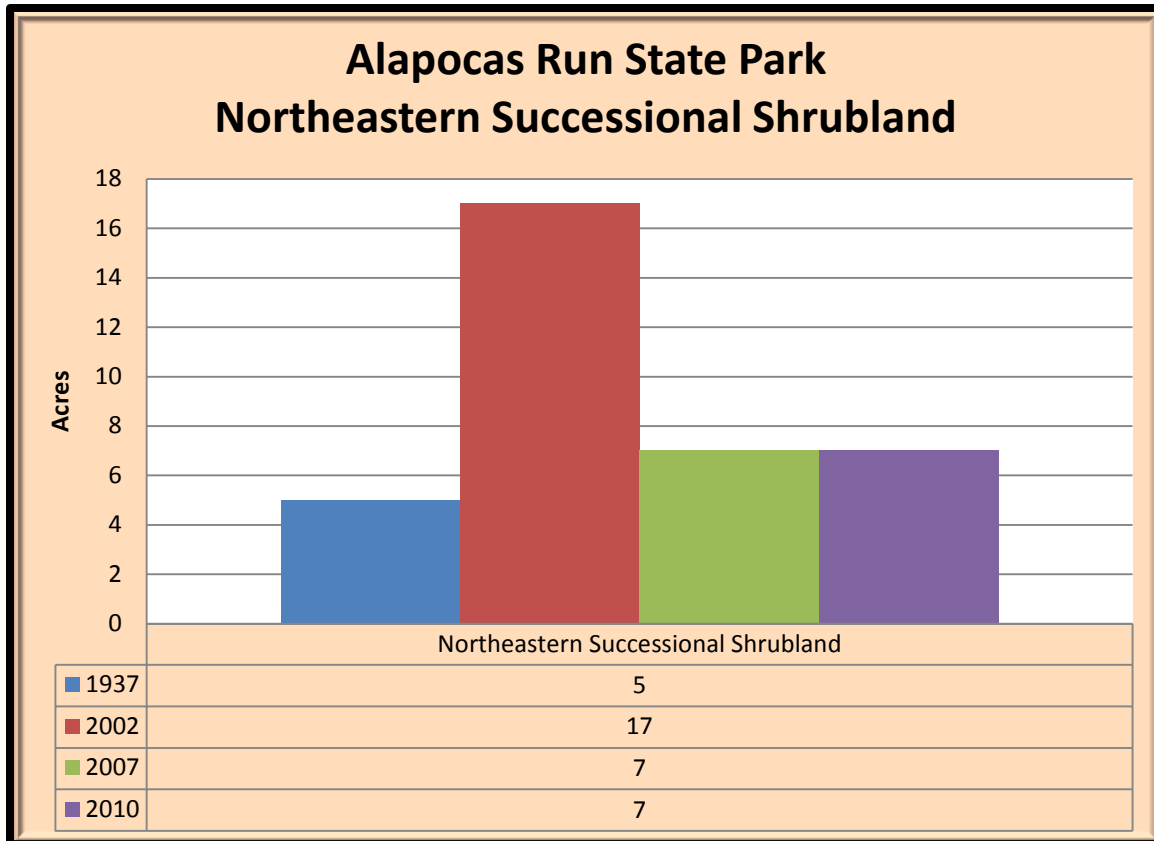


Figure 4.8. Northeastern Successional Shrubland at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.17)

Capital of Northeastern Successional Shrubland has increased overall from 1937 but decreased in the 2002-2007 period. It has been stable in 2007-2010.

Table 4.17. Natural Capital of Northeastern Successional Shrubland	
Year	Natural Capital (in 2012 dollars)
1937	\$729/year
2002	\$2,477/year
2007	\$1,020/year
2010	\$1,020/year

Northern Piedmont Mesic Oak-Beech Forest [160 acres (Figures 4.9-4.10, Tables 4.18-4.20)]

G5 S5

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

Description

This is the most common forested community in the park and in the Piedmont of Delaware. American beech (*Fagus grandifolia*) is a typical and characteristic canopy species and is associated by tuliptree (*Liriodendron tulipifera*), red maple (*Acer rubrum*), northern red oak (*Quercus rubra*), white oak (*Quercus alba*), and black oak (*Quercus velutina*). The understory contains flowering dogwood (*Cornus florida*), black gum (*Nyssa sylvatica*), and smaller canopy species. The shrub and vine layer includes maple-leaf viburnum (*Viburnum acerifolium*), lowbush blueberry (*Vaccinium pallidum*), and deciduous azalea (*Rhododendron periclymenoides*). Common herbs include white wood aster (*Eurybia divaricata*), Solomon's seal (*Polygonatum biflorum*), false solomon's seal (*Maianthemum racemosum*), and woodland



goldenrod (*Solidago caesia*). One example in the park contains swamp chestnut oak (*Quercus michauxii*) in the canopy and netted chain fern (*Woodwardia areolata*) in the herbaceous layer. Both of these species are disjunct from the coastal plain.

All of the occurrences of this community in the park are in late successional to mature condition with well-developed layering and 1.5-2.0 foot dbh canopy trees.

Figure 4.9. Northern Piedmont Mesic Oak-Beech Forest

Analysis of Condition at Alapocas Run State Park

In 2007, 132 acres of the 192 acres present in 1937 still existed. The rest of the acreage had become 40 acres of Successional Tuliptree Forest (likely via a clear-cut), 11 acres of Northeastern Modified Successional Forest, 4 acres of Impervious Surface, and 3 acres of cultivated lawn (Table 4.18). Since 1937, this community has grown into 9 acres of Northeastern Old Field, 7 acres of Modified Land, 2 acres of Northeastern Successional Shrubland, and 2 acres of Northeastern Modified Successional Forest (Table 4.19).

Table 4.18. 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	132 acres
Successional Tuliptree Forest	40 acres
Northeastern Modified Successional Forest	11 acres
Impervious Surface	4 acres
Cultivated Lawn	3 acres
Other vegetation communities/land covers	1 acre

Table 4.19. Northern Piedmont Mesic Oak-Beech Forest has migrated into X or remained since 1937	
X	Acreage
Northern Piedmont Mesic Oak-Beech Forest	132 acres
Northeastern Old Field	9 acres
Modified Land	7 acres
Northeastern Successional Shrubland	2 acres
Northeastern Modified Successional Forest	2 acres

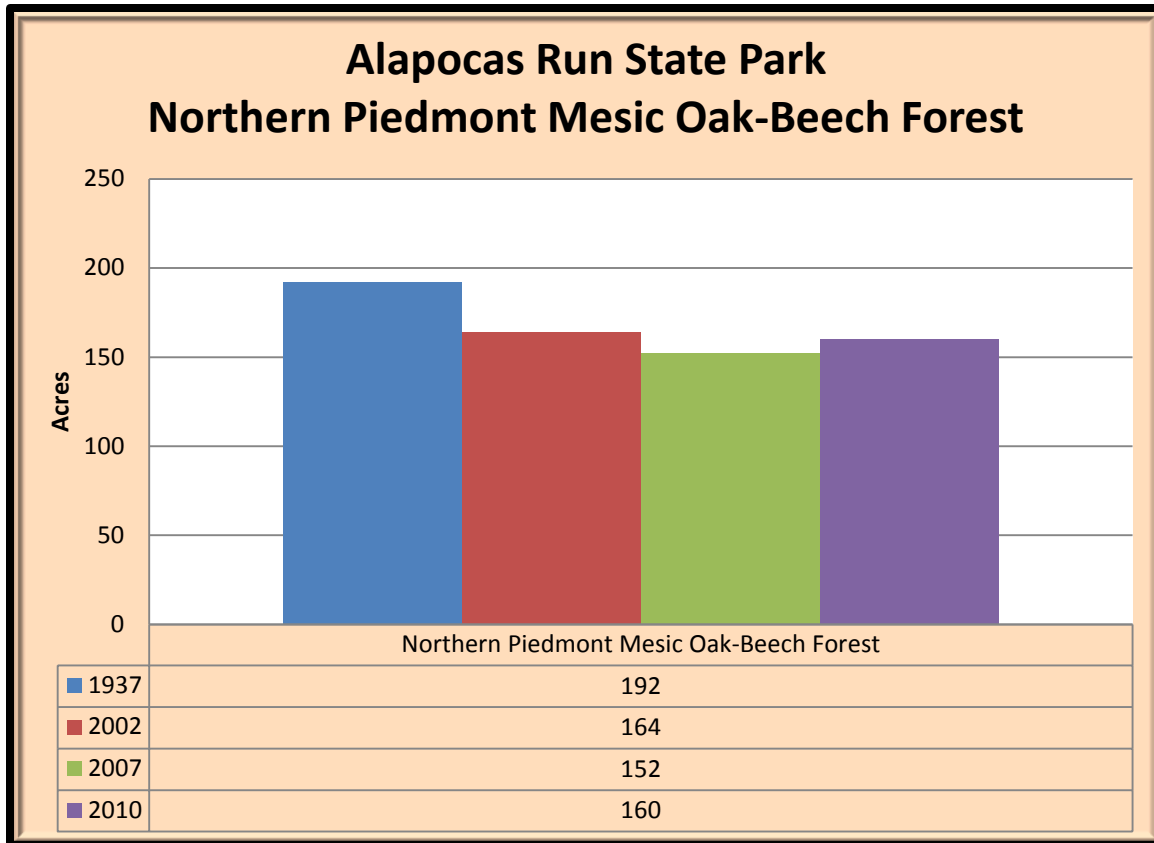


Figure 4.10. Northern Piedmont Mesic Oak-Beech Forest at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.20)

Capital of Northern Piedmont Mesic Oak-Beech Forest has oscillated with its acreage. Overall it has declined and is mainly due to conversion to other forest types and development in the park.

Year	Natural Capital (in 2012 dollars)
1937	\$36,307/year
2002	\$31,012/year
2007	\$28,743/year
2010	\$30,256/year

Successional Tuliptree Forest [32 acres (Figure 4.11, Tables 4.21-4.22)] GNA SNA

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

Description

This successional forest community is located on the higher slopes near the hospital and is dominated by tuliptree (*Liriodendron tulipifera*). Other canopy associates include red maple (*Acer rubrum*), white oak (*Quercus alba*), pignut hickory (*Carya glabra*), and a few American beech (*Fagus grandifolia*). The understory is composed of smaller members of the canopy plus blackgum (*Nyssa sylvatica*), spicebush (*Lindera benzoin*), pawpaw (*Asimina triloba*), American hornbeam (*Carpinus caroliniana*), and witch hazel (*Hamamelis virginiana*). The shrub and vine layer contains arrowwood (*Viburnum dentatum*), poison ivy (*Toxicodendron radicans*), Oriental bittersweet (*Celastrus orbiculatus*), and a few mountain laurel (*Kalmia latifolia*). Common herbs include wild yam (*Dioscorea villosa*), white wood aster (*Eurybia divaricata*), joe-pye-weed (*Eupatorium purpureum*), Japanese stiltgrass (*Microstegium vimineum*), hay-scented fern (*Dennstedtia punctilobula*), and Canadian clearweed (*Pilea pumila*).

Analysis of Condition at Alapocas Run State Park

All of the current Successional Tuliptree Forest came from Northern Piedmont Mesic Oak-Beech Forest, likely through cutting. These forest may succeeding back to Northern Piedmont Mesic Oak-Beech Forest given the species mix.

Table 4.21. Successional Tuliptree Forest has migrated into X or remained since 1937	
X	Acreage
Northern Piedmont Mesic Oak-Beech Forest	40 acres

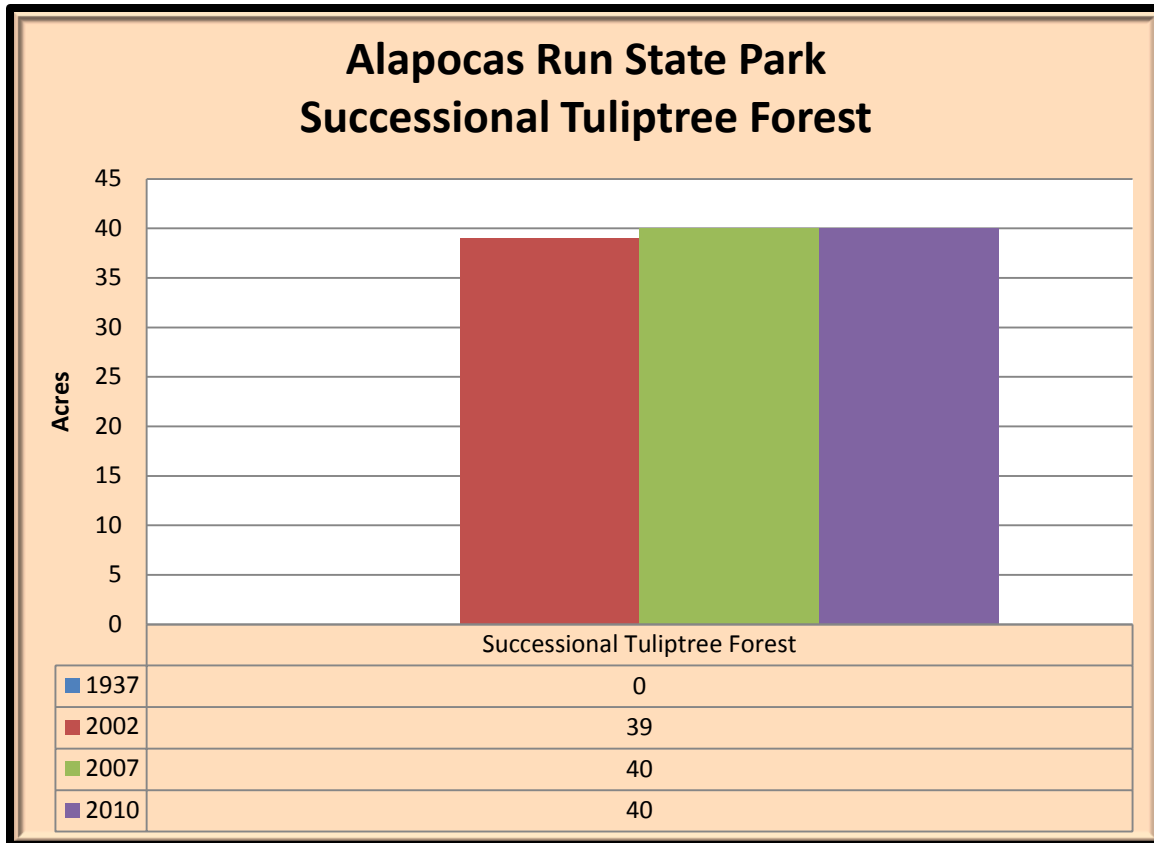


Figure 4.11. Successional Tuliptree Forest at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.22)

Capital of Successional Tuliptree Forest has increased to \$7,564 since 1937 when it was not present.

Table 4.22. Natural Capital of Successional Tuliptree Forest	
Year	Natural Capital (in 2012 dollars)
1937	\$0/year (not present)
2002	\$7,375/year
2007	\$7,564/year
2010	\$7,564/year

***Wisteria Vineland* [1 acre (Figures 4.12-4.13, Table 4.23)]**

GNA SNA

**DEWAP: Piedmont Stream Valley Wetlands
NHC: Semi-natural/Altered Vegetation and Conifer Plantations**

Description



Figure 4.12. Wisteria Vineland

This shrubland is located in a scour floodplain just downstream of the Central Appalachian/Piedmont Bedrock Floodplain Woodland. Wisteria (*Wisteria sinensis*) is the dominant species. Other associates are a smattering of the herbaceous species in the Central Appalachian/Piedmont Bedrock Floodplain Woodland.

Analysis of Condition at Alapocas Run State Park

All of the current Wisteria Vineland has originated from Central Appalachian/Piedmont Bedrock Floodplain Woodland present in 1937.

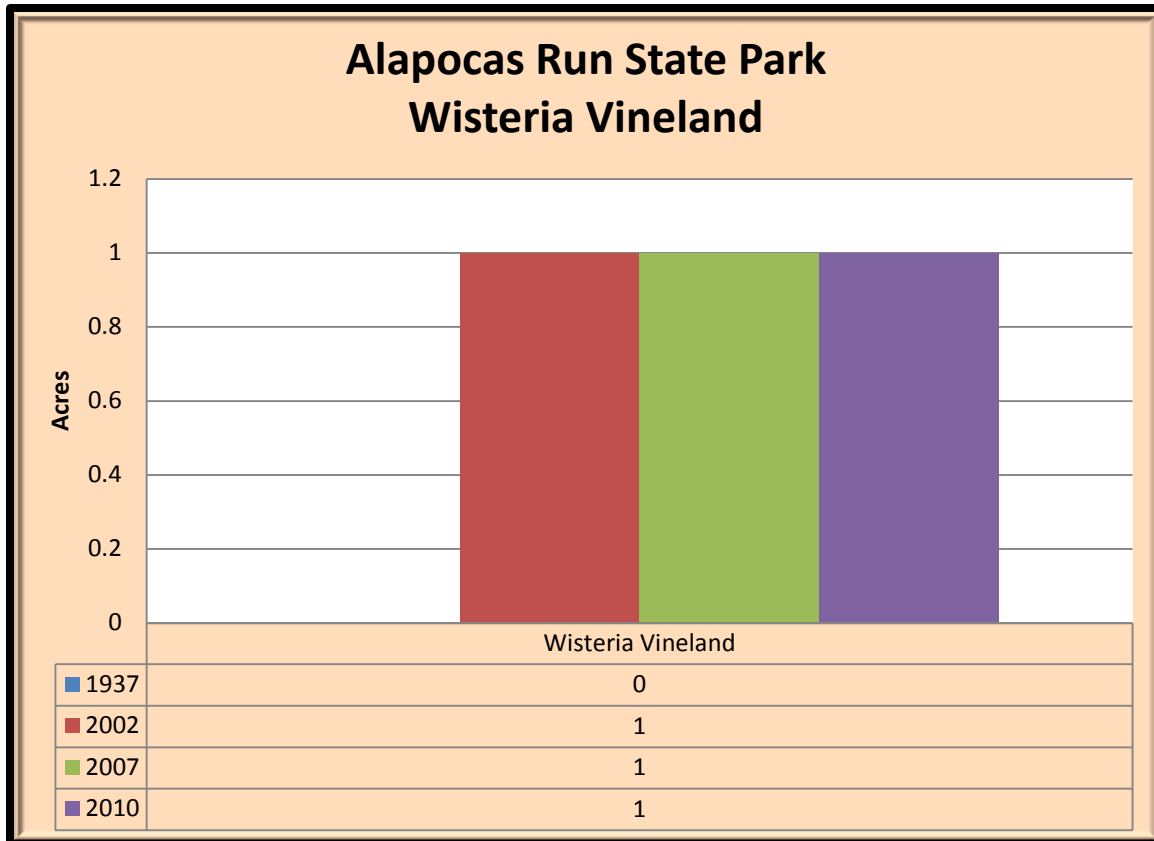


Figure 4.13. Wisteria Vineland at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.23)

Capital of Wisteria vineland has stayed the same since 2002. Its appearance has resulted in a capital loss for the park.

Table 4.23. Natural Capital of Wisteria Vineland	
Year	Natural Capital (in 2012 dollars)
1937	\$0/year (not present)
2002	\$146/year
2007	\$146/year
2010	\$146/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. Farm Pond/Artificial Pond—3 acres
2. Impervious Surface—28 acres
3. Semi-impervious Surface—1 acre
4. Water—2 acres

Agricultural Field [0 acres, (Figure 5.1, Tables 5.1-5.2)]

DEWAP: No Equivalent Classification

NHC: No Equivalent Classification

Description

Agricultural field is no longer present within the park and has been converted to developed uses.

Analysis of Condition at Alapocas Run State Park

Agricultural Field is no longer present in the park and has been converted to 13 acres of cultivated lawn, 4 acres of impervious surface, 3 acres of Northeastern Old Field, 2 acres of Northeastern Modified Successional Forest, and 2 acres of Northeastern Successional Shrubland (Table 5.1).

Table 5.1. What was Agricultural Field in 1937 has become X or remained in 2010	
X	Acreage
Cultivated Lawn	13 acres
Impervious Surface	4 acres
Northeastern Old Field	3 acres
Northeastern Modified Successional Forest	2 acres
Northeastern Successional Shrubland	2 acres

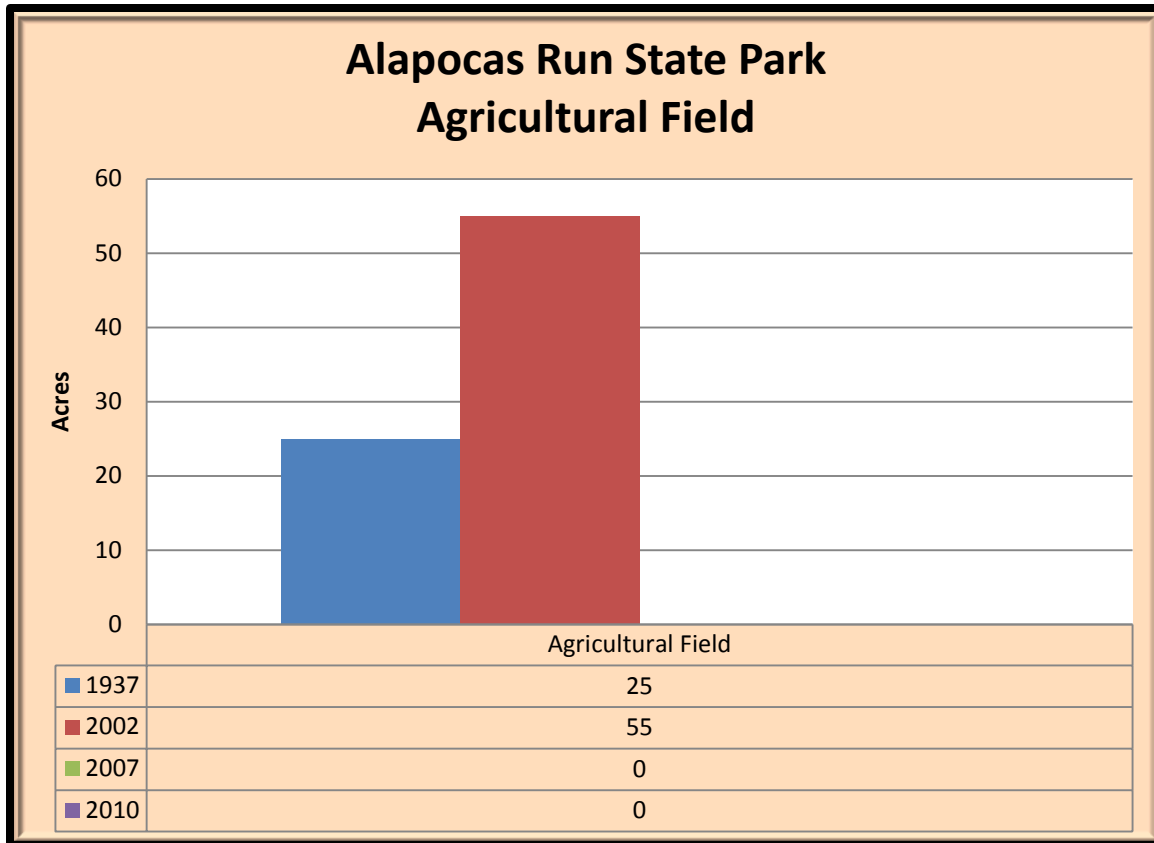


Figure 5.1. Agricultural Field at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Natural Capital (Table 5.2)

Capital of agricultural field has mostly been lost to development but some did transfer to Northeastern Old Field and Northeastern Successional Shrubland.

Table 5.2. Natural Capital of Agricultural Field	
Year	Natural Capital (in 2012 dollars)
1937	\$1,434/year
2002	\$3,154/year
2007	\$0/year (not present)
2010	\$0/year (not present)

Farm Pond/Artificial Pond [3 acres, (Figure 5.2, Tables 5.3-5.4)]

**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 Alapocas Run State Park

No farm pond/artificial pond was present in 1937 and have since been developed on 3 acres of Northeastern Old Field and 0.3 acres of Modified Land (Table 5.3).

Table 5.3. Farm Pond/Artificial Pond has been developed into X or remained since 1937	
X	Acreage
Northeastern Old Field	3 acres
Modified Land	0.3 acres

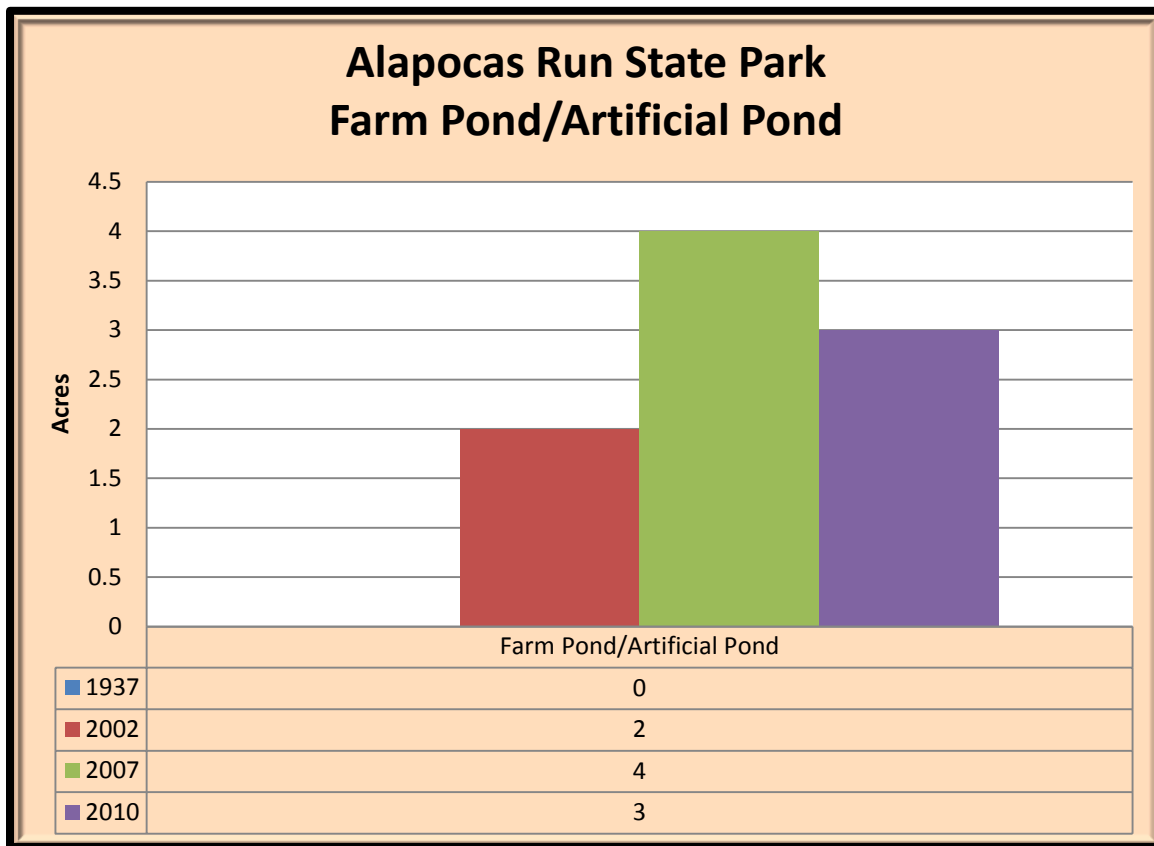


Figure 5.2. Farm Pond/Artificial Pond at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Natural Capital (Table 5.4)

Capital of Farm Pond/Artificial Pond has oscillated with its acreage during the study period.

Table 5.4. Natural Capital of Farm Pond/Artificial Pond	
Year	Natural Capital (in 2012 dollars)
1937	\$0/year (not present)
2002	\$10,670/year
2007	\$21,340/year
2010	\$16,005/year

Impervious Surface [28 acres, (Figure 5.3, Tables 5.5-5.6)]

DEWAP: No Equivalent Classification

NHC: No Equivalent Classification

Description

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

Analysis of Condition at Alapocas Run State Park

About half of the impervious surface area in 1937 was still present in 2010. The rest had become 1 acre of Northeastern Modified Successional Forest and 1 acre of cultivated lawn (Table 5.5). Since 1937, impervious surface has been placed on 17 acres of Northeastern Old Field, 4 acres of Northern Piedmont Mesic Oak-Beech Forest, 4 acres of agricultural field, and 0.4 acres of cultivated lawn (Table 5.6).

Table 5.5. What was Impervious Surface in 1937 has become X or remained in 2010	
X	Acreage
Impervious Surface	2 acres
Northeastern Modified Successional Forest	1 acre
Cultivated Lawn	1 acre

Table 5.6. Impervious Surface has been developed into X or remained since 1937	
X	Acreage
Northeastern Old Field	17 acres
Northern Piedmont Mesic Oak-Beech Forest	4 acres
Agricultural Field	4 acres
Impervious Surface	2 acres
Cultivated Lawn	0.4 acres
Other vegetation communities/land covers	1 acre

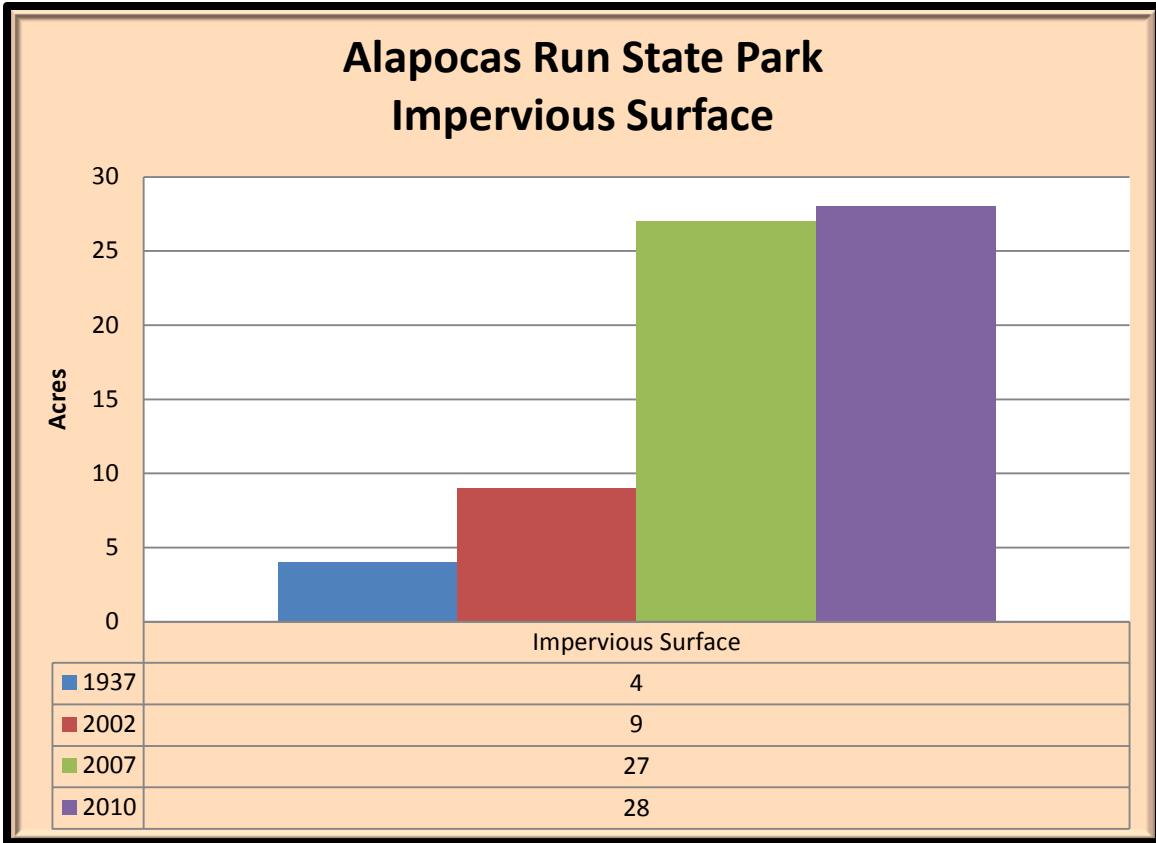


Figure 5.3. Impervious Surface at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Natural Capital

Impervious Surface does have any natural capital value.

Modified Land [0 acres, (Figure 5.4, Table 5.7)]

DEWAP: No Equivalent Classification

NHC: No Equivalent Classification

Description

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

Analysis of Condition at Alapocas Run State Park

None of the modified land from 1937 is still present and it is not currently present in the park. The former modified land has become 7 acres of Northern Piedmont Mesic Oak-Beech Forest, 4 acres of Northeastern Old Field, 0.4 acres of cultivated lawn, 0.3 acres of Farm Pond/Artificial Pond, and 0.2 acres of Impervious Surface (Table 5.7).

Table 5.7. What was Modified Land in 1937 has become X or remained in 2010	
X	Acreage
Northern Piedmont Mesic Oak-Beech Forest	7 acres
Northeastern Old Field	4 acres
Cultivated Lawn	0.4 acres
Farm Pond/Artificial Pond	0.3 acres
Impervious Surface	0.2 acres

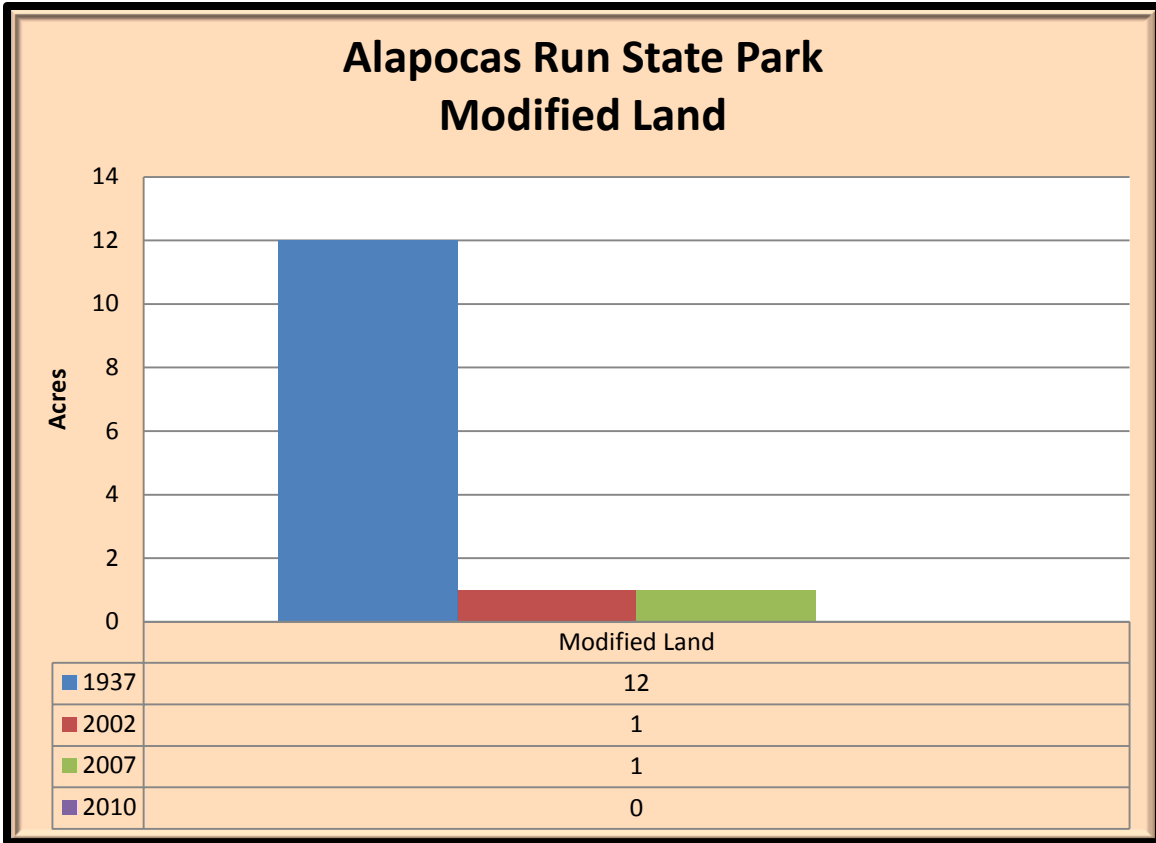


Figure 5.4. Modified Land at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Natural Capital

Modified Land does have any natural capital value.

Semi-impervious Surface [1 acres, (Figure 5.5)]

DEWAP: No Equivalent Classification

NHC: No Equivalent Classification

Description

Semi-impervious Surface includes those places where the flow of water is impeded such as a dirt road or trail.

Analysis of Condition at Alapocas Run State Park

The entire semi-impervious surface from 1937 has become Northeastern Modified Successional Forest and the entire semi-impervious surface currently present was developed in Northern Piedmont Mesic Oak-Beech Forest.

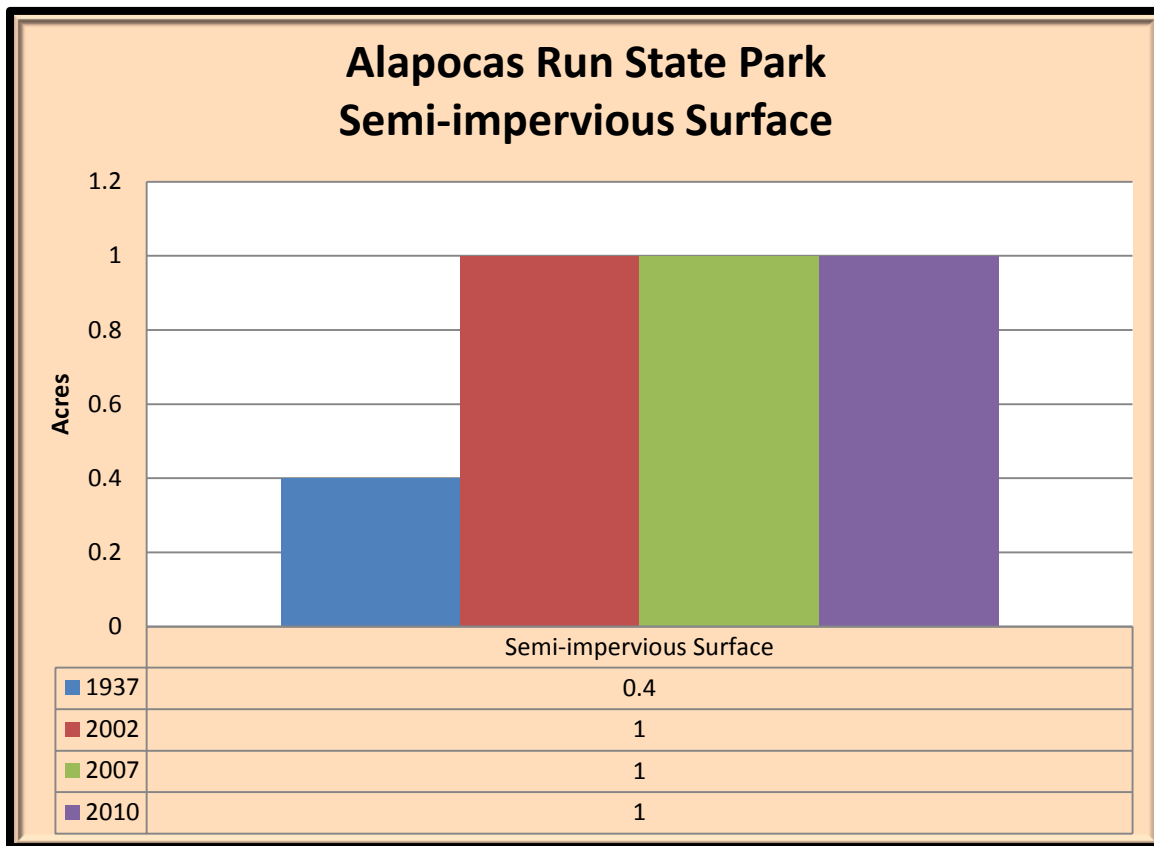


Figure 5.5. Semi-impervious Surface at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Natural Capital

Semi-impervious Surface does have any natural capital value.

Water [2 acres, (Figure 5.6, Table 5.8)]

DEWAP: No Equivalent Classification

NHC: No Equivalent Classification

Description

Agricultural field is no longer present within the park and has been converted to developed uses.

Analysis of Condition at Alapocas Run State Park

Water has not changed since 1937 except for about 0.1 acres of impervious surface has been developed on it and is within the rounding error.

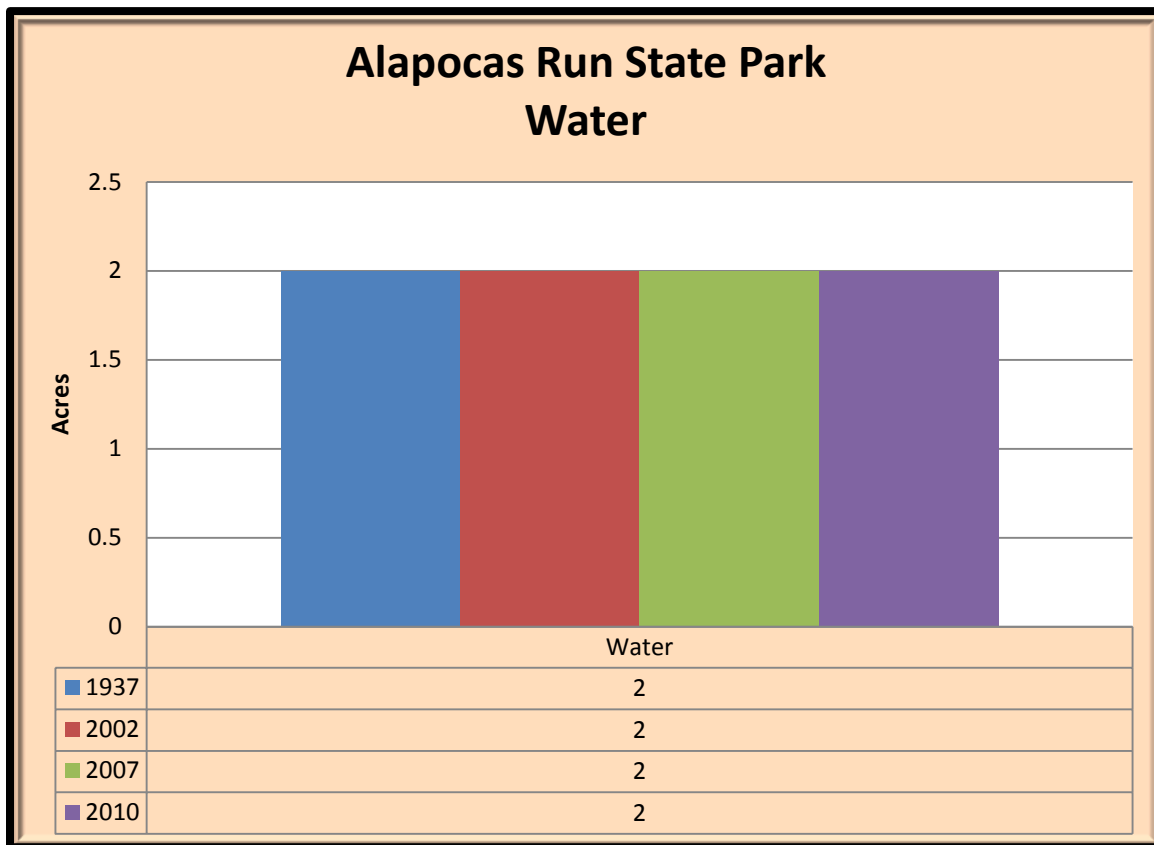


Figure 5.6. Water at Alapocas Run State Park (1937, 2002, 2007, and 2010)

Natural Capital (Table 5.8)

Capital of water has been stable along with its acreage.

Table 5.8. Natural Capital of Water	
Year	Natural Capital (in 2012 dollars)
1937	\$10,670/year
2002	\$10,670/year
2007	\$10,670/year
2010	\$10,670/year

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

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