Historical Analysis and Map of Vegetation Communities, Land Covers, and Habitats of Killens Pond State Park Kent County, Delaware

Murderkill River Watershed

Submitted to:

Delaware State Parks
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October 4, 2012

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CHAPTER 1: INTRODUCTION AND METHODS

Setting of Killens Pond State Park

Killens Pond State Park is located in southern Kent County, Delaware (Figure 1.1). The State Park totals 1,441 acres in one tract. The park is located wholly within the Murderkill River drainage.

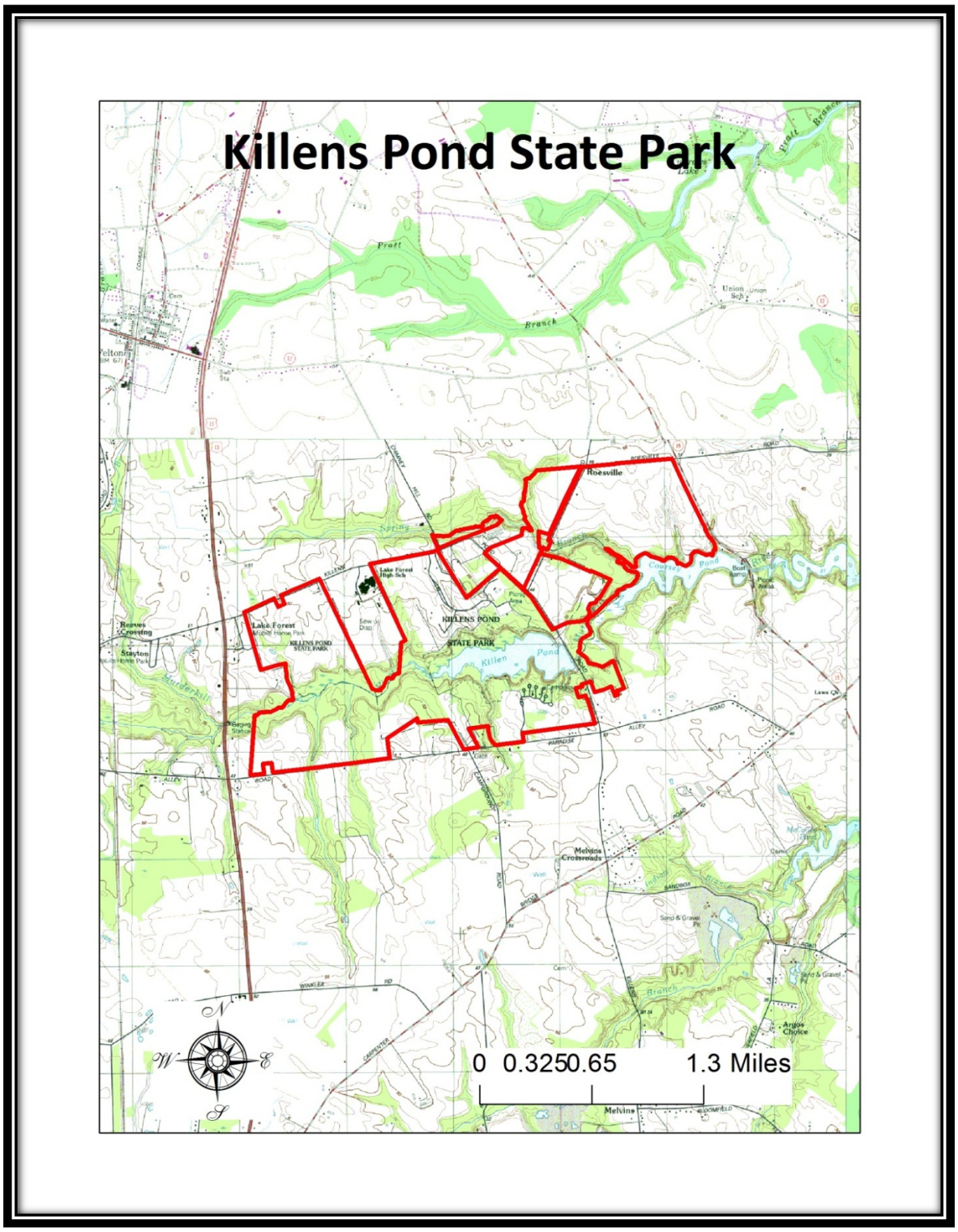


Figure 1.1. Location of Killens Pond State Park

History and Formation of Killens Pond State Park

Early History of the Land[1]

The land that became Killens Pond State park was once part of at least three plantations. The lower end of Coursey Pond was part of "Cambridge" which was owned by Dr. John Moore and Thomas Coursey. Both of these owners operated a grist mill and saw mill. The upper end of Coursey Pond and lower end of Killens Pond was part of "Fromes Elsworth", which was patented to John Brown by William Penn. The upper end of Killens Pond was likely part of "Andrews Venture", which was owned by Thomas Parke.

Formation of Killens Pond State Park

Killens Pond State Park was formed in 1965.

Soils and Geology of Killens Pond State Park[2]

Underlying Geology

Killens Pond State Park is located in the Coastal Plain province of Delaware. Two formations, Columbia and Lynch Heights and one deposit, Swamp, are found within the state park. The Lynch Heights Formation is located in the Coursey Pond area is described as a "heterogeneous unit of light-gray to brown to light-yellowish brown, medium to fine sand with discontinuous beds of coarse sand, gravel, silt, fine to very fine sand, and organic-rich clayey silt to silty sand." The Columbia Formation underlies most of the west Coastal Plain of Delaware and is located in the Killens Pond area. It is described as a "yellowish to reddish-brown, fine to coarse, feldspathic quartz sand with varying amounts of gravel." Both of the these formations date from the Pleistocene period. The youngest sediments are the swamp deposits, which are found between Coursey and Killens Pond and the valley upstream of Killens Pond. These deposits date from the Holocene and are described as "structureless, black to brown, organic-rich, silty and clayey, fine to coarse quartz sand with thin interbeds of medium to coarse quartz sand."

Soils

Three soils are prominent in Killens Pond State Park and include Downer Loamy Sand (357 acres), Fort Mott Loamy Sand (261 acres), and Galestown Loamy Sand (209 acres). Other minor soils include Evesboro Loamy Sand, Rosedale Loamy Sand, Sassafras Sandy Loam, and Longmarsh and Indiantown Soils. Killens Pond State Park ranges in elevation from 7 feet at Coursey Pond to about 55 feet near Lake Forest High School.

[1] Scharf, John Thomas. 1888. History of Delaware: 1609-1888, Local History.
[2] Ramsey, Kelvin W. 2007. Geologic Map of Kent County, Delaware. Delaware Geologic Survey, Geologic Map Series No. 14.

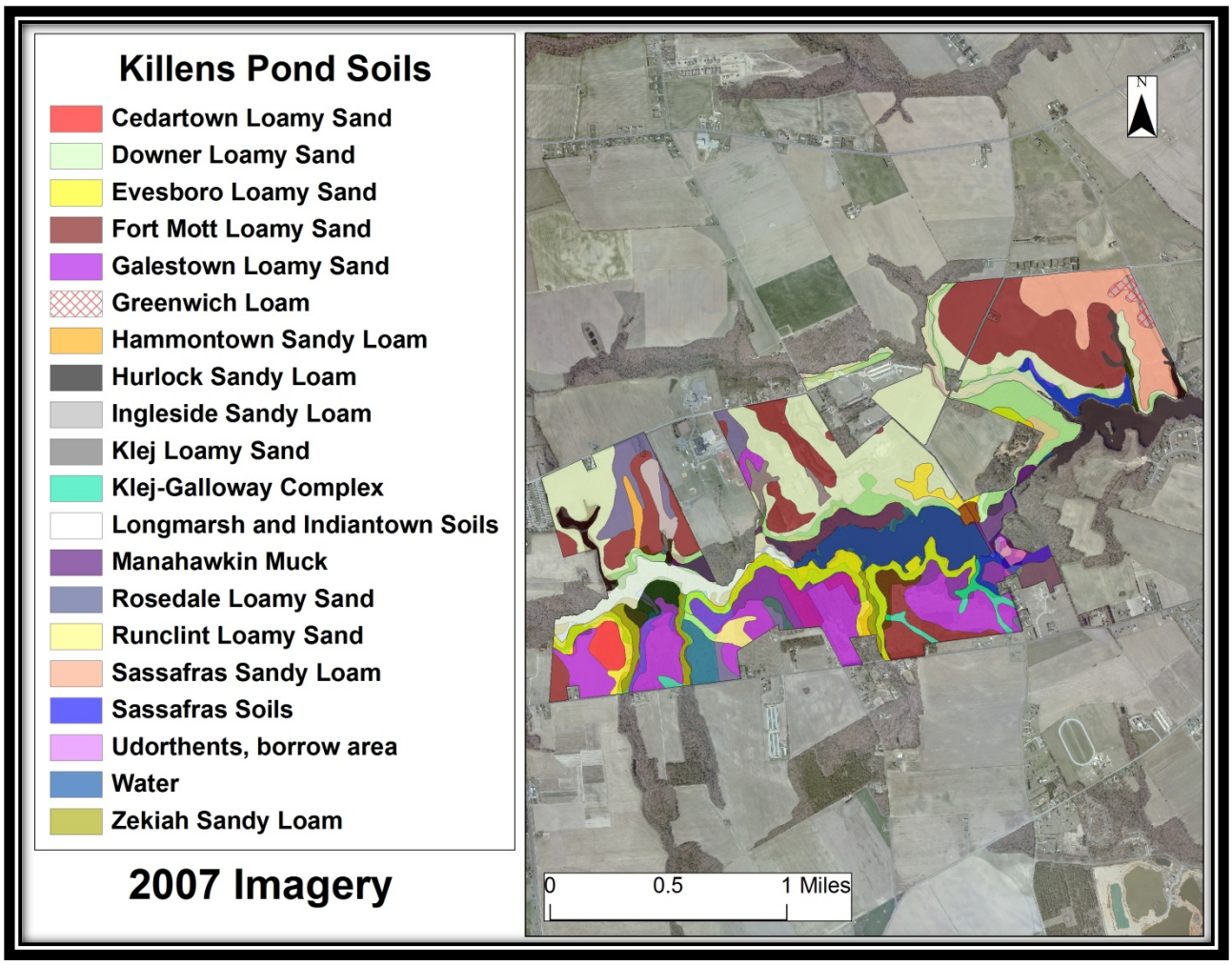


Figure 1.2. Killens Pond State Park Soil Map

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 Killens Pond State Park based on 1937, 2002, and 2007 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 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 and 2007 aerial imagery. Vegetation communities are named according to the *Guide to Delaware Vegetation Communities* [3]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 Chapter 4 and of the land covers in Chapter 5. A crosswalk to the Delaware Action Plan (DEWAP) and the Northeast Habitat Classification (NHC) is given at the top of each individual description.

Analysis of Historical Imagery

Historical imagery of Killens Pond State Park from 1937 and 2002 and current imagery from 2007 were examined. A vegetation community map was produced for each year in order to compare vegetation and land cover change over a 5, 65, and 70 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 access area 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 Killens Pond State Park included in the EIA analysis are listed in Table 2.3.

Forest Block Analysis

Current forest blocks within or partially within the access area 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.[4] 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

[3] Coxe, Robert. 2010. Guide to Delaware Vegetation Communities-Summer 2010 Edition. Unpublished report.
[4] 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.[5] 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.

[5] 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:** Twenty vegetation communities and seven land covers were found at Killens Pond State Park. Mid-Atlantic Mesic Mixed Hardwood Forest (272 acres) is the largest vegetation community, followed by Cultivated Lawn with 127 acres. Agricultural Field (465 acres) is the largest land cover.

2. **Rare Plants:** Four rare plants are known to exist in Killens Pond State Park (Table 2.1).

Scientific Name	Common Name	Rank	Last Observed
Carex striatula	Lined Sedge	S1	2003
Helonias bullata	Swamp-pink	S2	2012
Kalmia angustifolia	Sheep-laurel	S3	2003
Lechea mucronata	Hairy Pinweed	S3	1993

Table 2.1 Rare Plants at Killens Pond State Park

3. **Rare Animals:** Three rare animals are known to exist in Killens Pond State Park (Table 2.2).

Scientific Name	Common Name	Rank	Last Observed
Anondonta implicata	Alewife Floater	S1	2000
Coccyzus erythropthalmus	Black-billed Cuckoo	S1B	1997
Lampropeltis getula	Common Kingsnake	S2S3	1973

Table 2.2 Rare Animals at Killens Pond State Park

Ecological Integrity Assessment (EIA)

One vegetation community is ranked S2 or higher. These areas are mapped and summarized in Table 2.3.

Table 2.3. EIA Vegetation Communities located in Killens Pond State Park

Community Map	Community Name/EIA Score	Description
	**Killens Pond 1** **Alluvial Alder Swamp (2 acres)** **EIA = 4.4 (B rank)**	This shrub swamp is located on the north bank of the Murderkill River between Killens Pond and Coursey Pond.

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 predators[6]. 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 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.

[6] 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 and one here at Killens Pond State Park.

Analysis of Forest Blocks at Killens Pond State Park

Three 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.

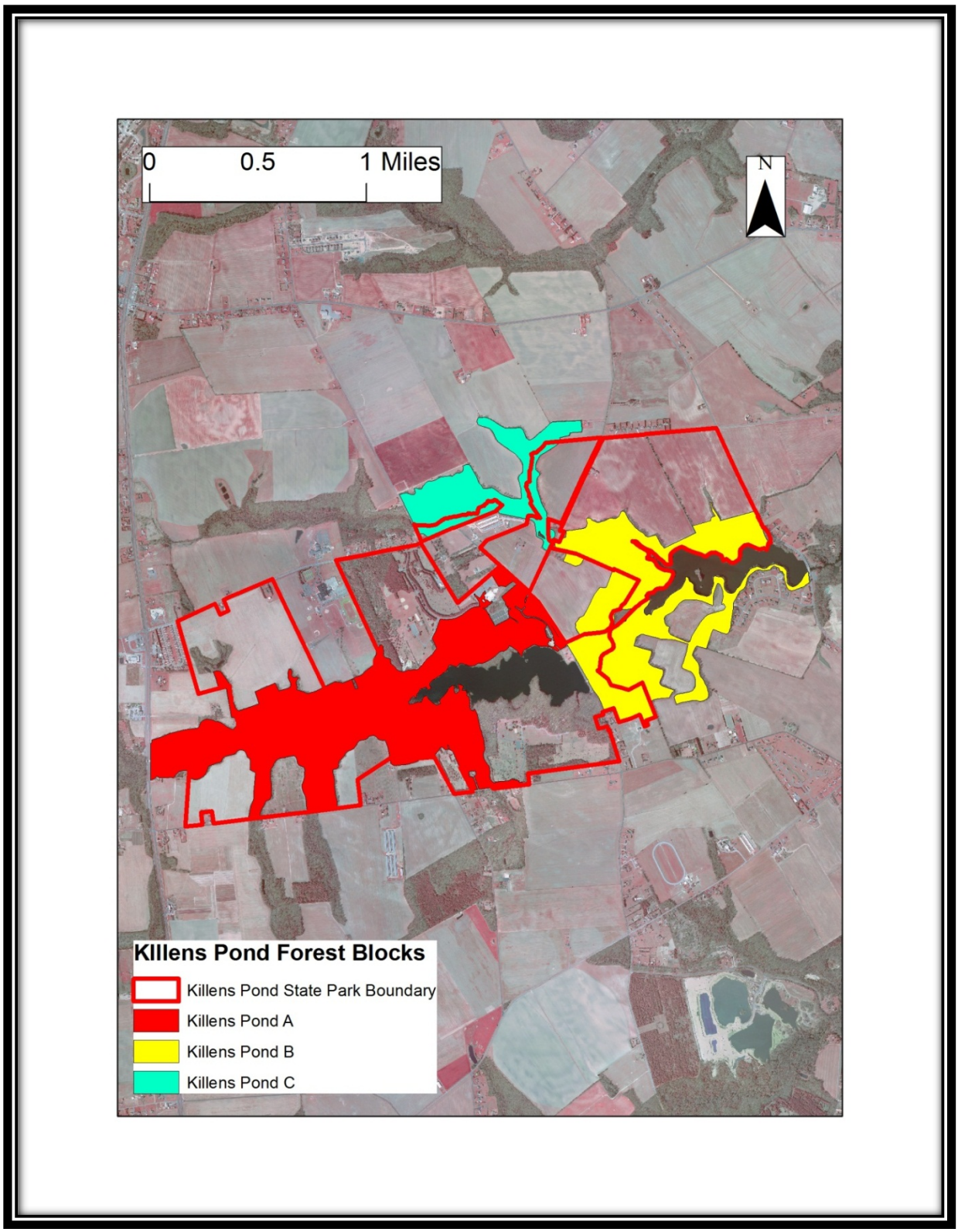
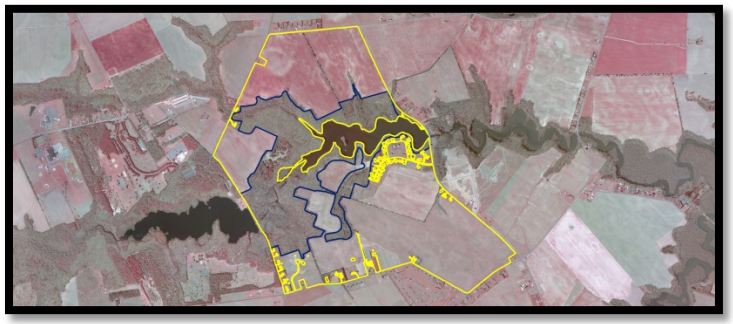


Figure 2.1. Forest Blocks at Killens Pond State Park

Table 2.4. Forest Blocks located in whole or part in Killens Pond State Park

Forest Block Map	Block Name/Acreage	Description
	**Killens Pond A** **Current Block = 422 acres (130 acres interior)** **Potential Block = 1,120 acres (544 acres interior)**	Killens Pond A is centered on the main part of Killens Pond State Park. It is bounded by agricultural fields and cultivated lawn on the north, Killens Pond Road on the east, Alley Road on the south, and US 13 on the west. Nine vegetation communities are located within this block and include Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp, Coastal Plain Oak Floodplain Swamp, Mid to Late Successional Loblolly Pine-Sweetgum Forest, Mid-Atlantic Mesic Mixed Hardwood Forest, Northeastern Modified Successional Forest, Southern Red Maple-Blackgum Swamp, Southern Red Oak/Heath Forest, Virginia Pine Successional Forest, and White Pine Planted Forest. The Murderkill River drains this block. Currently this block contains 130 acres of interior habitat. Potentially this block could be 1,120 acres and contain 544 acres of interior habitat.
	**Killens Pond B** **Current Block = 271 acres (53 acres interior)** **Potential Block = 958 acres (569 acres interior)**	Killens Pond B is located between Killens Pond and Coursey Pond. It is bounded by agricultural field on the north, DE 15 on the east, agricultural field on the south, and Killens Pond Road on the west. Six vegetation communities are in this block and include Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp, Early to Mid-Successional Loblolly Pine Forest, Mid-Atlantic Mesic Mixed Hardwood Forest, Northeastern Modified Successional Forest, Southern Red Maple-Blackgum Swamp, and Successional Tuliptree Forest. This block is drained by the Murderkill River. Currently this block contains 53 acres of interior habitat. Potentially this block could be 958 acres and contain 569 acres of interior habitat.

Forest Block Map	Block Name/Acreage	Description
	**Killens Pond C** **Current Block = 108 acres (15 acres interior)** **Potential Block = 723 acres (458 acres interior)**	Killens Pond C is located to the north of the main part of the park. It is bounded by agricultural field on the north, east, and south, and Chimney Hill Road on the west. Three vegetation communities are in this block and include Mid-Atlantic Mesic Mixed Hardwood Forest, Northeastern Modified Successional Forest, and Southern Red Maple-Blackgum Swamp. A tributary to the Murderkill River drains this block. Currently this block contains 15 acres of interior habitat. Potentially this block could be 723 acres and contain 458 acres of interior habitat.

CHAPTER 3: BROAD TRENDS AT KILLENS POND STATE PARK

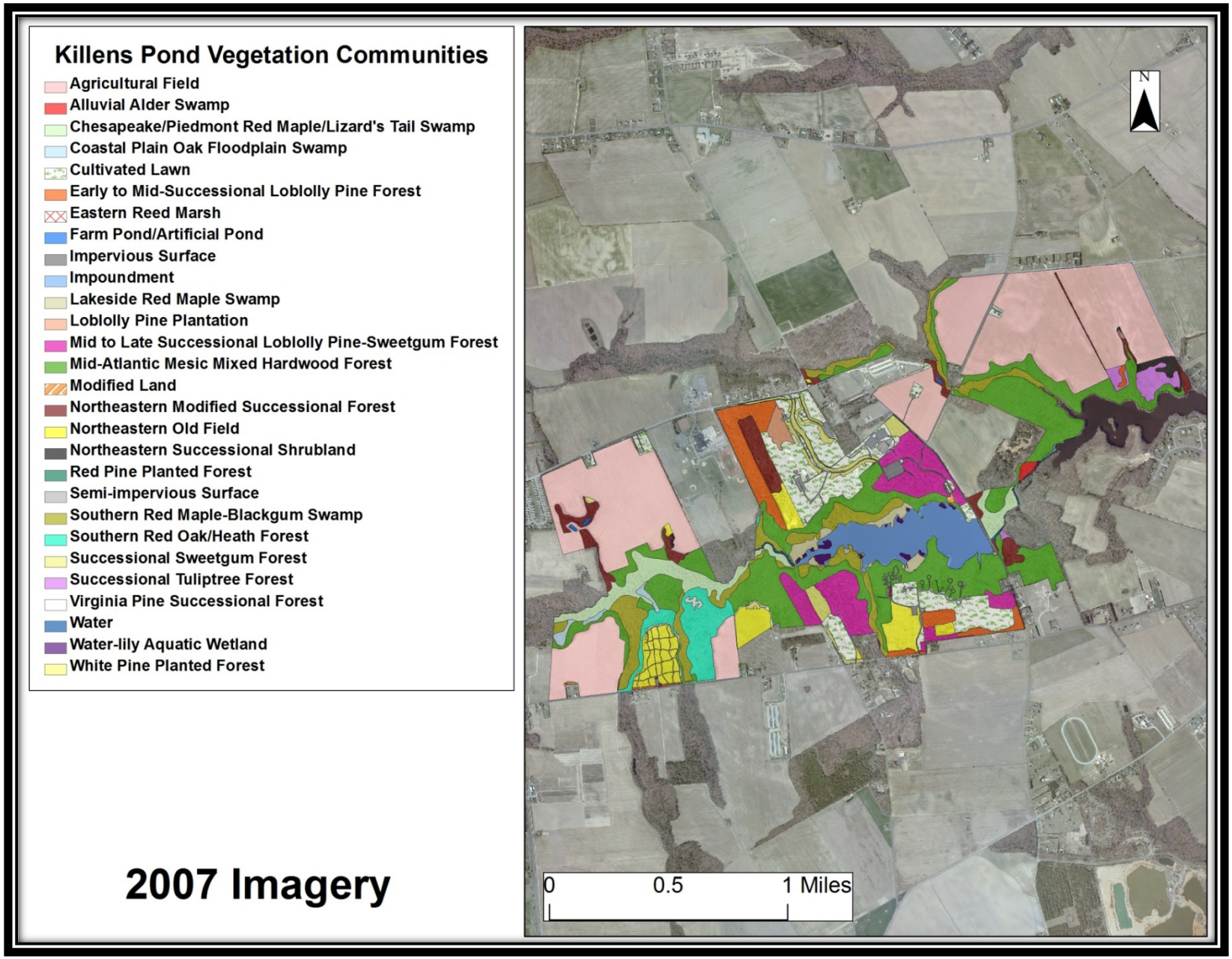


Figure 3.1. 2007 Vegetation Community Map of Killens Pond State Park

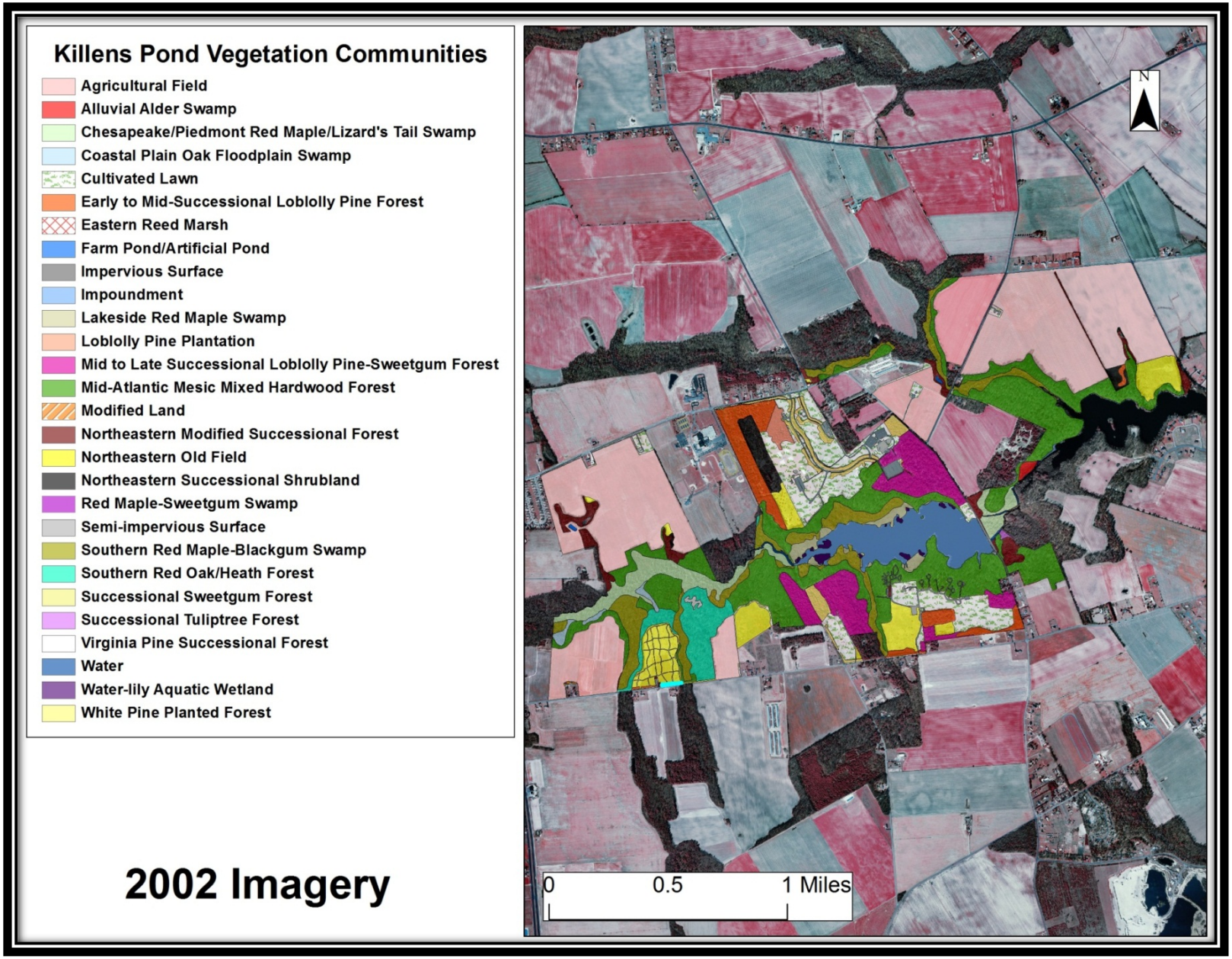


Figure 3.2. 2002 Vegetation Community Map of Killens Pond State Park

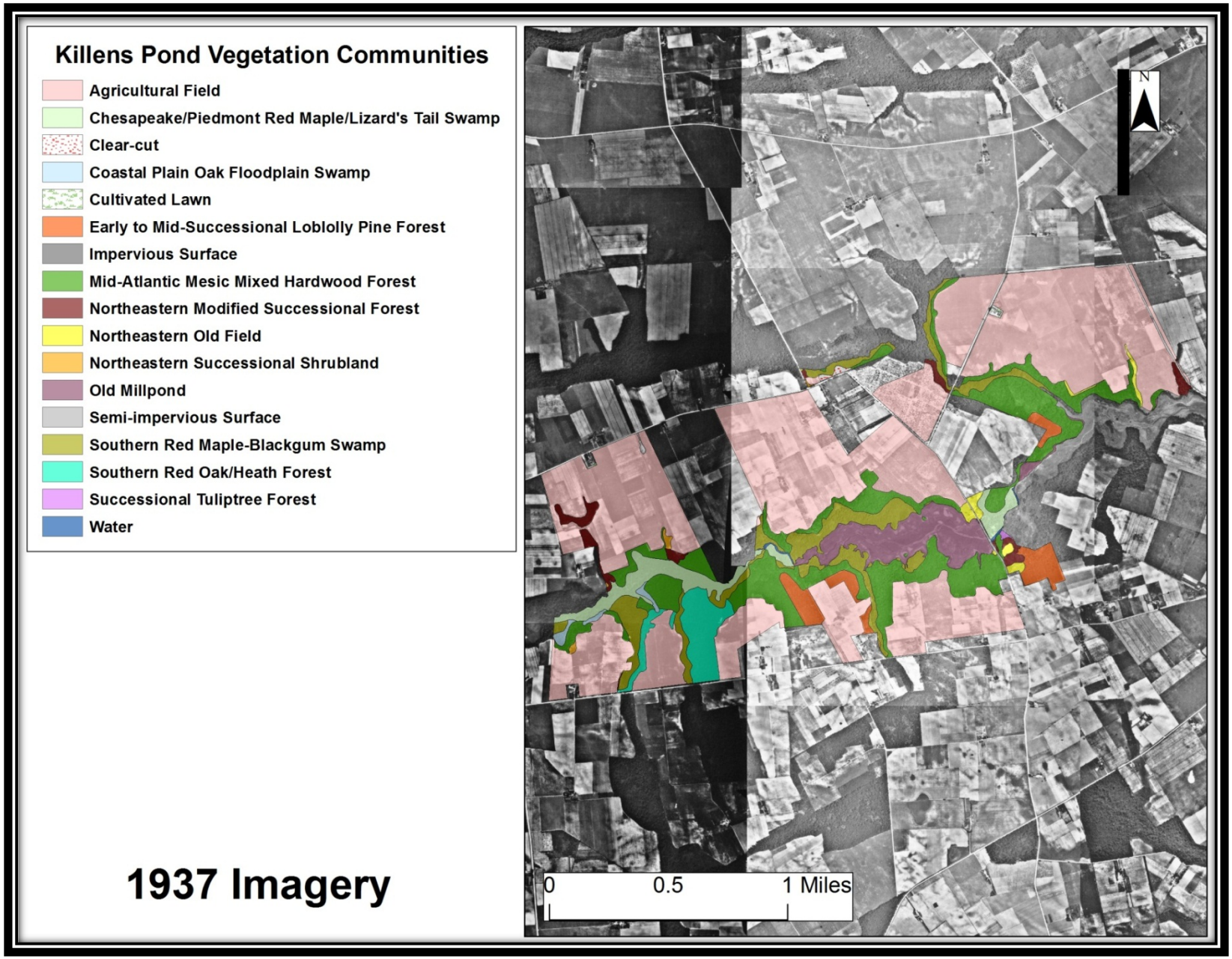


Figure 3.3. 1937 Vegetation Community Map of Killens Pond State Park

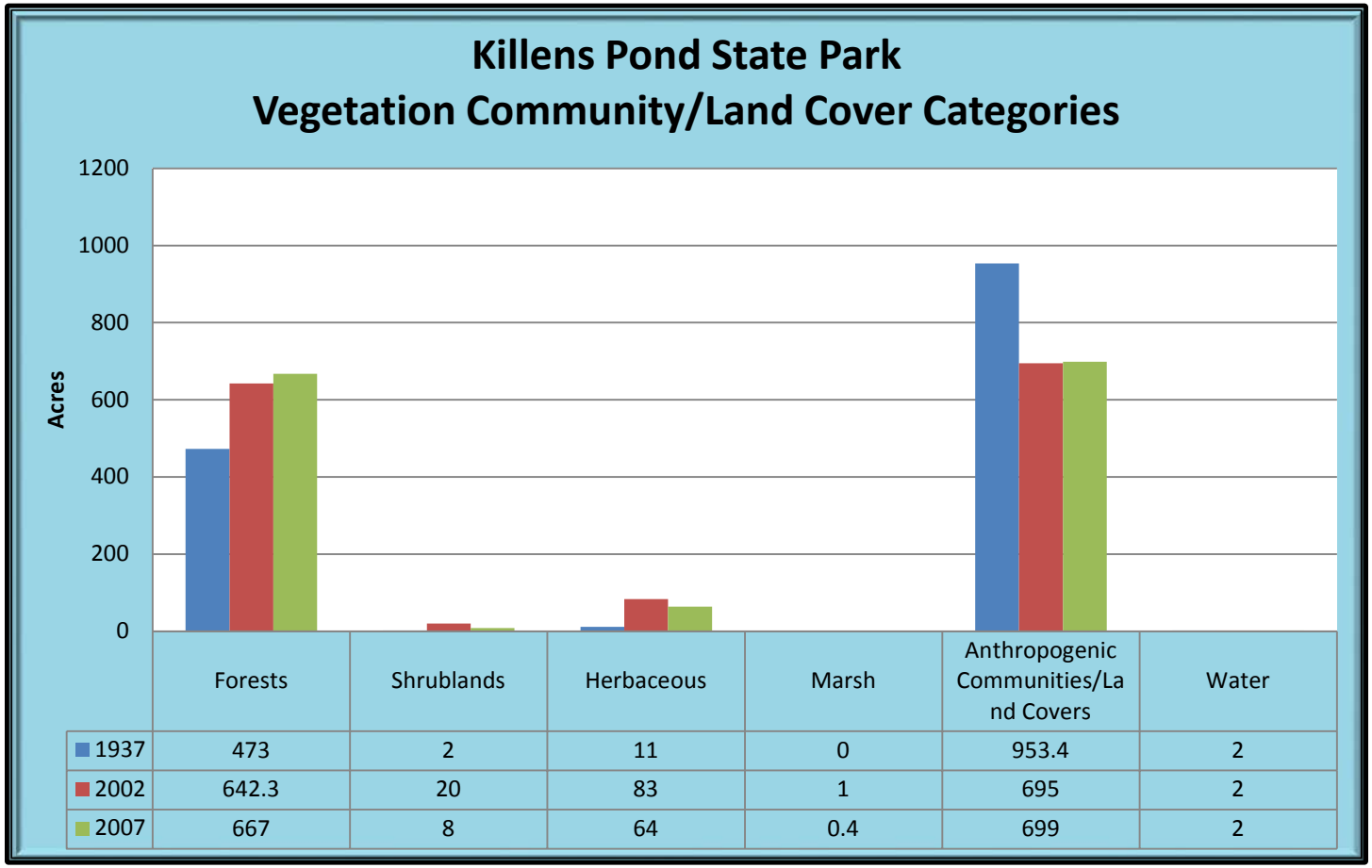


Figure 3.4. Killens Pond State Park Vegetation Categories/Land Covers (1937, 2002, and 2007)

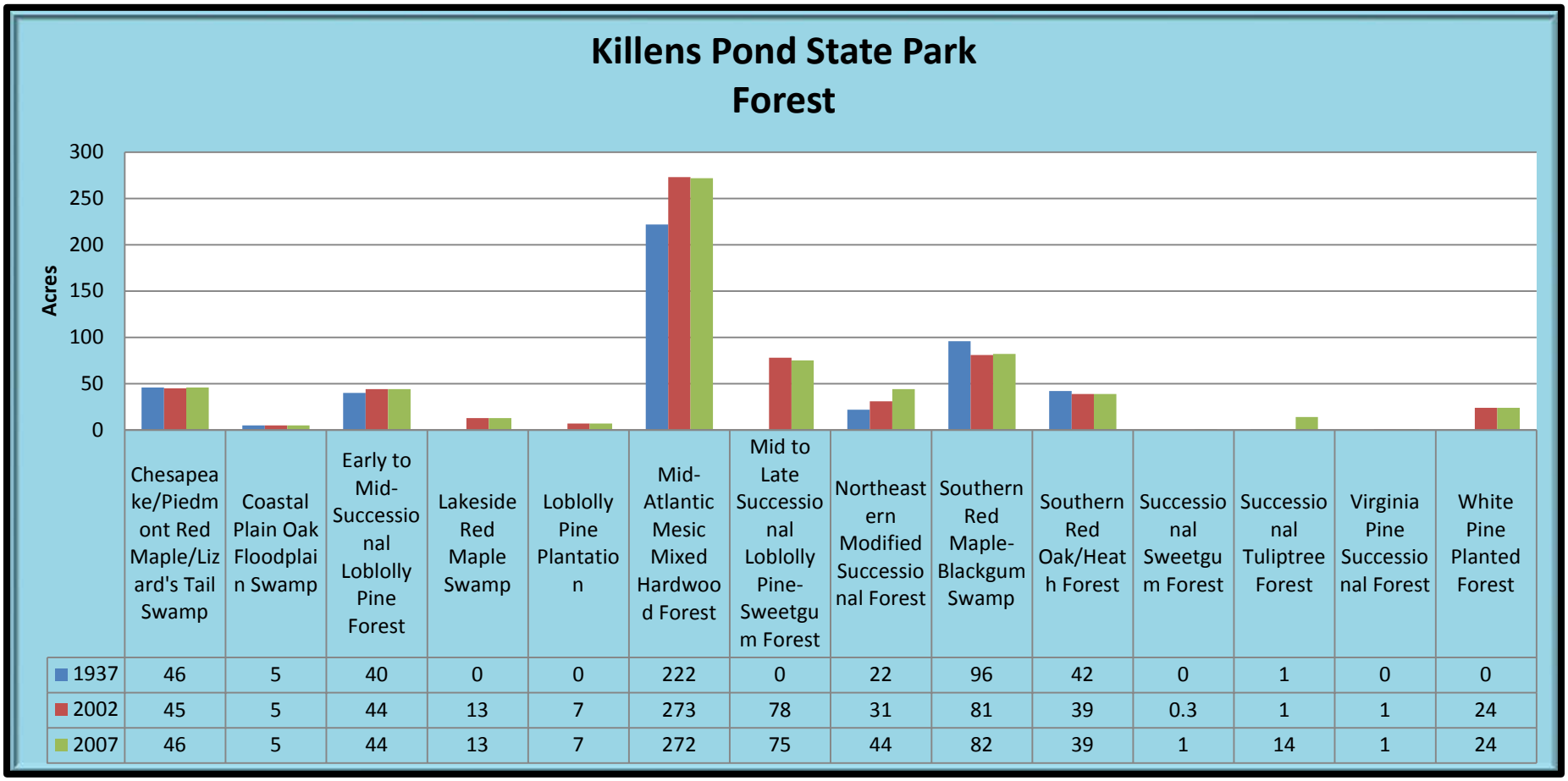
Killens Pond State Park Broad Trends (Figure 3.4): Anthropogenic communities/land covers are the most common vegetation/land cover category at Killens Pond State Park. Most of these communities are agricultural field. Forestland follows up a close second.

Natural Capital (Table 3.1)

Natural capital at Killens Pond State Park has been increasing since 1937 with the maturation of early successional communities and the abandonment of agricultural fields. Most of the gains have come from the development of forested areas and wetland communities.

Table 3.1. Natural Capital of Killens Pond State Park

Year	Natural Capital (in 2012 dollars)
1937	$1,930,612/year
2002	$2,384,577/year
2007	$2,403,368/year



	Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp	Coastal Plain Oak Floodplain Swamp	Early to Mid-Successional Loblolly Pine Forest	Lakeside Red Maple Swamp	Loblolly Pine Plantation	Mid-Atlantic Mesic Mixed Hardwood Forest	Mid to Late Successional Loblolly Pine-Sweetgum Forest	Northeastern Modified Successional Forest	Southern Red Maple-Blackgum Swamp	Southern Red Oak/Heath Forest	Successional Sweetgum Forest	Successional Tuliptree Forest	Virginia Pine Successional Forest	White Pine Planted Forest
1937	46	5	40	0	0	222	0	22	96	42	0	1	0	0
2002	45	5	44	13	7	273	78	31	81	39	0.3	1	1	24
2007	46	5	44	13	7	272	75	44	82	39	1	14	1	24

Figure 3.5. Forest at Killens Pond State Park (1937, 2002, and 2007)

Killens Pond State Park Forest (Figure 3.5): Mid-Atlantic Mesic Mixed Hardwood Forest is the most common forest community at Killens Pond State Park, followed distantly by Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp.

Natural Capital (Table 3.2)

Forestland capital has been increasing with the maturation of early successional communities.

Table 3.2. Natural Capital of Killens Pond State Park Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$1,868,497/year
2002	$1,769,976/year
2007	$1,893,080/year

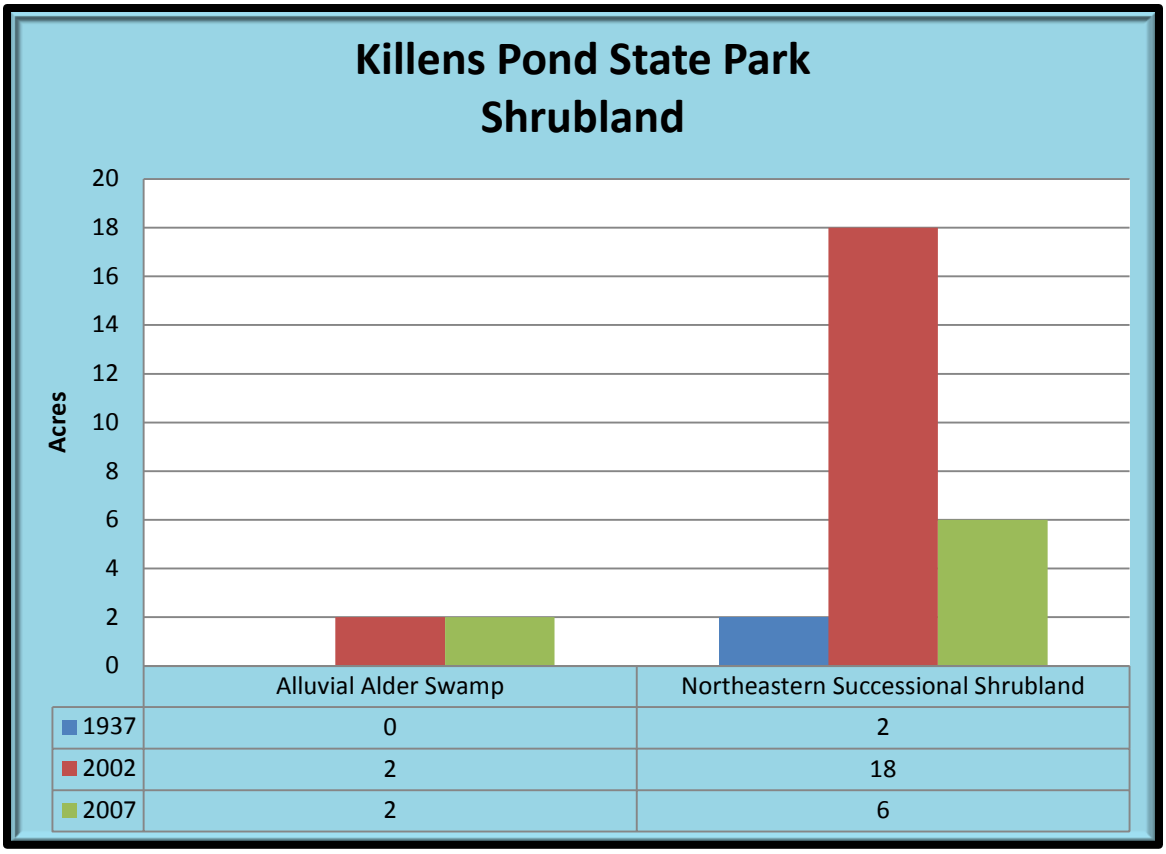


Figure 3.6. Shrubland at Killens Pond State Park (1937, 2002, and 2007)

Killens Pond State Park Shrubland (Figure 3.6): Northeastern Successional Shrubland is the most common shrubland at Killens Pond State Park. A highly ranked example of an Alluvial Alder Swamp is located in the park as well.

Natural Capital (Table 3.3)

Shrubland capital has increased since 1937 but has declined recently due to successional to forest.

Table 3.3. Natural Capital of Killens Pond State Park Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1937	$291/year
2002	$21,185/year
2007	$19,436/year

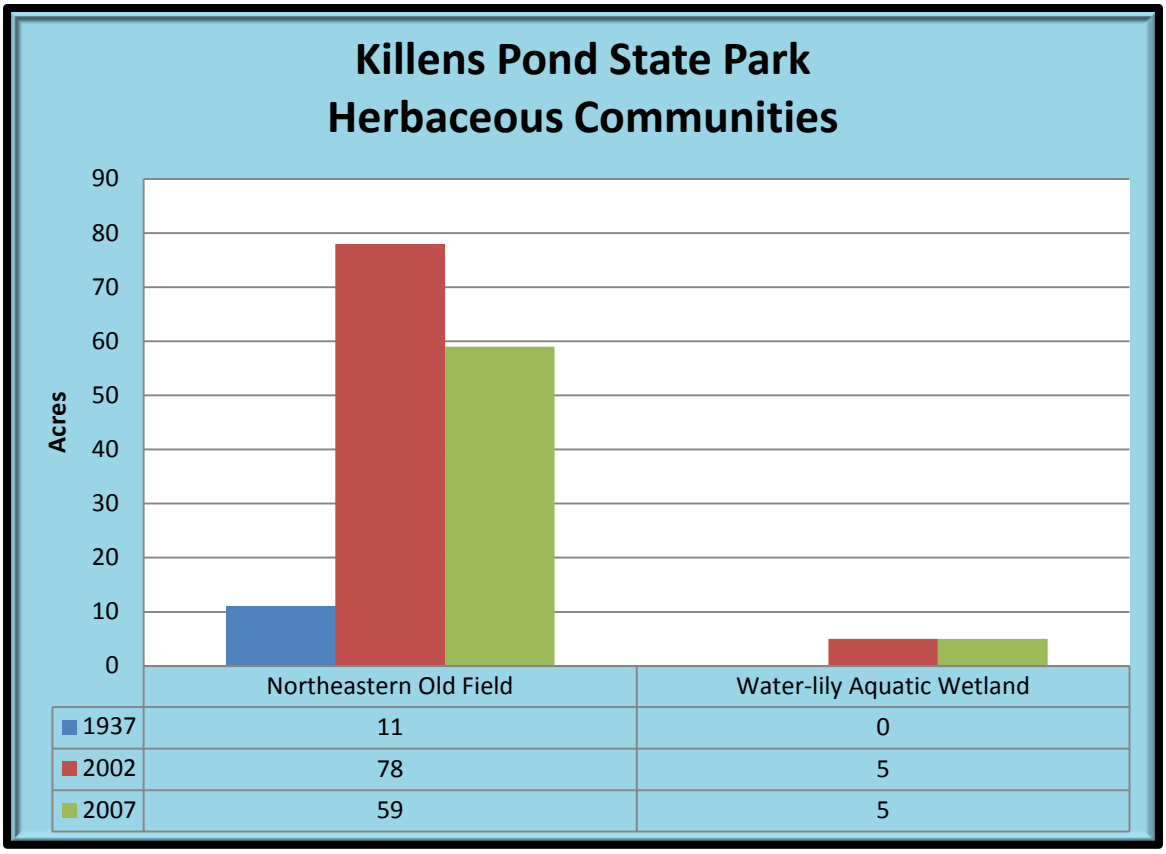


Figure 3.7. Herbaceous Communities at Killens Pond State Park (1937, 2002, and 2007)

Killens Pond State Park Herbaceous Communities (Figure 3.7): Northeastern Old Field is the most common herbaceous community in the park followed distantly by Water-lily Aquatic Wetland.

Natural Capital (Table 3.4)

Herbaceous communities' capital has increased greatly since 1937 with the abandonment of agricultural fields. In the recent, they have declined somewhat through succession.

Table 3.4. Natural Capital of Killens Pond State Park Herbaceous Communities	
Year	**Natural Capital (in 2012 dollars)**
1937	$1,603/year
2002	$57,772/year
2007	$55,003/year

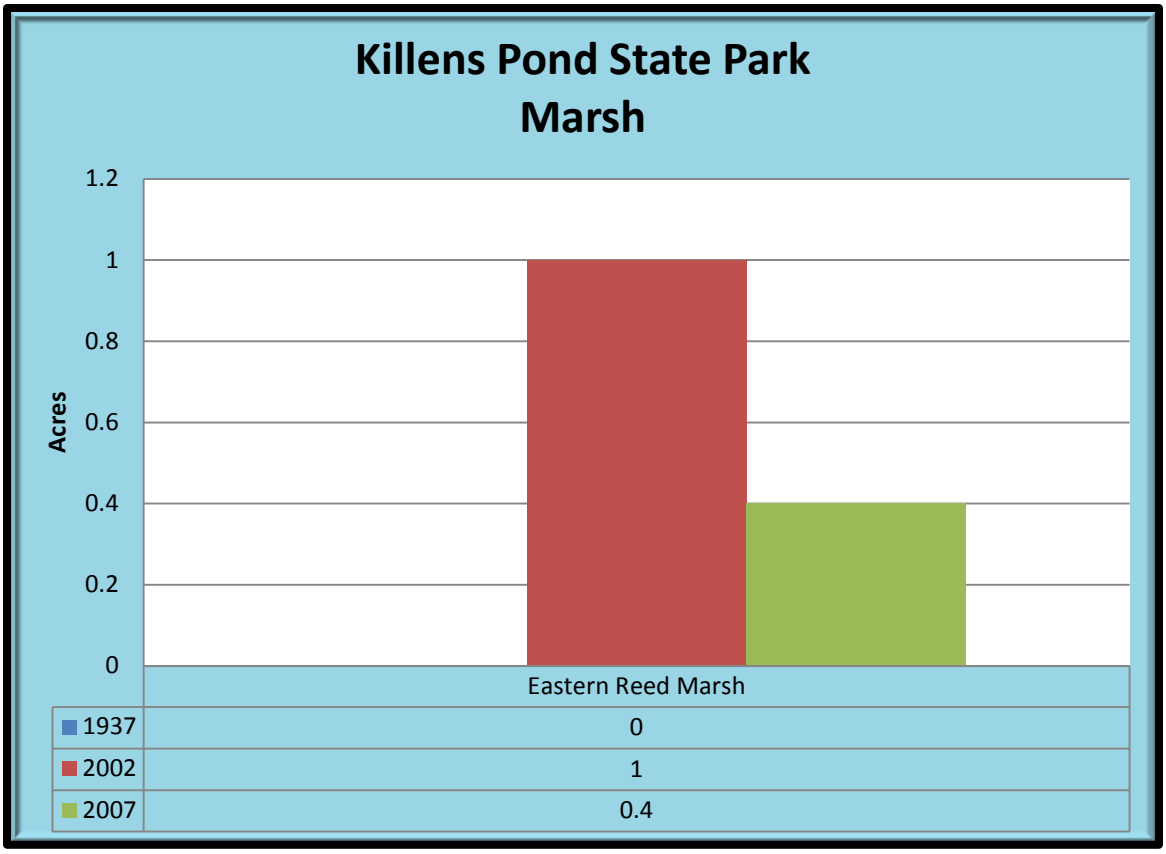


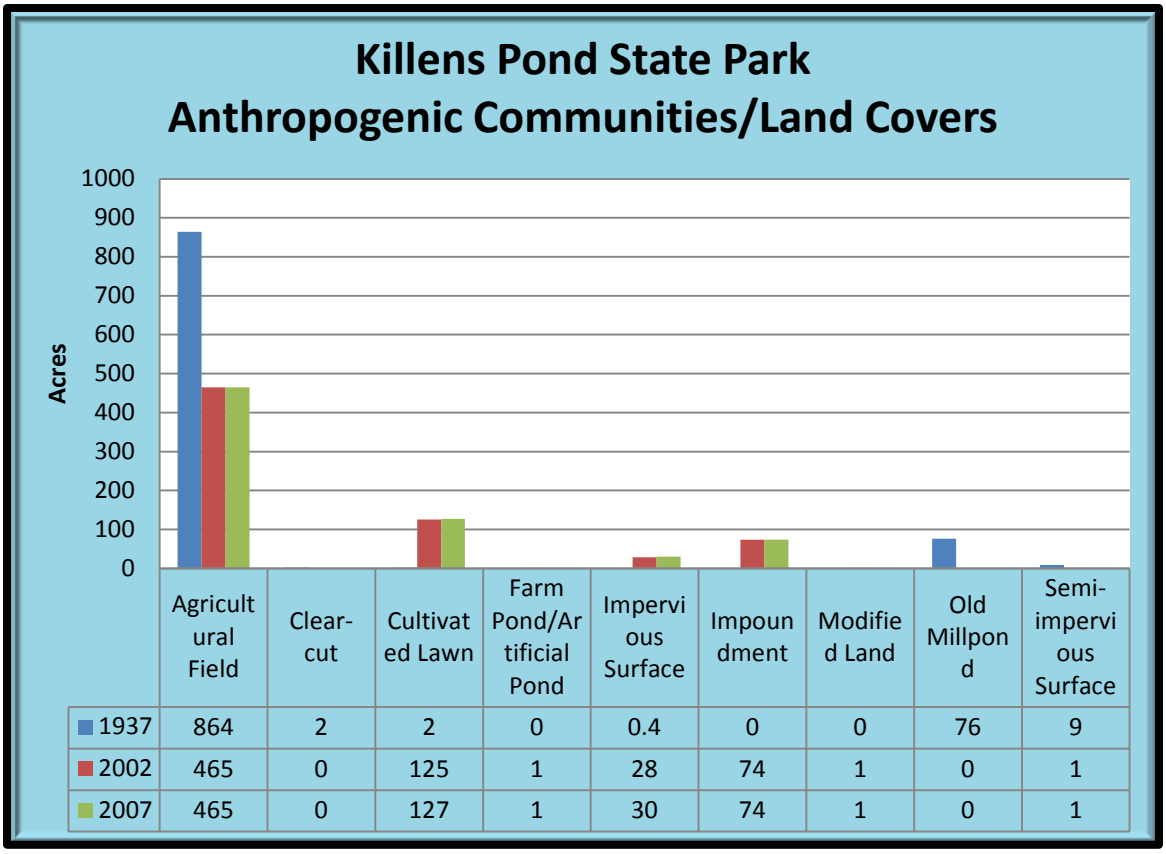
Figure 3.8. Marsh at Killens Pond State Park (1937, 2002, and 2007)

Killens Pond State Park Marsh (Figure 3.8): Eastern Reed Marsh is the only marsh community present in the park.

Natural Capital (Table 3.5)

Marsh capital has increased since 1937 when there was none present. In the recent period however, it has declined with management of the reed grass.

Table 3.5. Natural Capital of Killens Pond State Park Marsh	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$9,281/year
2007	$3,713/year



	Agricultural Field	Clear-cut	Cultivated Lawn	Farm Pond/Artificial Pond	Impervious Surface	Impoundment	Modified Land	Old Millpond	Semi-impervious Surface
1937	864	2	2	0	0.4	0	0	76	9
2002	465	0	125	1	28	74	1	0	1
2007	465	0	127	1	30	74	1	0	1

Figure 3.9. Anthropogenic Communities/Land Covers at Killens Pond State Park (1937, 2002, and 2007)

Killens Pond State Park Anthropogenic Communities/Land Covers (Figure 3.9): Agricultural Field is the most common anthropogenic community in the park followed distantly by cultivated lawn.

Natural Capital (Table 3.6)

Anthropogenic Communities/Land covers have increased with the redevelopment of Killens Pond and Coursey Pond and despite the losses in agricultural fields.

Table 3.6. Natural Capital of Killens Pond State Park Anthropogenic Communities/Land Covers	
Year	**Natural Capital (in 2012 dollars)**
1937	$49,550/year
2002	$421,465/year
2007	$421,465/year

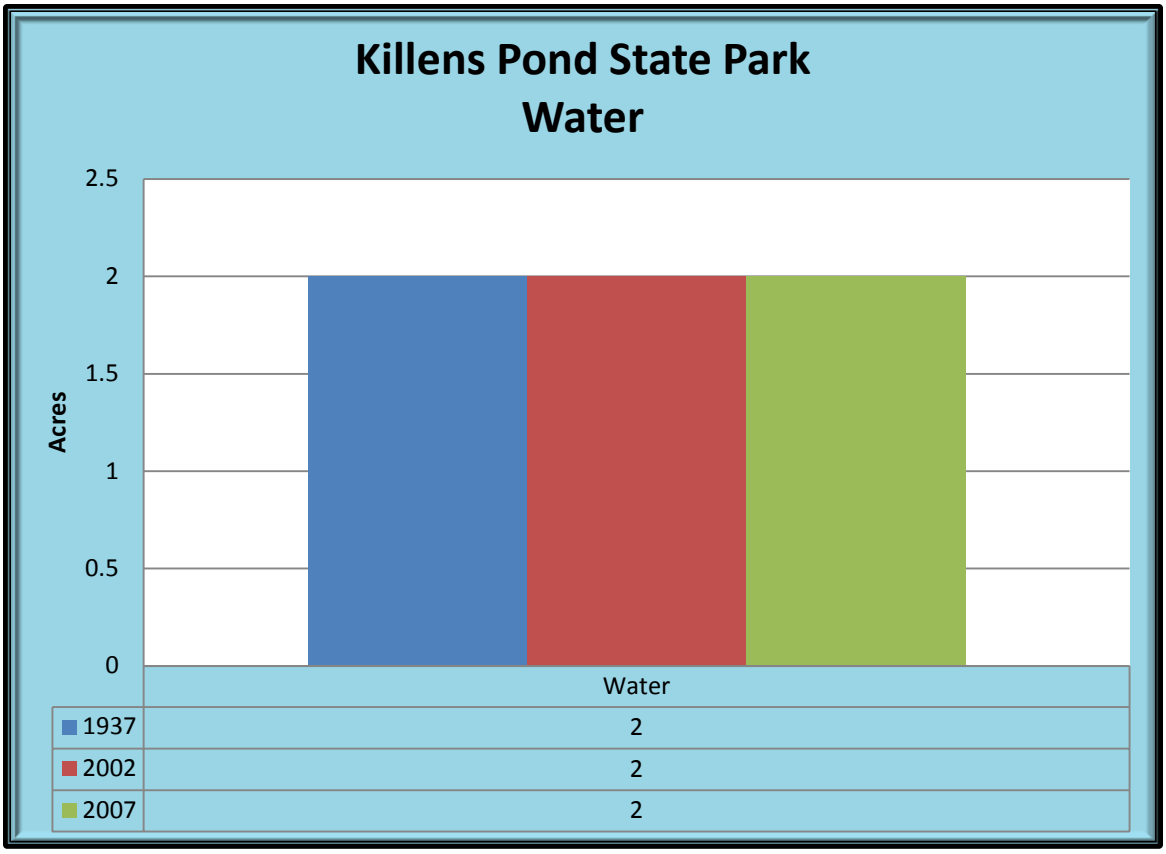


Figure 3.10. Water at Killens Pond State Park (1937, 2002, and 2007)

Killens Pond State Park Water (Figure 3.10): Water, in the main stem of the Murderkill River, has stayed at the same amount throughout the study period.

Natural Capital (Table 3.7)

Like the acreage, the amount of water capital has remained the same throughout the study period.

Table 3.7. Natural Capital of Killens Pond State Park Water	
Year	**Natural Capital (in 2012 dollars)**
1937	$10,670/year
2002	$10,670/year
2007	$10,670/year

CHAPTER 4: DESCRIPTIONS AND ANALYSIS OF THE VEGETATION COMMUNITIES

Twenty vegetation communities and seven land covers were noted in the survey (Figures 3-6). Below is a list of the vegetation communities present in 2007 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. Alluvial Alder Swamp (CEGL006414)—2 acres
2. Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp (CEGL006606)—46 acres
3. Coastal Plain Oak Floodplain Swamp (CEGL006605)—5 acres
4. Cultivated Lawn (CEGL008462)—127 acres
5. Early to Mid-Successional Loblolly Pine Forest (CEGL006011)—44 acres
6. Eastern Reed Marsh (CEGL004141)—0.4 acres
7. Lakeside Red Maple Swamp (No NVCS Classification)—13 acres
8. Loblolly Pine Plantation (CEGL007179)—7 acres
9. Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075)—272 acres
10. Mid to Late Successional Loblolly Pine-Sweetgum Forest (CEGL008462)—75 acres
11. Northeastern Modified Successional Forest (CEGL006599)—44 acres
12. Northeastern Old Field (CEGL006107)—59 acres
13. Northeastern Successional Shrubland (CEGL006451)—6 acres
14. Southern Red Maple-Blackgum Swamp (CEGL006238)—82 acres
15. Southern Red Oak/Heath Forest (CEGL006269)—39 acres
16. Successional Sweetgum Forest (CEGL007216)—1 acre
17. Successional Tuliptree Forest (CEGL007220)—14 acres
18. Virginia Pine Successional Forest (CEGL002591)—1 acre
19. Water-lily Aquatic Wetland (CEGL002386)—5 acres
20. White Pine Planted Forest (CEGL007178)—24 acres

Alluvial Alder Swamp **[2 acres (Figures 4.1-4.2, Table 4.1)] GNR S1**

DEWAP: Shrub Swamps
NHC: Northern Atlantic Coastal Plain Stream and River

Description

This community is located in a wetland floodplain of the north side of the Murderkill River between Killens Pond and Coursey Pond. The low canopy is composed of young age red maple (*Acer rubrum*) and joined by speckled alder (*Alnus spectabilis*) in places. A small amount of river birch (*Betula nigra*) is located on the edges. The diverse shrub layer is composed of highbush blueberry (*Vaccinium corymbosum*), sweet pepperbush (*Clethra alnifolia*), common greenbrier (*Smilax rotundifolia*), arrow-wood (*Viburnum dentatum*), possum-haw viburnum (*Viburnum nudum*), swamp rose (*Rosa palustris*), and winterberry (*Ilex verticillata*). Herbs include netted chainfern (*Woodwardia areolata*), lizard's tail (*Saururus cernuus*), turtle head (*Chelone glabra*), arrow-arum (*Peltandra virginica*), asymmetrical fringed sedge (*Carex crinita*), false nettle (*Boehmeria cylindrica*), spike rush (*Juncus effusus*), and arrow-leaf tearthumb (*Polygonum arifolium*).

Figure 4.1. Alluvial Alder Swamp

In time this community may succeed to a Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp. Most of the ingredients (species) for this community are already here.

Analysis of Condition at Killens Pond State Park

The Alluvial Alder Swamp grew in from the remnants of an old millpond area in 1937.

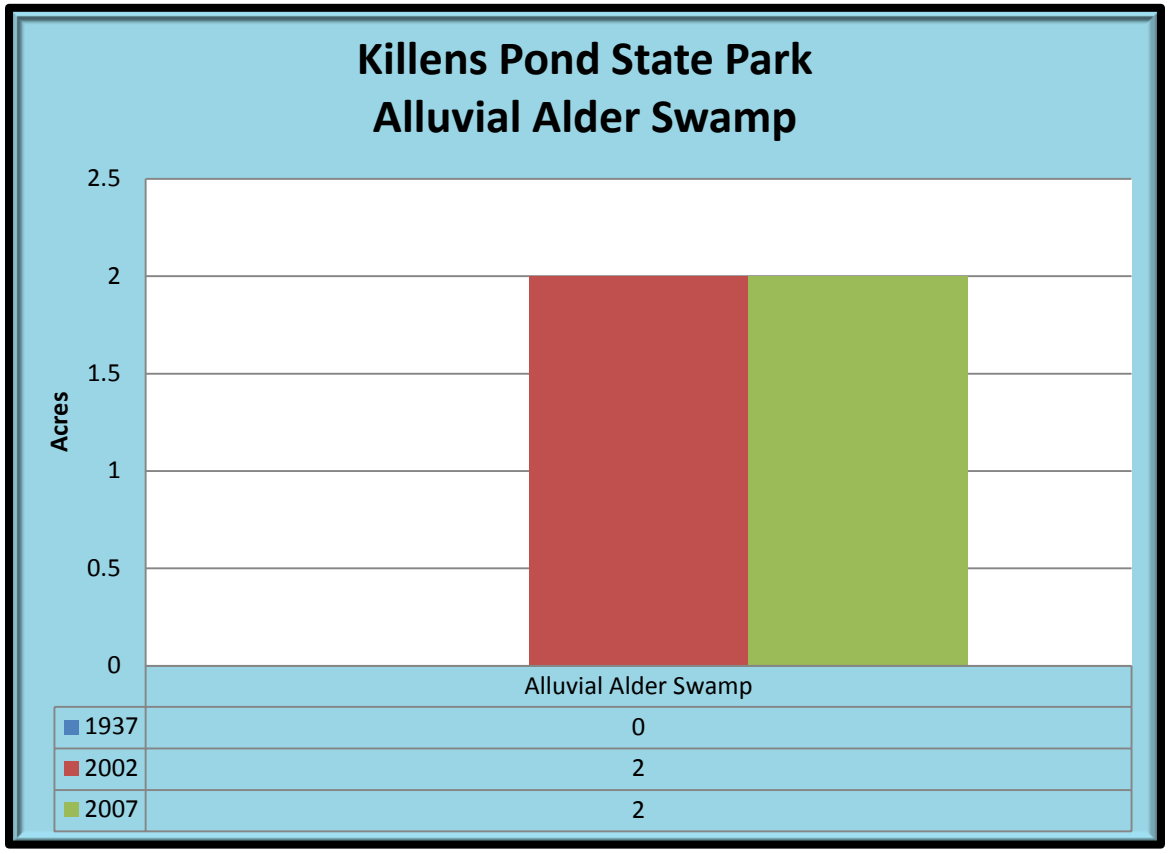


Figure 4.2. Alluvial Alder Swamp at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.1)

Alluvial Alder Swamp was not present in 1937 and has since added $18,563 in natural capital to the park.

Table 4.1. Natural Capital of Alluvial Alder Swamp	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$18,563/year
2007	$18,563/year

Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp **[46 acres (Figures 4.3-4.4, Tables 4.2-4.4)] GNR S3**

DEWAP: Forested Floodplains and Riparian Swamps
NHC: Northern Atlantic Coastal Plain Basin Swamp and Wet Hardwood Forest

Description

This community is found in the floodplain of the Murderkill River above and below Killens Pond. It is often intermingled with Southern Red Maple-Blackgum Swamp where it occurs. Red maple (*Acer rubrum*), and green ash (*Fraxinus pennsylvanica*) are common in the canopy and associated by a few river birch (*Betula nigra*) and blackgum (*Nyssa sylvatica*). The understory is composed of smaller members of the canopy plus spicebush (*Lindera benzoin*), American hornbeam (*Carpinus caroliniana*), American holly (*Ilex opaca*). Common shrubs and vines include common greenbrier (*Smilax rotundifolia*), arrow-wood (*Viburnum dentatum*), strawberry-bush (*Euonymus americanus*), poison ivy (*Toxicodendron radicans*), winterberry (*Ilex verticillata*), sweet pepperbush (*Clethra alnifolia*), and silky dogwood (*Cornus amomum*). Lizard's tail (*Saururus cernuus*), Pennsylvania sedge (*Carex pennsylvanica*), common blue violet (*Viola sororia*), jack-in-the-pulpit (*Arisaema triphyllum*), false nettle (*Boehmeria cylindrica*), Virginia creeper (*Parthenocissus quinquefolia*), and cinnamon fern (*Osmunda cinnamomea*) make up the herbaceous layer.

Figure 4.3. Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp

All of the examples within the park are mature with diameters-at-breast height's (dbh) ranging from 1 to 2 feet in diameter. They all show good layering and structure.

Analysis of Condition at Killens Pond State Park

Nearly all of the acreage present in 1937 (45 acres out of 46) was still present in 2007. The rest of the acreage had become 1 acre of water and 1 acre of Southern Red Maple-Blackgum Swamp (Table 4.2). Since 1937 this community has grown into 0.2 acres of water and 0.1 acres of Agricultural Field (Table 4.3).

Table 4.2. What was once Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp in 1937 has become X or remained in 2007	
X	**Acreage**
Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp	45 acres
Water	1 acre
Southern Red Maple-Blackgum Swamp	0.1 acres

Table 4.3. Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp has migrated into X or remained since 1937	
X	**Acreage**
Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp	45 acres
Water	0.2 acres
Agricultural Field	0.1 acres

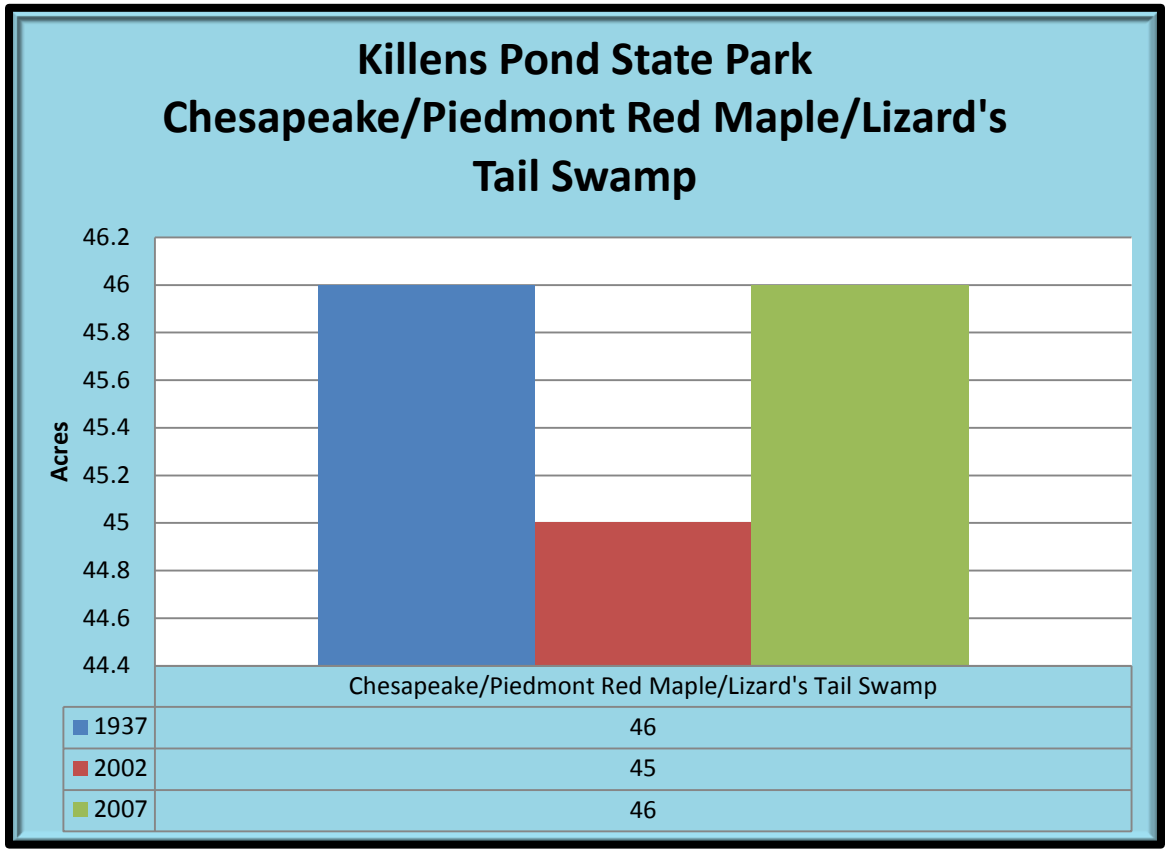


Figure 4.4. Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp (1937, 2002, and 2007)

Natural Capital (Table 4.4)

Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp accounts for about 1/3 of the total natural capital in Killens Pond State Park. The amount of capital has remained roughly the same through the study period.

Table 4.4. Natural Capital of Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp	
Year	**Natural Capital (in 2012 dollars)**
1937	$565,409/year
2002	$553,118/year
2007	$565,409/year

Coastal Plain Oak Floodplain Swamp **[5 acres (Figures 4.5-4.6, Table 4.5)] GNR S3?**

DEWAP: Forested Floodplains and Riparian Swamps
NHC: Atlantic Coastal Plain Brown-water Stream Floodplain Forest

Description

This community is found in some of the back coves of the Murderkill River floodplain above Killens Pond. Distinguished by a large presence of oak (*Quercus bicolor,* and *Q. michauxii*), other species that may be in the canopy include green ash (*Fraxinus pennsylvanica*), American hornbeam (*Carpinus caroliniana*), red maple (*Acer rubrum*) and American holly (*Ilex opaca*). The understory includes smaller members of the canopy plus a small amount of blackgum (*Nyssa sylvatica*). The shrub and vine layer is made up of blackberry (*Rubus* sp.), poison ivy (*Toxicodendron radicans*), Japanese honeysuckle (*Lonicera japonica*), summer grape (*Vitis aestivalis*), highbush blueberry (*Vaccinium corymbosum*), and pinxter flower (*Rhododendron periclymenoides*). Common herbs include skunk cabbage (*Symplocarpus foetidus*), sensitive fern (*Onoclea sensibilis*), jack-in-the-pulpit (*Arisaema triphyllum*), New York fern (*Thelypteris novaboracensis*), partridge-berry (*Mitchella repens*), and Virginia creeper (*Parthenocissus quinquefolia*).

Figure 4.5. Coastal Plain Oak Floodplain Swamp

All of the occurrences of this community are in mature condition and were all present in 1937, making these stands at least 70 years old. Most trees were above 1.5 feet in diameter and there are well defined layers.

Analysis of Condition at Killens Pond State Park

The occurrences of Coastal Plain Oak Floodplain Swamp and the acreage have not changed since 1937. All of the 1937 acreage was still present in 2007.

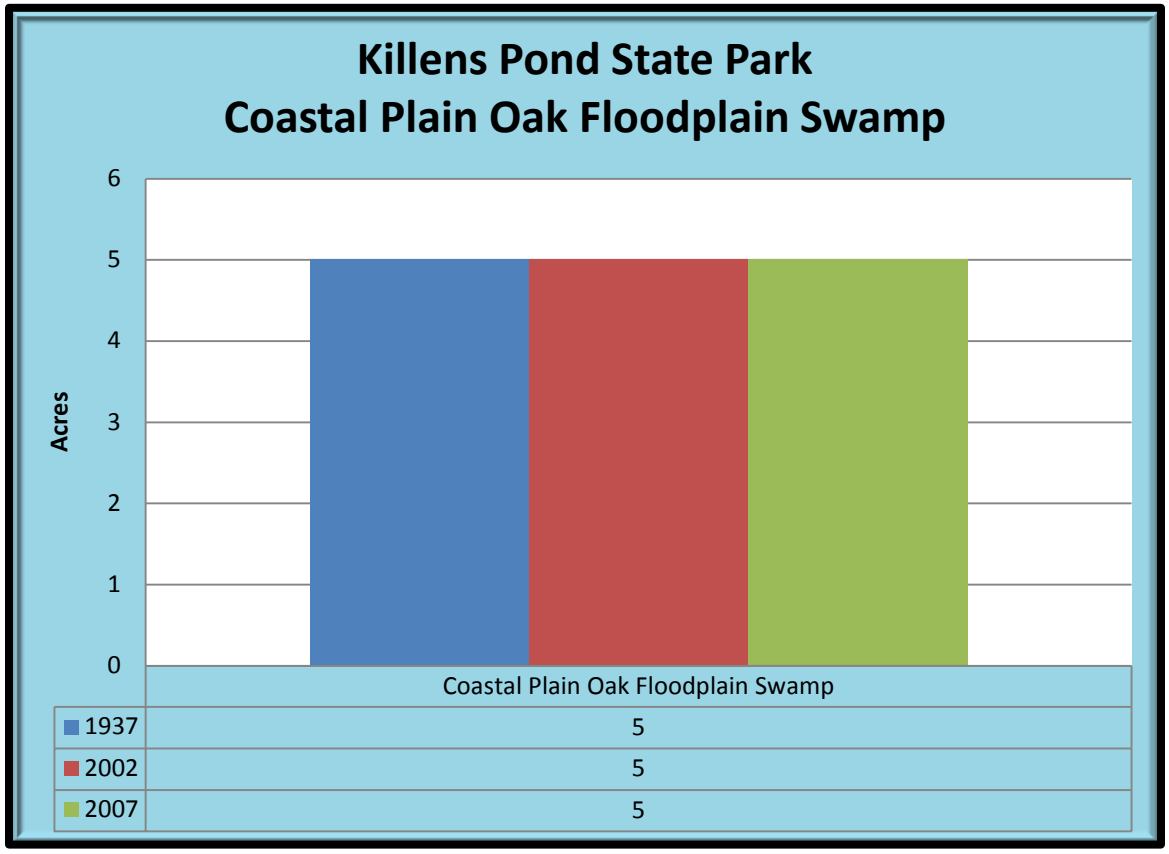


Figure 4.6. Coastal Plain Oak Floodplain Swamp at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.5)

Capital and acreage for Coastal Plain Oak Floodplain Swamp has remained the same throughout the study period.

Table 4.5. Natural Capital of Coastal Plain Oak Floodplain Swamp	
Year	**Natural Capital (in 2012 dollars)**
1937	$61,458/year
2002	$61,458/year
2007	$61,458/year

Cultivated Lawn **[127 acres (Figure 4.7, Tables 4.6-4.7)] GNA SNA**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

Cultivated lawns are similar to Northeastern Old Field, except that the cultivated lawn is mowed more than once per year. Lawns are generally planted in ornamentals and grasses such as tall fescue (*Festuca arundinacea*).

Analysis of Condition at Killens Pond State Park

All of the cultivated lawn from 1937 was still present in 2007 (Table 4.6). Since 1937, cultivated lawn has been developed in 122 acres of agricultural field, 2 acres of Northeastern Old Field, 1 acre of semi-impervious surface, and 0.3 acres of Mid-Atlantic Mesic Mixed Hardwood Forest (Table 4.7).

Table 4.6. What was once Cultivated Lawn in 1937 has become X or remained in 2007	
X	**Acreage**
Cultivated Lawn	2 acres

Table 4.7. Cultivated Lawn has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	122 acres
Northeastern Old Field	2 acres
Cultivated Lawn	2 acres
Semi-impervious Surface	1 acre
Mid-Atlantic Mesic Mixed Hardwood Forest	0.3 acres
Other vegetation communities/land covers	1 acre

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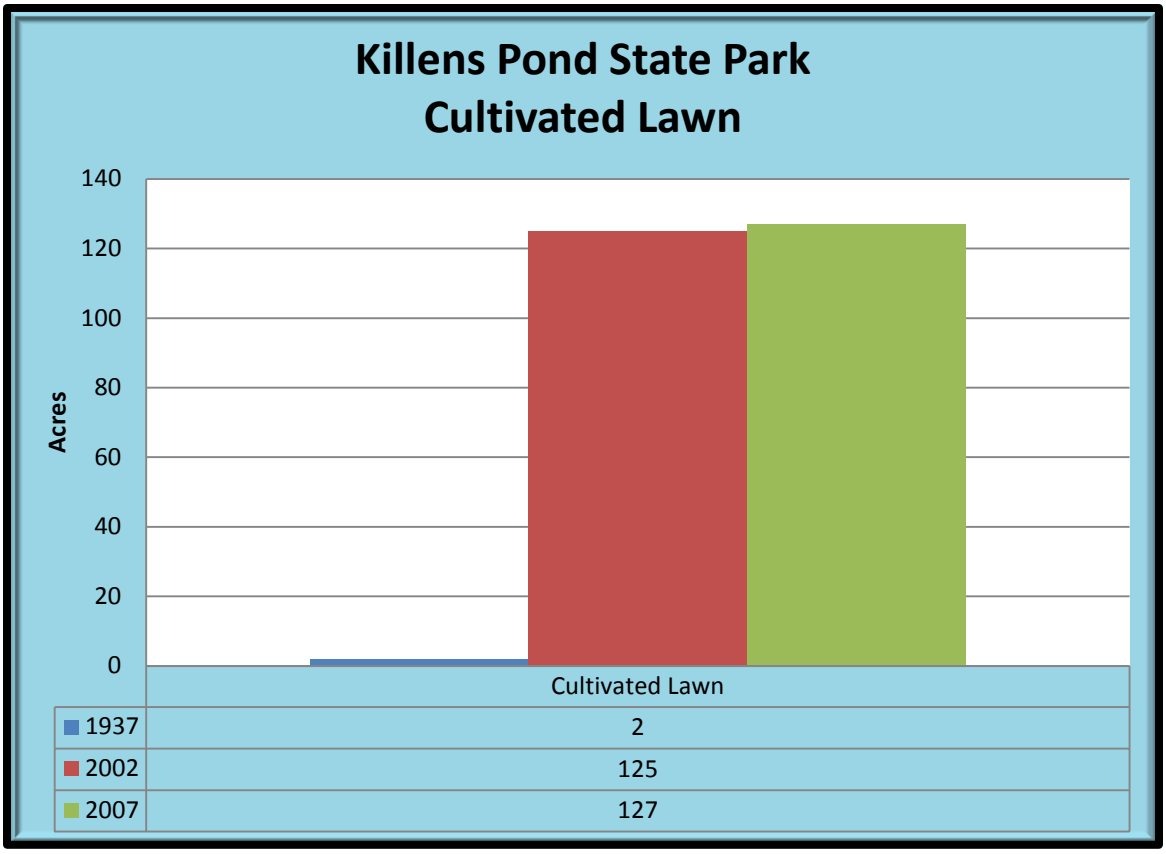

Figure 4.7. Cultivated Lawn at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital

Cultivated lawn does not have any natural capital value.

Early to Mid-Successional Loblolly Pine Forest **[44 acres (Figures 4.8-4.9, Tables 4.8-4.10)]**
GNA SNA

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

Description

Figure 4.8. Early to Mid-Successional Loblolly Pine Forest

This successional forest community is found in isolated places around the park. Loblolly Pine (*Pinus taeda*) is the canopy species over an understory of primarily sweetgum (*Liquidambar styraciflua*). Japanese honeysuckle (*Lonicera japonica*) and multiflora rose (*Rosa multiflora*) were the only shrubs and vine noted. The herb noted in this community included mouse-ear chickweed (*Stellaria media*).

Analysis of Condition at Killens Pond State Park

None of the Early to Mid-Successional Loblolly Pine Forest present in 1937 was still present in 2007. These communities had matured into 21 acres of Mid-Atlantic Mesic Mixed Hardwood Forest, 17 acres of Mid to Late Successional Loblolly Pine-Sweetgum Forest, and 2 acres of White Pine Planted Forest (Table 4.8). Since 1937 this community has grown into 43 acres of agricultural field and 0.3 acres of Mid-Atlantic Mesic Mixed Hardwood Forest (Table 4.9).

Table 4.8. What was once Early to Mid-Successional Loblolly Pine in 1937 has become X or remained in 2007	
X	**Acreage**
Mid-Atlantic Mesic Mixed Hardwood Forest	21 acres
Mid to Late Successional Loblolly Pine-Sweetgum Forest	17 acres
White Pine Planted Forest	2 acres

Table 4.9. Early to Mid-Successional Loblolly Pine has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	43 acres
Mid-Atlantic Mesic Mixed Hardwood Forest	0.3 acres

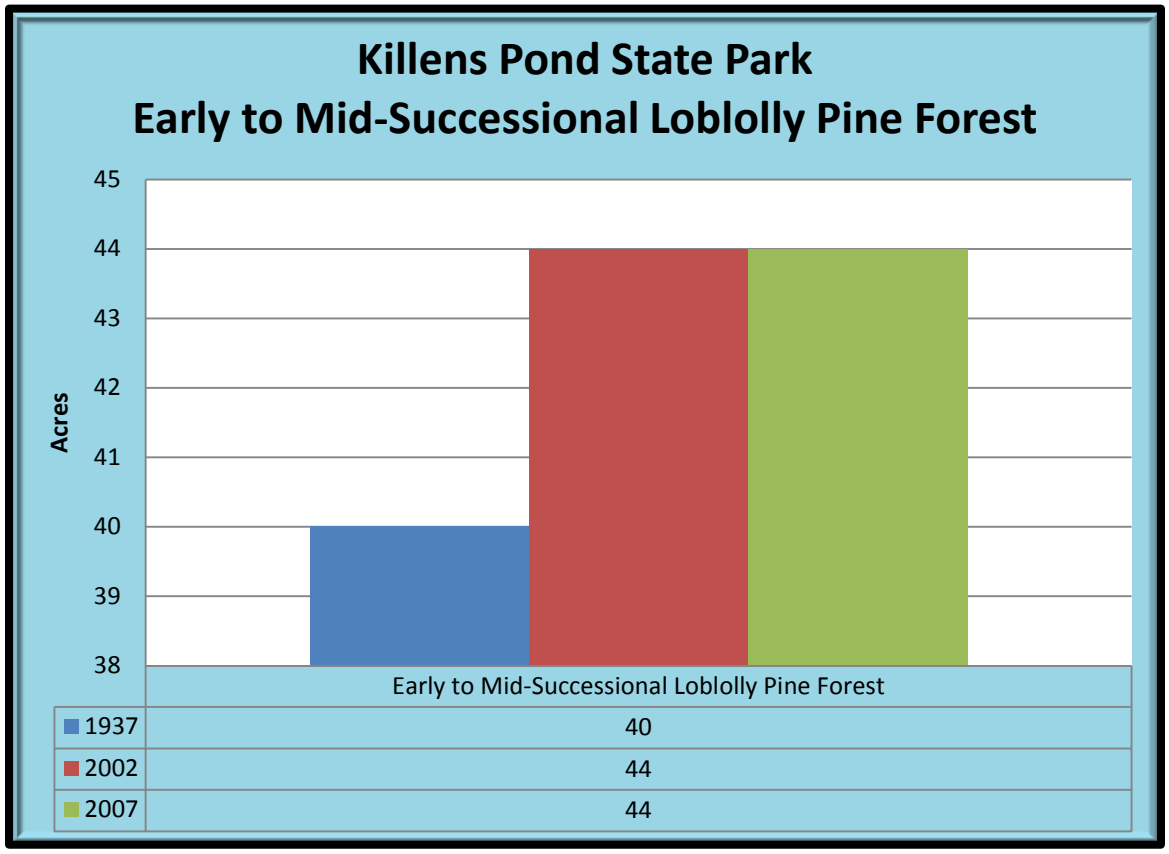

Figure 4.9. Early to Mid-Successional Loblolly Pine Forest at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.10)

Natural capital of Early to Mid-Successional Loblolly Pine Forest has increased since 1937, mainly being driven by abandonment of agricultural fields.

Table 4.10. Natural Capital of Early to Mid-Successional Loblolly Pine Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$3,148/year
2002	$8,131/year
2007	$8,131/year

Eastern Reed Marsh **[0.4 acres (Figures 4.10-4.11, Tables 4.11-4.12)] GNA SNA**

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

Description

This community is a non-tidal wetland that is wholly dominated by common reed (*Phragmites australis*).

Figure 4.10. Eastern Reed Marsh

Analysis of Condition at Killens Pond State Park

Eastern Reed Marsh was not present in the park in 1937 and has since grown into 0.4 acres of agricultural field.

Table 4.11. Eastern Reed Marsh has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	0.4 acres

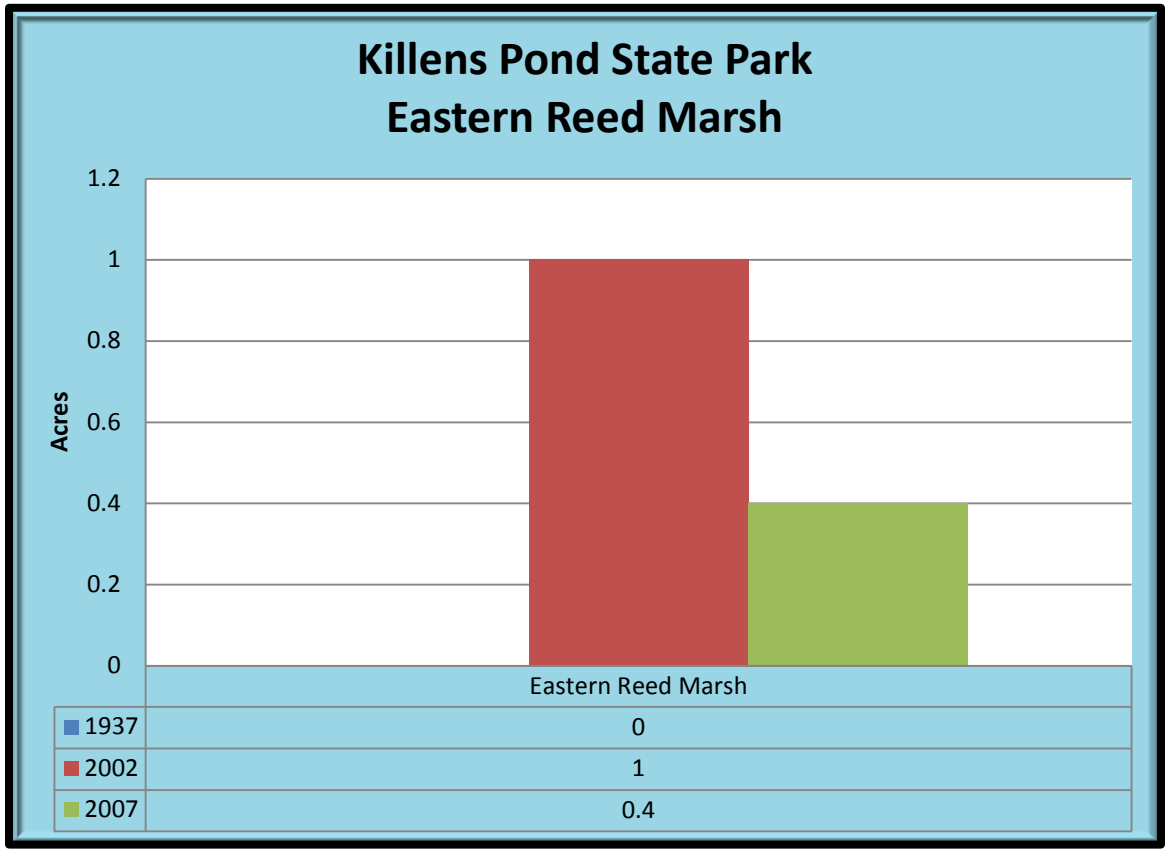

Figure 4.11. Eastern Reed Marsh at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.12)

Eastern Reed Marsh was not present in 1937 and has since grown into an agricultural field increasing the capital for the park as a wetland. In the recent period the capital has gone down, maybe as a result of *Phragmites* control efforts.

Table 4.12. Natural Capital of Eastern Reed Marsh	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$9,281/year
2007	$3,713/year

Lakeside Red Maple Swamp **[13 acres (Figures 4.12-4.13, Tables 4.13-4.14)] GNA SNA**

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

Description

This apparently artificial community is located on the sides Killens Pond. The canopy is dominated by stunted red maple (*Acer rubrum*) and associated by green ash (*Fraxinus pennsylvanica*), blackgum (*Nyssa sylvatica*), and sweetgum (*Liquidambar styraciflua*). The short understory contains American holly (*Ilex opaca*), American hornbeam (*Carpinus caroliniana*), sweetbay (*Magnolia virginiana*), and swamp chestnut oak (*Quercus michauxii*). The shrub and vine layer contains arrowwood (*Viburnum dentatum*), Japanese honeysuckle (*Lonicera japonica*), common greenbrier (*Smilax rotundifolia*), creeping raspberry (*Rubus hispidus*), silky dogwood (*Cornus amomum*), sweet pepperbush (*Clethra alnifolia*), and highbush blueberry (*Vaccinium corymbosum*). Common herbs include cinnamon fern (*Osmunda cinnamomea*), wetland blue violet (*Viola cucullata*), skunk cabbage (*Symplocarpus foetidus*), jack-in-the-pulpit (*Arisaema triphyllum*), royal fern (*Osmunda regalis*), netted chain fern (*Woodwardia areolata*), and indian cucumber root (*Medeola virginica*).

Figure 4.12. Lakeside Red Maple Swamp

The occurrences of this community appear to be mid-successional and dates to time of the re-flooding of the pond in the 1940's. These communities are likely about 40-50 years old. Diameters of the trees range from 0.5 feet to 1.0 foot.

Analysis of Condition at Killens Pond State Park

This apparently artificial forested community was not present in 1937. It has formed from 13 acres of Southern Red Maple-Blackgum Swamp and 0.1 acres of Old Millpond from 1937 (Table 4.13). This community may have come about from a higher water level caused by the re-impounding of the pond, by flooding a Southern Red Maple-Blackgum Swamp. This community only occurs around Killens Pond in Delaware, but is not currently considered for ranking because of the artificial nature of the community.

Table 4.13. Lakeside Red Maple Swamp has migrated into X or remained since 1937

X	**Acreage**
Southern Red Maple-Blackgum Swamp	13 acres
Old Millpond	0.1 acres

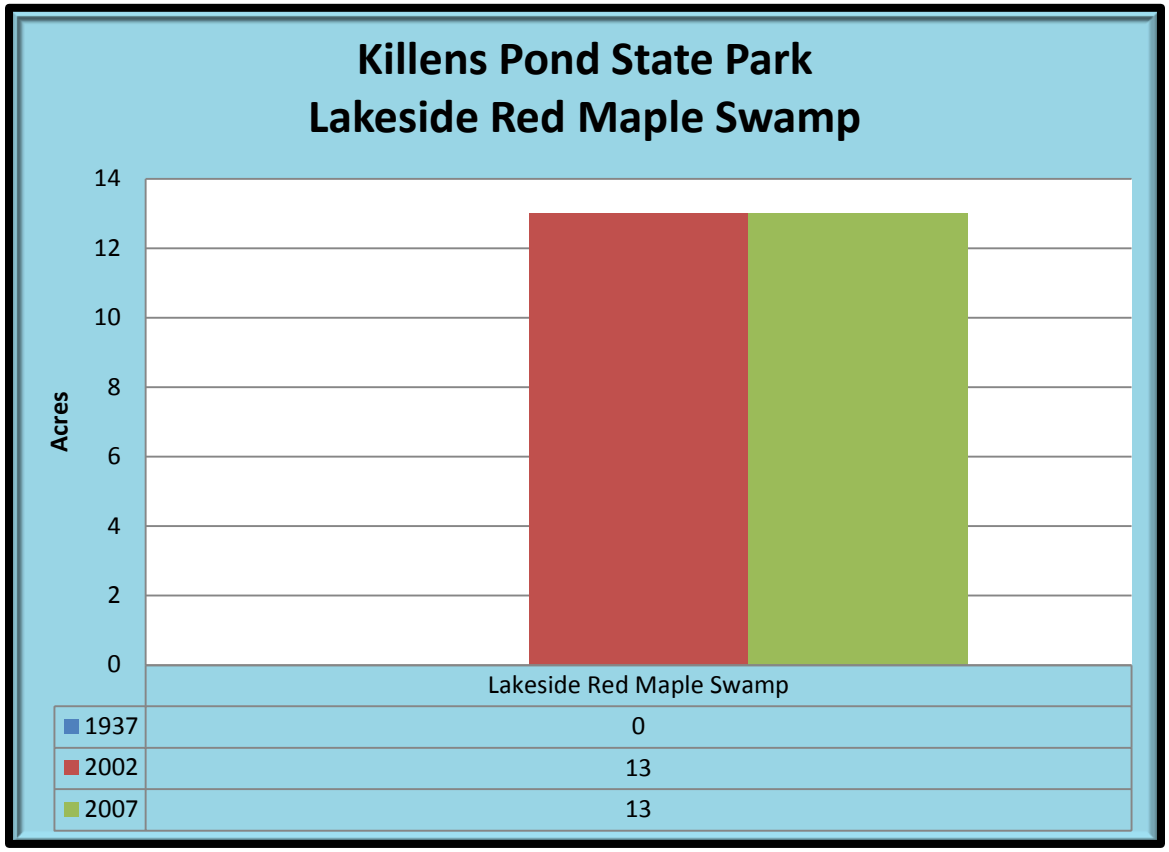

Figure 4.13. Lakeside Red Maple Swamp at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.14)

This community was not present in 1937 and has apparently arisen from an increase in the lake levels. Currently this community accounts for $159,790 in capital for the park.

Table 4.14. Natural Capital of Lakeside Red Maple Swamp	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$159,790/year
2007	$159,790/year

Loblolly Pine Plantation **[7 acres (Figure 4.14, Table 4.15)] GNA SNA**

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

Description

Loblolly Pine Plantation is located just west of the park office. It is composed of dense loblolly pine (*Pinus taeda*), planted in rows. Otherwise the species list for these communities is similar to that for the Early to Mid-Successional Loblolly Pine Forest.

Analysis of Condition at Killens Pond State Park

This community was not present in 1937 and all of its current extent arose from an agricultural field.

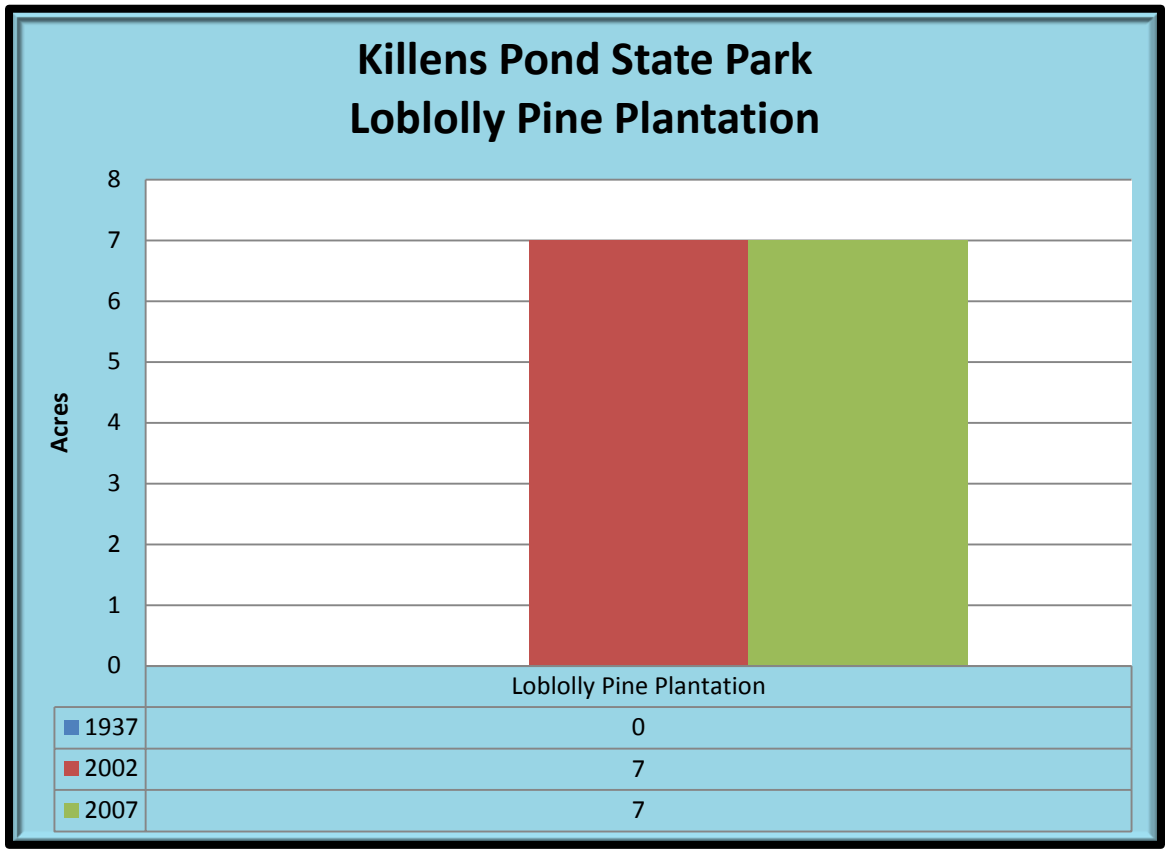

Figure 4.14. Loblolly Pine Plantation at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.15)

This community was not present in 1937 and has since achieved $1,324 in capital for the park, adding to the total.

Table 4.15. Natural Capital of Loblolly Pine Plantation	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$1,324/year
2007	$1,324/year

Mid to Late Successional Loblolly Pine-Sweetgum Forest **[75 acres (Figure 4.15-4.16, Tables 4.16-4.17)] GNA SNA**

DEWAP: Coastal Plain Upland Forest
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

Mid to Late Successional Loblolly Pine-Sweetgum is located on the north side of the lake in the vicinity of the Nature Center. Most of the occurrences of this community could be considered to a borderline Northeastern Modified Successional Forest. The canopy in this community is composed of loblolly pine (*Pinus taeda*), southern red oak (*Quercus falcata*), and Virginia pine (*Pinus virginiana*). The understory contains smaller members of the canopy plus flowering dogwood (*Cornus florida*), sassafras (*Sassafras albidum*), American beech (*Fagus grandifolia*), red maple (*Acer rubrum*), American holly (*Ilex opaca*), sweetbay (*Magnolia virginiana*), and hercule's club (*Aralia spinosa*). The shrub and vine layer includes common greenbrier (*Smilax rotundifolia*), blackberry (*Rubus* sp.), and Japanese honeysuckle (*Lonicera japonica*). No herbs were noted in this forest.

Figure 4.15. Mid to Late Successional Loblolly Pine-Sweetgum Forest

Analysis of Condition at Killens Pond State Park

This community did exist in the park in 1937 and has since populated 58 acres of agricultural field, 17 acres of Early to Mid-Successional Loblolly Pine Forest and 0.1 acres of Semi-impervious Surface (Table 4.16).

Table 4.16. Mid to Late Successional Loblolly Pine-Sweetgum Forest has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	58 acres
Early to Mid-Successional Loblolly Pine Forest	17 acres
Semi-impervious Surface	0.1 acres

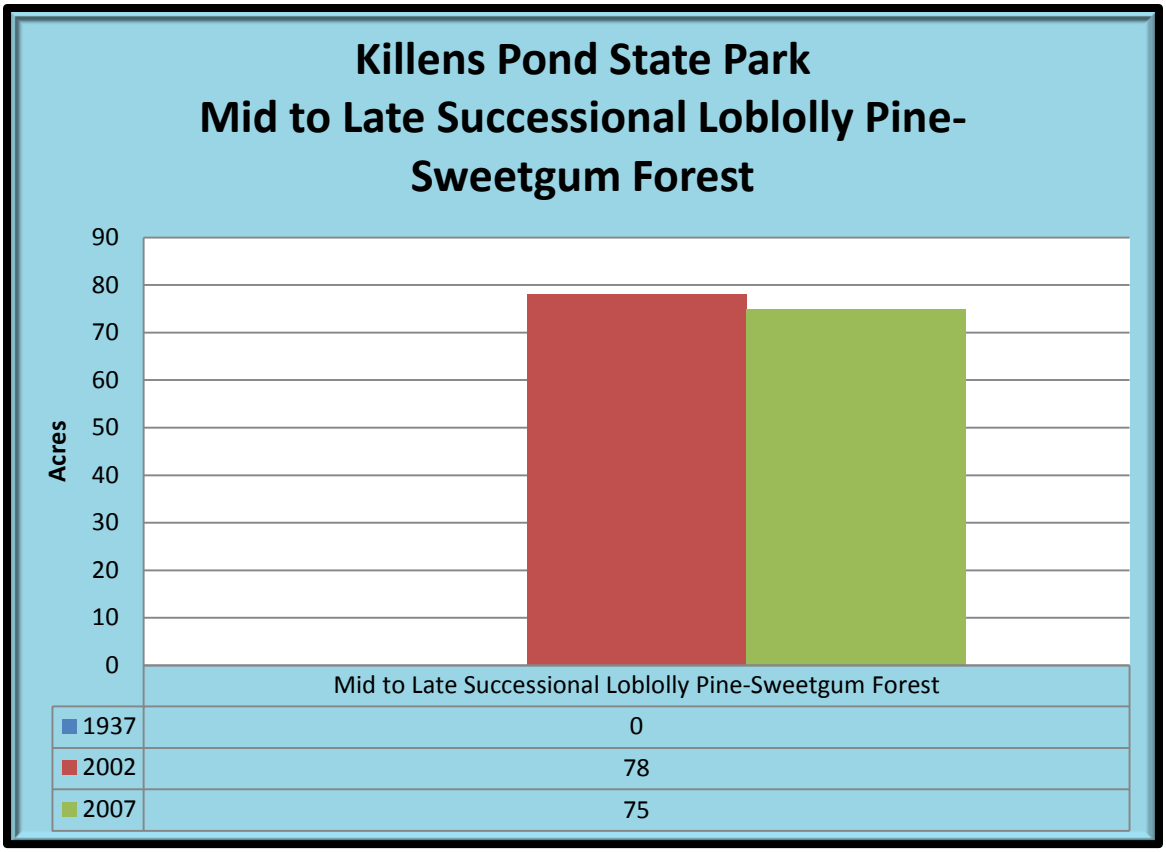

Figure 4.16. Mid to Late Successional Loblolly Pine-Sweetgum Forest at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.17)

Mid to Late Successional Loblolly Pine-Sweetgum Forest has grown to achieve $14,750 in capital for the park. This has resulted in a net gain for the park. A slight decrease in the recent period (2002-2007) was observed as part of the forest was developed into the new nature center.

Table 4.17. Natural Capital of Mid to Late Successional Loblolly Pine-Sweetgum Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$14,750/year
2007	$14,183/year

Mid-Atlantic Mesic Mixed Hardwood Forest **[272 acres (Figures 4.17-4.18, Tables 4.18-4.20)]**
G5 S5

DEWAP: Coastal Plain Upland Forest
NHC: Northern Atlantic Coastal Plain Hardwood Forest

Description

This is the most common forested community in the park. It is composed of a mixed assemblage of hardwoods in the canopy and characteristically American beech (*Fagus grandifolia*), although some of occurrences at Killens Pond do not have all that much beech. Other canopy members include tuliptree (*Liriodendron tulipifera*), southern red oak (*Quercus falcata*), Virginia pine (*Pinus virginiana*), sweetgum (*Liquidambar styraciflua*), northern red oak (*Quercus rubra*), white oak (*Quercus alba*), and a few mockernut hickory (*Carya alba*). Smaller members of the canopy plus American hornbeam (*Carpinus caroliniana*), American holly (*Ilex opaca*), flowering dogwood (*Cornus florida*), and wild black cherry (*Prunus serotina*) compose the understory. The shrub and vine layer is composed of poison ivy (*Toxicodendron radicans*), Japanese honeysuckle (*Lonicera japonica*), strawberry-bush (*Euonymus americanus*), common greenbrier (*Smilax rotundifolia*), lowbush blueberry (*Vaccinium pallidum*), arrow-wood (*Viburnum dentatum*), and a few multiflora rose (*Rosa multiflora*). Herbs noted in this community include wild licorice (*Galium tinctorium*), Virginia creeper (*Parthenocissus quinquefolia*), wild oats (*Uvularia perfoliata*), false solomon's seal (*Maianthemum racemosum*), southern forest bedstraw (*Galium circaezans*), Pennsylvania sedge (*Carex pensylvanica*), crane-fly orchid (*Tipularia discolor*), and common blue violet (*Viola sororia*).

Figure 4.17. Mid-Atlantic Mesic Mixed Hardwood Forest

The occurrences of this community could be considered at least late successional if not mature. Diameters of trees ranged from 1.0 foot to 1.5 feet with good layering in places that were not affected by deer browsing. Those areas to the south of the Murderkill River showed a lot of deer browsing and a browse line was evident in most places.

Analysis of Condition at Killens Pond State Park

Most of the examples of this community from 1937 were still present in 2007 (215 acres out of 222 acres). The rest of the acreage had become 2 acres of Impervious Surface, 2 acres of agricultural field, 1 acre of Northeastern Old Field, and 1 acre of impoundment (Table 4.18). Since 1937 this community has grown into 29 acres of agricultural field, 21 acres of Early to Mid-

Successional Loblolly Pine Forest, 5 acres of Northeastern Old Field, and 2 acres of Clear-cut (Table 4.19).

Table 4.18. What was once Mid-Atlantic Mesic Mixed Hardwood Forest in 1937 has become X or remained in 2007	
X	**Acreage**
Mid-Atlantic Mesic Mixed Hardwood Forest	215 acres
Impervious Surface	2 acres
Agricultural Field	2 acres
Northeastern Old Field	1 acre
Impoundment	1 acre
Other communities/land covers	2 acres

Table 4.19. Mid-Atlantic Mesic Mixed Hardwood Forest has migrated into X or remained since 1937	
X	**Acreage**
Mid-Atlantic Mesic Mixed Hardwood Forest	215 acres
Agricultural Field	29 acres
Early to Mid-Successional Loblolly Pine Forest	21 acres
Northeastern Old Field	5 acres
Clear-cut	2 acres
Other communities/land covers	1 acre

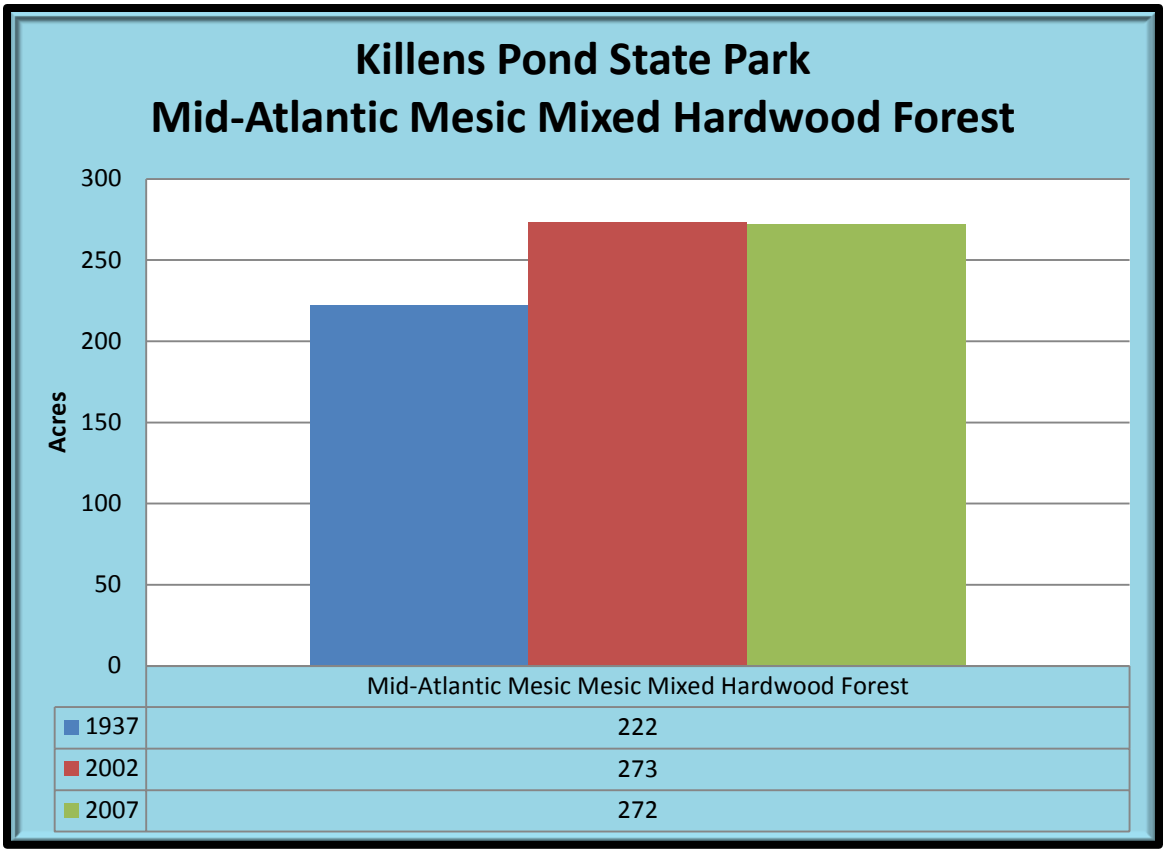

Figure 4.18. Mid-Atlantic Mesic Mixed Hardwood Forest at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.20)

Capital of Mid-Atlantic Mesic Mixed Hardwood Forest has grown since 1937, with a slight decrease in the recent period (2002-2007).

Table 4.20. Natural Capital of Mid-Atlantic Mesic Mixed Hardwood Forest

Year	Natural Capital (in 2012 dollars)
1937	$41,908/year
2002	$51,624/year
2007	$51,435/year

Northeastern Modified Successional Forest **[44 acres (Figures 4.19-4.20, Tables 4.21-4.23)]**
GNA SNA

DEWAP: Coastal Plain Upland Forest
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

This disturbed forest community is found in old sand pits and waste areas of the park. Often the canopy is fairly intact but contains an understory choked with exotic invasive plant species due to disturbance. Sadly a lot of successional forests from agricultural fields also turn into this forest. Canopy species in this community include red maple (*Acer rubrum*), loblolly pine (*Pinus taeda*), white oak (*Quercus alba*), southern red oak (*Quercus falcata*), black walnut (*Juglans nigra*), tuliptree (*Liriodendron tulipifera*), and wild black cherry (*Prunus serotina*). The understory is composed of spicebush (*Lindera benzoin*), Hercules club (*Aralia spinosa*), osage-orange (*Maclura pomifera*), box-elder (*Acer negundo*), American holly (*Ilex opaca*), and a few princess tree (*Paulownia tomentosa*). Common greenbrier (*Smilax rotundifolia*), Japanese honeysuckle (*Lonicera japonica*), multiflora rose (*Rosa multiflora*), summer grape (*Vitis aestivalis*), and poison ivy (*Toxicodendron radicans*) compose the shrub and vine layer. Common herbs include jack-in-the-pulpit (*Arisaema triphyllum*), pokeweed (*Phytolacca americana*), henbit (*Lamium purpureum*), ground ivy (*Glechoma hederacea*), crown vetch (*Coronilla varia*), and Virginia creeper (*Parthenocissus quinquefolia*).

Figure 4.19. Northeastern Modified Successional Forest

Most occurrences of this community in the park are in a mid-successional to late successional state, except for those areas that were present in 1937, which could be considered to be perpetually late successional. Diameters range from 0.5 feet to 1 foot in the mid-successional areas to up to 1.5 feet in the late successional area. Exotics are prevalent and thick in this community.

Analysis of Condition at Killens Pond State Park

Nineteen acres of the 22 acres from 1937 were still present in 2007. The rest of the acreage had become 1 acre of Northeastern Successional Shrubland (probably via another community), 1 acre of Farm Pond/Artificial Pond, and 1 acre of Successional Tuliptree Forest (Table 4.21). Since 1937 this community has grown into 20 acres of agricultural field, 4 acres of

Northeastern Old Field, 1 acre of Northeastern Successional Shrubland, and 0.4 acres of Semi-impervious Surface (Table 4.22).

Table 4.21. What was once Northeastern Modified Successional Forest in 1937 has become X or remained in 2007	
X	**Acreage**
Northeastern Modified Successional Forest	19 acres
Northeastern Successional Shrubland	1 acre
Farm Pond/Artificial Pond	1 acre
Successional Tuliptree Forest	1 acre
Mid-Atlantic Mesic Mixed Hardwood Forest	0.3 acres

Table 4.22. Northeastern Modified Successional Forest has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	20 acres
Northeastern Modified Successional Forest	19 acres
Northeastern Old Field	4 acres
Northeastern Successional Shrubland	1 acre
Semi-impervious Surface	0.4 acres
Other communities/land covers	0.3 acres

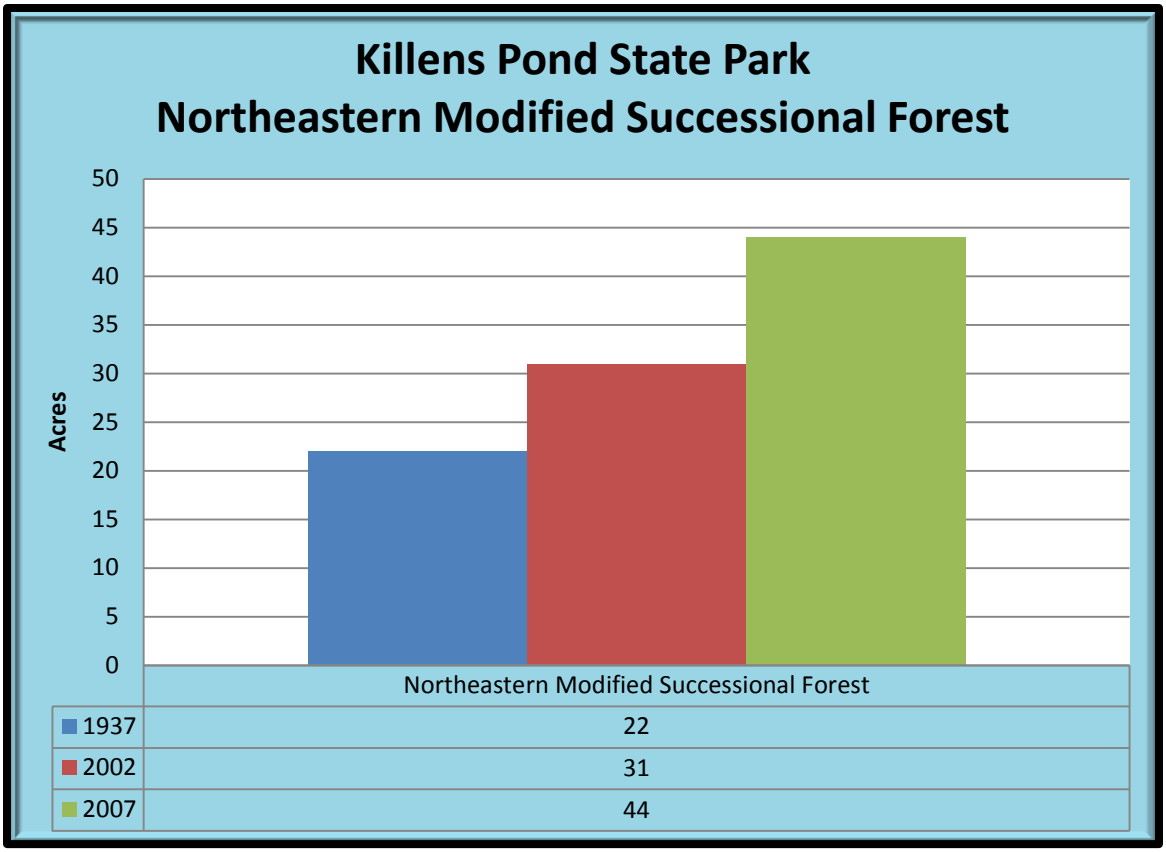

Figure 4.20. Northeastern Modified Successional Forest at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.23)

Capital of Northeastern Modified Successional Forest has increased throughout the study period with abandonment of agricultural fields and spreading the species contained within. Overall this community has increased the capital in the park.

Table 4.23. Natural Capital of Northeastern Modified Successional Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$4,160/year
2002	$5,862/year
2007	$8,320/year

Northeastern Old Field **[59 acres (Figures 4.21-4.22, Tables 4.21-4.23)] GNA SNA**

DEWAP: Coastal Plain Upland Forest
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

Northeastern Old Fields are often the first community to appear after the abandonment of an agricultural field. Separated from cultivated lawn by the fact that these fields are mowed once or less per year, one large example is located on the south side of the park. Species in this field includes tall fescue (*Festuca rubra*), crown vetch (*Coronilla varia*), and blackberry (*Rubus* sp.).

Figure 4.21. Northeastern Old Field

Analysis of Condition at Killens Pond State Park

None of the Northeastern Old Field present in 1937 was still present in 2007. The acreage instead had grown into 5 acres of Mid-Atlantic Mesic Mixed Hardwood Forest, 4 acres of Northeastern Modified Successional Forest, and 2 acres of Cultivated Lawn, 0.2 acres of Impervious Surface, and 0.1 acres of Semi-impervious Surface (Table 4.21). Since 1937, 57 acres of agricultural field, 1 acre of Southern Red Oak/Heath Forest, and 1 acre of Mid-Atlantic Mesic Mixed Hardwood Forest has become Northeastern Old Field (Table 4.22).

Table 4.21. What was once Northeastern Old Field in 1937 has become X or remained in 2007	
X	**Acreage**
Mid-Atlantic Mesic Mixed Hardwood Forest	5 acres
Northeastern Modified Successional Forest	4 acres
Cultivated Lawn	2 acres
Impervious Surface	0.2 acres
Semi-impervious Surface	0.1 acres

Table 4.22. Northeastern Old Field has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	57 acres
Southern Red Oak/Heath Forest	1 acre
Mid-Atlantic Mesic Mixed Hardwood Forest	1 acre

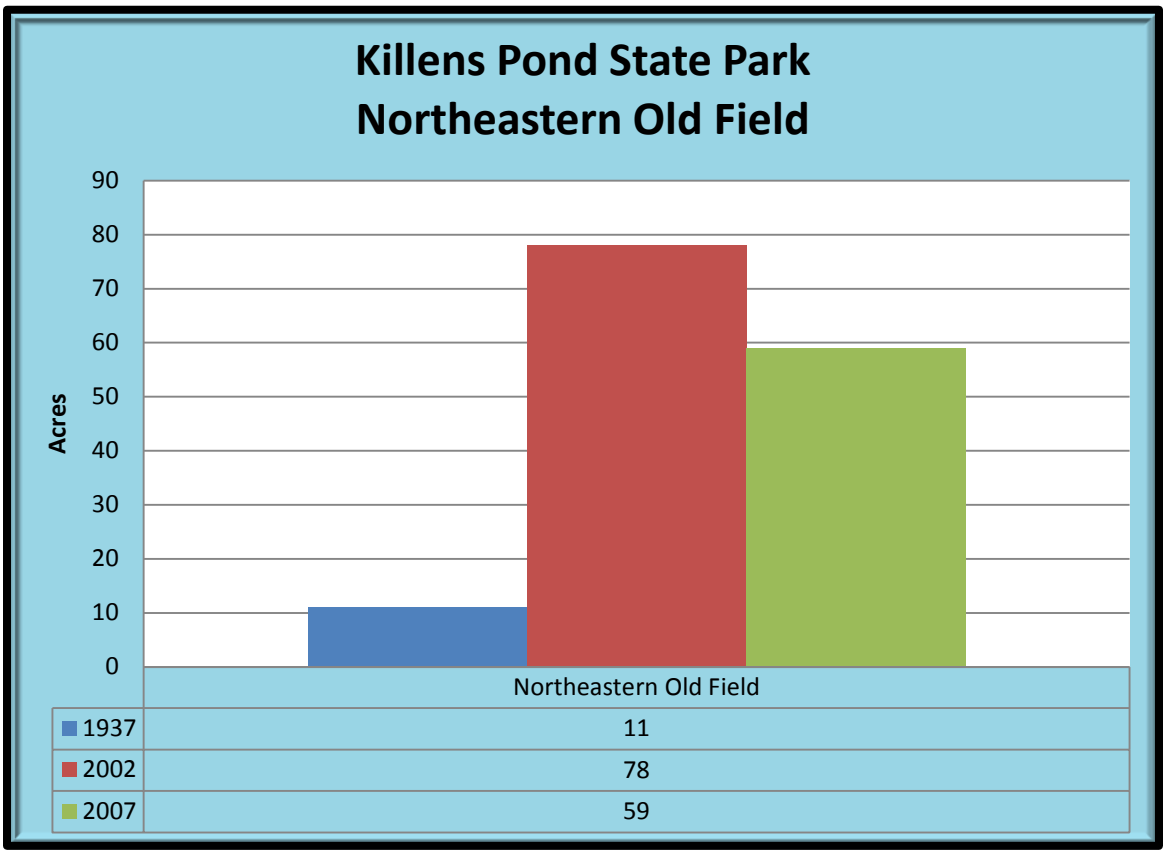

Figure 4.22. Northeastern Old Field at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.23)

Capital of Northeastern Old Field has increased since 1937 and declined in the recent period (2002-2007).

Table 4.23. Natural Capital of Northeastern Old Field	
Year	**Natural Capital (in 2012 dollars)**
1937	$1,654/year
2002	$11,727/year
2007	$8,871/year

Northeastern Successional Shrubland **[6 acres (Figures 4.23-4.24, Tables 4.24-4.26)] GNA SNA**

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

Description

This shrubland community is located to the north of Coursey Pond at the far eastern end of the park and around some old sandpits in the northwest section. Common species in this community include multiflora rose (*Rosa multiflora*), blackberry (*Rubus* sp.), Japanese honeysuckle (*Lonicera japonica*), mulberry (*Morus* sp.), eastern red cedar (*Juniperus virginiana*), poison ivy (*Toxicodendron radicans*), common greenbrier (*Smilax rotundifolia*), privet (*Ligustrum sinense*), autumn olive (*Elaeagnus umbellata*), summer grape (*Vitis aestivalis*), and salt shrub (*Baccharis halimifolia*). A scattered canopy of sassafras (*Sassafras albidum*) and wild black cherry (*Prunus serotina*) is present in the northwest section. Because of the scattered nature of some of the shrubs, and herb layer was present and included crown vetch (*Coronilla varia*), Virginia smartweed (*Polygonum virginiana*), dock (*Rumex crispus*), broom sedge (*Andropogon virginicus*), and false nettle (*Boehmeria cylindrica*), timothy (*Phleum pratense*), and common reed (*Phragmites australis*).

Figure 4.23. Northeastern Successional Shrubland

Analysis of Condition at Killens Pond State Park

None of the Northeastern Successional Shrubland from 1937 still survived in 2007. All of the acreage has become 1 acre of Northeastern Modified Successional Forest, 1 acre of agricultural field, and 0.1 acres of cultivated lawn (Table 4.24). Since 1937, Northeastern Successional Shrubland has grown into 5 acres of agricultural field (most likely through Northeastern Old Field), 1 acre of Northeastern Modified Successional Forest, and 0.2 acres of Semi-impervious Surface (Table 4.25).

Table 4.24. What was once Northeastern Successional Shrubland in 1937 has become X or remained in 2007	
X	**Acreage**
Northeastern Modified Successional Forest	1 acre
Agricultural Field	1 acre
Cultivated Lawn	0.1 acres

Table 4.25. Northeastern Successional Shrubland has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	5 acres
Northeastern Modified Successional Forest	1 acre
Semi-impervious Surface	0.2 acres

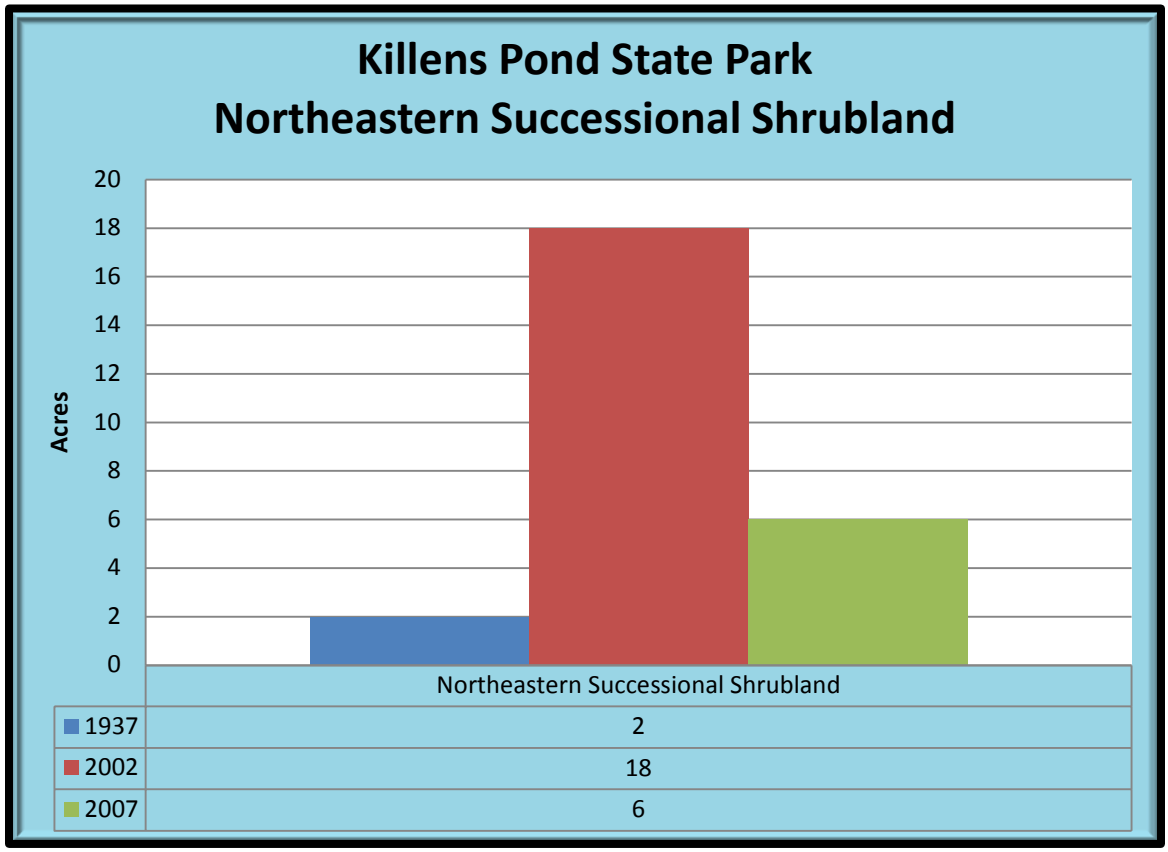

Figure 4.24. Northeastern Successional Shrubland at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.26)

Capital of Northeastern Successional Shrubland has increased overall since 1937. The successional nature of this community makes it come and go and as such it has decreased in the recent period (2002-2007).

Table 4.26. Natural Capital of Northeastern Successional Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1937	$301/year
2002	$2,706/year
2007	$902/year

Southern Red Maple-Blackgum Swamp **[82 acres (Figures 4.25-4.26, Tables 4.27-4.29)] G3 S3?**

DEWAP: Forested Floodplains and Riparian Swamps
NHC: Northern Atlantic Coastal Plain Stream and River

Description

Southern Red Maple-Blackgum Swamp is found on the major floodplains in the park. The canopy is dominated by red maple (*Acer rubrum*) and associated by green ash (*Fraxinus pennsylvanica*), blackgum (*Nyssa sylvatica*), and few loblolly pine (*Pinus taeda*), and tuliptree (*Liriodendron tulipifera*). Understory members include American holly (*Ilex opaca*), American hornbeam (*Carpinus caroliniana*), sweetbay (*Magnolia virginiana*), and few spicebush (*Lindera benzoin*), and willow oak (*Quercus phellos*). The shrub and vine layer is composed of common greenbrier (*Smilax rotundifolia*), poison ivy (*Toxicodendron radicans*), highbush blueberry (*Vaccinium corymbosum*), sweet pepperbush (*Clethra alnifolia*), creeping raspberry (*Rubus hispidus*), and pinxter flower (*Rhododendron periclymenoides*). False solomon's seal (*Maianthemum racemosum*), jack-in-the-pulpit (*Arisaema triphyllum*), orange-spotted jewelweed (*Impatiens capensis*), indian cucumber root (*Medeola virginica*), and partridgeberry (*Mitchella repens*) compose the herb layer.

Figure 4.25. Southern Red Maple-Blackgum Swamp

Most of the examples of this community are in a mature state with large canopy trees and distinct layers. Substrates are often saturated to soupy making walking difficult. Exotic invasive plants are few.

Analysis of Condition at Killens Pond State Park

In 2007, 77 acres of the 96 acres from 1937 still existed as forest in the park. The rest of the acreage had become 13 acres of Lakeside Red Maple Swamp, 4 acres of impoundment, 1 acre of Water-lily Aquatic Wetland, and 0.3 acres of water (Table 4.27). Since 1937 this forest has grown into 3 acres of agricultural field, 1 acre of old millpond, 0.3 acres of water, and 0.2 acres of Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp (Table 4.28).

Table 4.27. What was once Southern Red Maple-Blackgum Swamp in 1937 has become X or remained in 2007	
X	**Acreage**
Southern Red Maple-Blackgum Swamp	77 acres
Lakeside Red Maple Swamp	13 acres
Impoundment	4 acres
Water-lily Aquatic Wetland	1 acre
Water	0.3 acres

Table 4.28. Southern Red Maple-Blackgum Swamp has migrated into X or remained since 1937	
X	**Acreage**
Southern Red Maple-Blackgum Swamp	77 acres
Agricultural Field	3 acres
Old Millpond	1 acre
Water	0.3 acres
Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp	0.2 acres

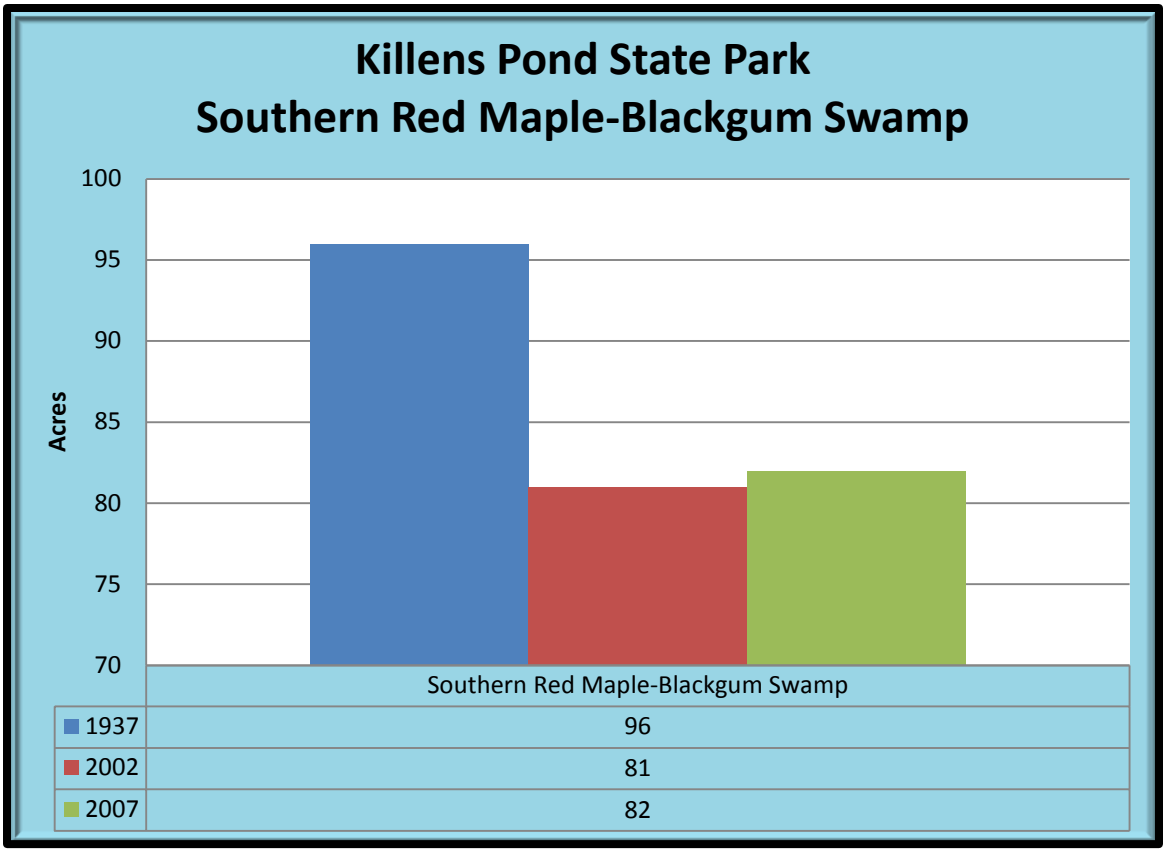

Figure 4.26. Southern Red Maple-Blackgum Swamp at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.29)

Capital of Southern Red Maple-Blackgum Swamp has decreased overall with losses to Lakeside Red Maple Swamp. However, there has been an increase in the recent period (2002-2007).

Table 4.26. Natural Capital of Southern Red Maple-Blackgum Swamp	
Year	**Natural Capital (in 2012 dollars)**
1937	$1,179,984/year
2002	$995,611/year
2007	$1,007,903/year

Southern Red Oak/Heath Forest **[39 acres (Figures 4.37-4.28, Tables 4.30-4.32)]G4G5 S5**

DEWAP: Coastal Plain Upland Forest
NHC: Northern Atlantic Coastal Plain Hardwood Forest

Description

Southern Red Oak/Heath Forest is found mostly in the uplands south of the Murderkill River. The canopy is composed of southern red oak (*Quercus falcata*), white oak (*Quercus alba*), Virginia pine (*Pinus virginiana*), tuliptree (*Liriodendron tulipifera*), and northern red oak (*Quercus rubra*). The understory is composed of flowering dogwood (*Cornus florida*), mockernut hickory (*Carya alba*), American holly (*Ilex opaca*), chestnut oak (*Quercus prinus*), and American hornbeam (*Carpinus caroliniana*). The shrub and vine layer contains lowbush blueberry (*Vaccinium pallidum*), common greenbrier (*Smilax rotundifolia*), blackberry (*Rubus* sp.), strawberry-bush (*Euonymus americanus*), and Japanese honeysuckle (*Lonicera japonica*). No herbs were noted in this community.

Figure 4.27. Southern Red Oak/Heath Forest

Most of the examples in the park of this community are in mature condition with a scattered young example. A lot them are deer browsed giving a thin lowbush blueberry layer, which should be dense in this community.

Analysis of Condition at Killens Pond State Park

Most of the Southern Red Oak/Heath Forest from 1937 was still present in 2007 (39 acres from 42 acres). The rest of the acreage had become 2 acres of agricultural field, 1 acre of Northeastern Old Field, 1 acre of Virginia Pine Successional Forest, and 0.2 acres of cultivated lawn (Table 4.30). Since 1937, Southern Red Oak/Heath Forest has only grown into 3 acres of agricultural field resulting in a decrease in the total acreage (Table 4.31).

Table 4.30. What was once Southern Red Oak/Heath Forest in 1937 has become X or remained in 2007	
X	**Acreage**
Southern Red Oak/Heath Forest	37 acres
Agricultural Field	2 acres
Northeastern Old Field	1 acre
Virginia Pine Successional Forest	1 acre
Cultivated Lawn	0.2 acres
Other vegetation communities/land covers	0.1 acres

Table 4.31. Southern Red Oak/Heath Forest has migrated into X or remained since 1937	
X	**Acreage**
Southern Red Oak/Heath Forest	37 acres
Agricultural Field	3 acres

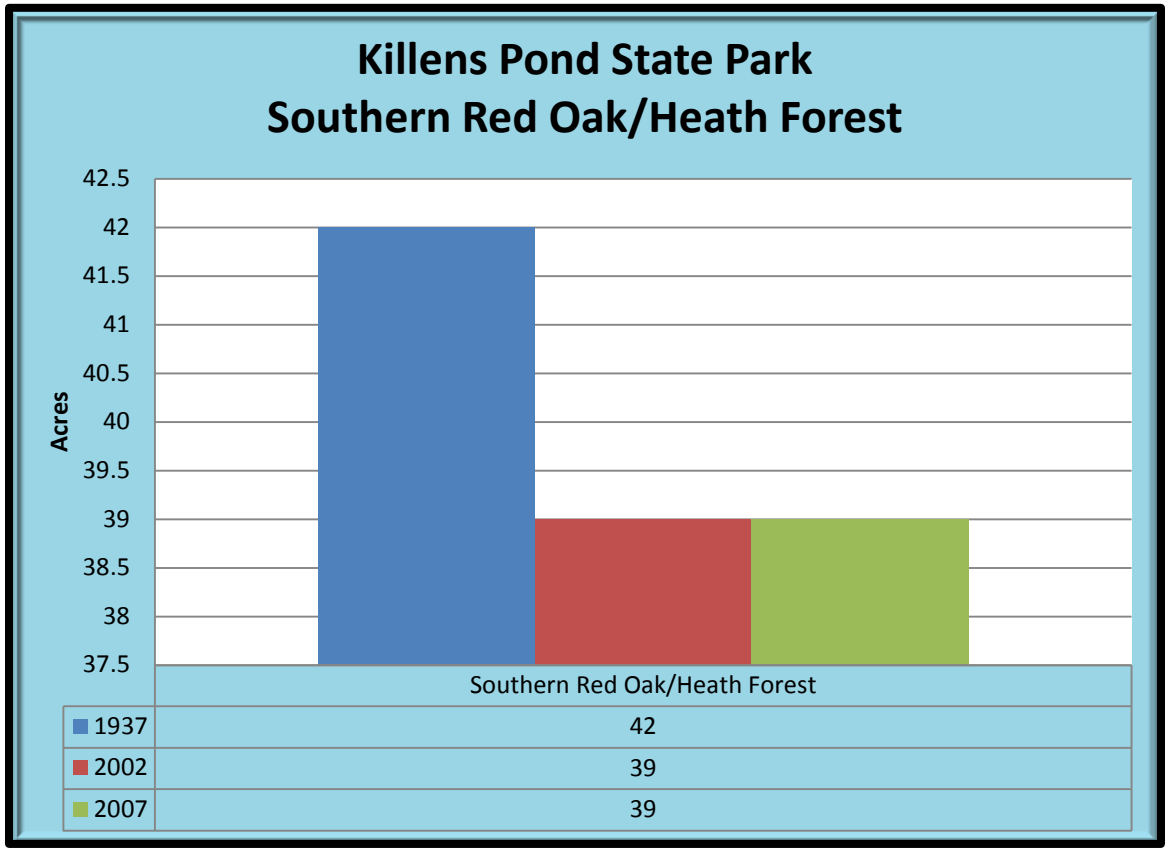

Figure 4.28. Southern Red Oak/Heath Forest at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.32)

Capital of Southern Red Oak/Heath Forest has declined with its acreage since 1937. It has been stable in the recent period (2002-2007).

Table 4.32. Natural Capital of Southern Red Oak/Heath Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$7,942/year
2002	$7,375/year
2007	$7,375/year

Successional Sweetgum Forest **[1 acre (Figures 4.29-4.30, Tables 4.33-4.34)] GNA SNA**

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

Description

Successional Sweetgum Forest is located in a large Northeastern Old Field in the south part of the park. Sweetgum (*Liquidambar styraciflua*) is the dominant species and is associated by loblolly pine (*Pinus taeda*). The short understory contains American holly (*Ilex opaca*) and red maple (*Acer rubrum*). Shrubs and vines include blackberry (*Rubus* sp.) and multiflora rose (*Rosa multiflora*). Southern forest bedstraw (*Galium aparine*) and Virginia smartweed (*Polygonum virginianum*) were the only herbs noted.

Figure 4.29. Successional Sweetgum Forest

Analysis of Condition at Killens Pond State Park

Successional Sweetgum Forest has grown into 1 acre of agricultural field since 1937 (Table 4.33).

Table 4.33. Successional Sweetgum Forest has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	1 acre

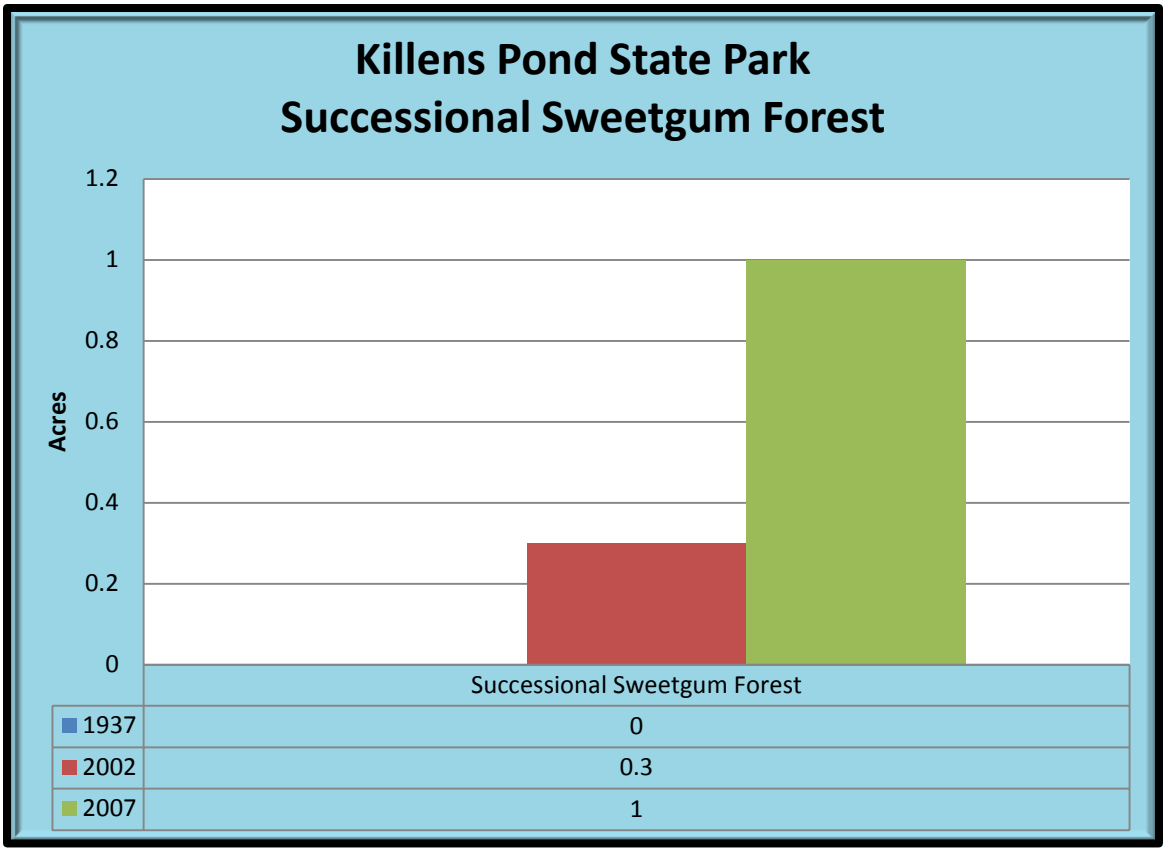

Figure 4.30. Successional Sweetgum Forest at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.34)

Capital of Successional Sweetgum Forest has increased with its acreage.

Table 4.34. Natural Capital of Successional Sweetgum Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$57/year
2007	$189/year

Successional Tuliptree Forest **[14 acres (Figures 4.31-4.32, Tables 4.35-4.37)] GNA SNA**

DEWAP: Coastal Plain Upland Forest
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

Most of the Successional Tuliptree Forest in the park is located at the eastern end, north of Coursey Pond. Tuliptree (*Liriodendron tulipifera*) is the dominant species and is associated by sweetgum (*Liquidambar styraciflua*). Eastern Red Cedar (*Juniperus virginiana*) and wild black cherry (*Prunus serotina*) grow underneath. The shrub and vine layer contains multiflora rose (*Rosa multiflora*), blackberry (*Rubus* sp.), Japanese honeysuckle (*Lonicera japonica*), and poison ivy (*Toxicodendron radicans*). A number of herbs are present in this community and include Virginia creeper (*Parthenocissus quinquefolia*), crown vetch (*Coronilla varia*), swan's sedge (*Carex swanii*), wild onion (*Allium* sp.), strawberry (*Fragaria virginica*), bedstraw (*Galium tinctorium*), Grapefern (*Botrychium virginianum*), and ebony spleenwort (*Asplenium platyneuron*).

Figure 4.31. Successional Tuliptree Forest

Analysis of Condition at Killens Pond State Park

All of the acreage present in 1937 was still present in 2007 (Table 4.35). Since 1937 and recently in the 2002-2007 period this community has increased on the eastern side of the park. Thirteen acres of agricultural field, 1 acre of Northeastern Modified Successional Forest, and 0.2 acre of Mid-Atlantic Mesic Mixed Hardwood Forest have become this community since 1937 (Table 4.36).

Table 4.35. What was once Successional Tuliptree Forest in 1937 has become X or remained in 2007	
X	**Acreage**
Successional Tuliptree Forest	1 acre

Table 4.36. Successional Tuliptree Forest has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	13 acres
Successional Tuliptree Forest	1 acre
Northeastern Modified Successional Forest	1 acre
Mid-Atlantic Mesic Mixed Hardwood Forest	0.2 acres

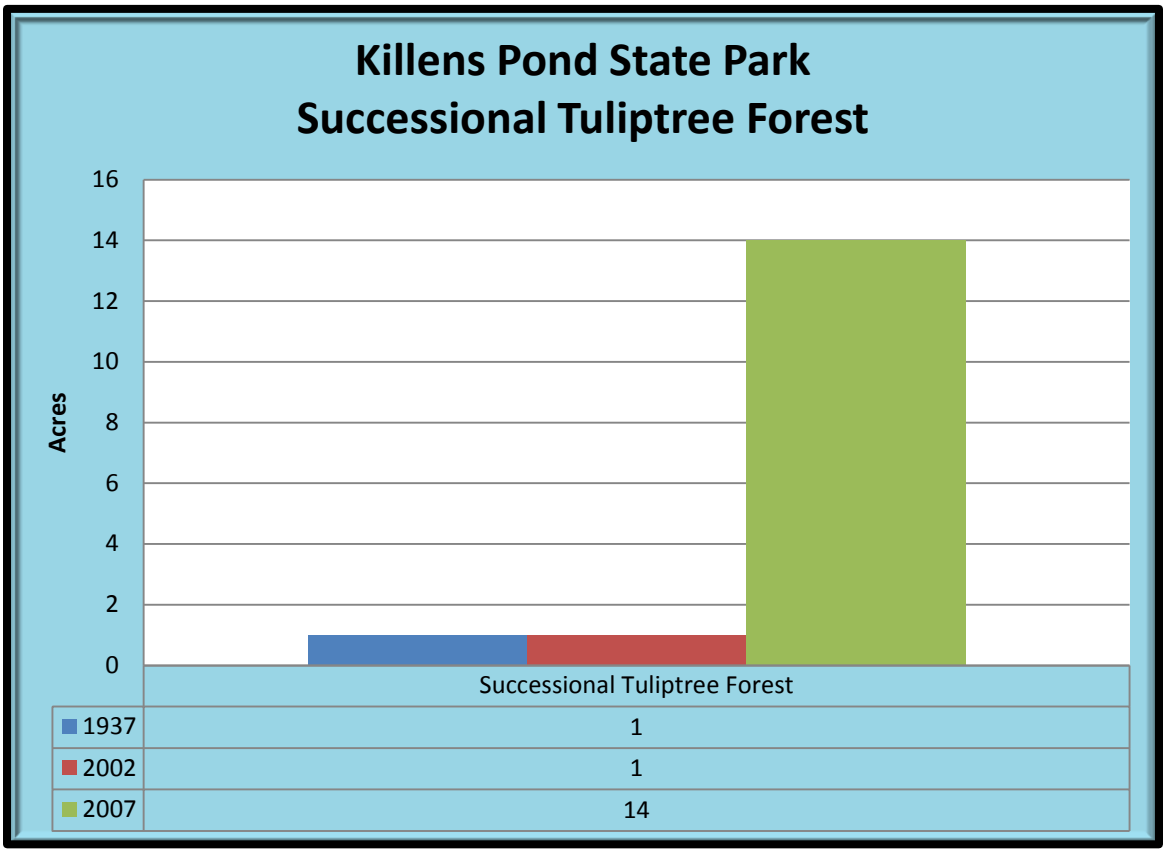

Figure 4.32. Successional Tuliptree Forest at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.37)

Capital of Successional Tuliptree Forest has increased with its acreage in the recent period 2002-2007.

Table 4.37. Natural Capital of Successional Tuliptree Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$189/year
2002	$189/year
2007	$2,647/year

Virginia Pine Successional Forest **[1 acre (Figures 4.33-4.34, Table 4.38)]** **GNA SNA**

DEWAP: Coastal Plain Upland Forest
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

Virginia pine (*Pinus virginiana*) is dominant in this community and is associated by a small amount of white oak (*Quercus alba*) and sweetgum (*Liquidambar styraciflua*). The understory contains a similar species list to the adjacent Southern Red Oak/Heath Forest. Common understory associates include red maple (*Acer rubrum*), American hornbeam (*Carpinus caroliniana*), flowering dogwood (*Cornus florida*), American holly (*Ilex opaca*), sassafras (*Sassafras albidum*), and mockernut hickory (*Carya alba*). The shrub and vine layer is composed of lowbush blueberry (*Vaccinium pallidum*), blackberry (*Rubus* sp.), and a very few wisteria (*Wisteria sinensis*). Herbs in this community include Virginia creeper (*Parthenocissus quinquefolia*), deer-tongue grass (*Dichanthelium clandestinum*), partridgeberry (*Mitchella repens*), and large twayblade (*Liparis lilifolia*).

Figure 4.33. Virginia Pine Successional Forest

Analysis of Condition at Killens Pond State Park

All of the Virginia Pine Successional Forest currently present came from a Southern Red Oak/Heath from 1937.

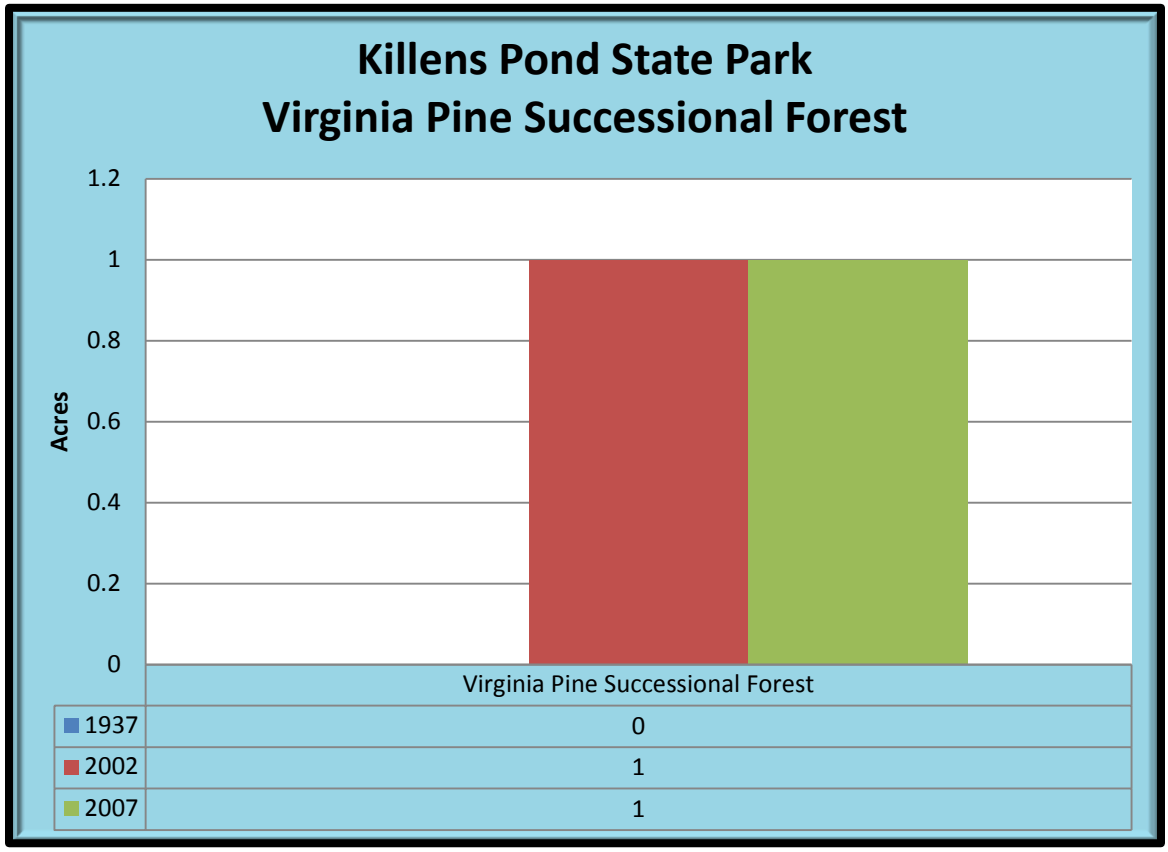

Figure 4.34. Virginia Pine Successional Forest at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.38)

Capital of Virginia Pine Successional Forest has come about since 1937 but is neutral capital gain for the park.

Table 4.38. Natural Capital of Virginia Pine Successional Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$189/year
2007	$189/year

Water-lily Aquatic Wetland **[5 acres (Figures 4.35-4.36, Tables 4.39-4.40)] G4G5 S3?**

DEWAP: Riverine Aquatic and Submerged Vegetation
NHC: Laurentian-Acadian Freshwater Marsh

Description

Water-lily Aquatic Wetland is found in the still waters of Killens Pond and Coursey Pond. Spatterdock (*Nuphar lutea* spp. *advena*) and water-lily (*Nymphaea odorata*) are both co-dominant in this community. Other associates include duckweed (*Lemna* sp.) and watershield (*Brasenia schreberi*).

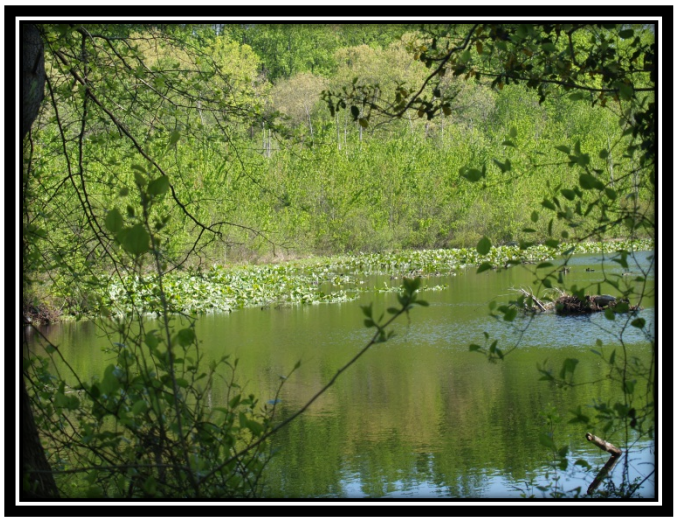

Figure 4.35. Water-lily Aquatic Wetland (in background)

Analysis of Condition at Killens Pond State Park

This community has come into the ponds since 1937 after they were re-impounded. Since this time Water-lily Aquatic Wetland has populated 3 acres of Old Millpond, 1 acre of Southern Red Maple-Blackgum Swamp, and 0.3 acres of Mid-Atlantic Mesic Mixed Hardwood Forest (Table 4.39).

Table 4.39. Water-lily Aquatic Wetland has migrated into X or remained since 1937	
X	**Acreage**
Old Millpond	3 acres
Southern Red Maple-Blackgum Swamp	1 acre
Mid-Atlantic Mesic Mixed Hardwood Forest	0.3 acres

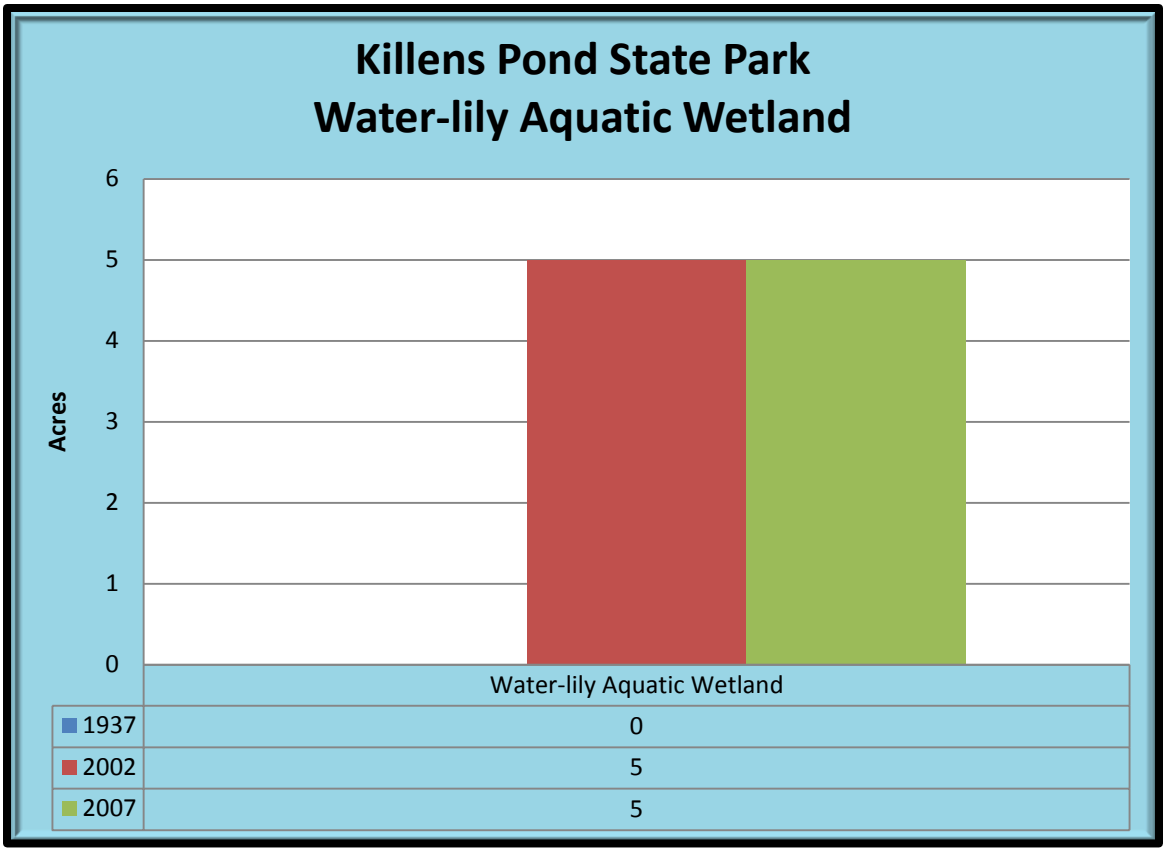

Figure 4.36. Water-lily Aquatic Wetland at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.40)

Capital of Water-lily Aquatic Wetland has come about since 1937 and has increased capital for the park.

Table 4.40. Natural Capital of Water-lily Aquatic Wetland	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$46,407/year
2007	$46,407/year

White Pine Planted Forest **[24 acres (Figures 4.37-4.38, Table 4.41-)] GNA SNA**

DEWAP: Coastal Plain Upland Forest
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

White Pine Planted Forest is located in the entrance area of the park and around the west end of the campground on the south side. White pine (*Pinus strobus*) that have been planted dominate the canopy completely. Understory associates include sweetgum (*Liquidambar styraciflua*), American holly (*Ilex opaca*), and American hornbeam (*Carpinus caroliniana*). The shrub and vine layer includes poison ivy (*Toxicodendron radicans*), Japanese honeysuckle (*Lonicera japonica*), and highbush blueberry (*Vaccinium corymbosum*). Virginia creeper (*Parthenocissus quinquefolia*) and ebony spleenwort (*Asplenium platyneuron*) were the only herbs noted.

Figure 4.37. White Pine Planted Forest

Analysis of Condition at Killens Pond State Park

White Pine Planted Forest was not present in 1937 and has since grown into 22 acres of agricultural field, 2 acres of Early to Mid-Successional Loblolly Pine Forest, and 0.1 acres of impervious surface (Table 4.41).

Table 4.41. White Pine Planted Forest has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	13 acres
Successional Tuliptree Forest	1 acre
Northeastern Modified Successional Forest	1 acre
Mid-Atlantic Mesic Mixed Hardwood Forest	0.2 acres

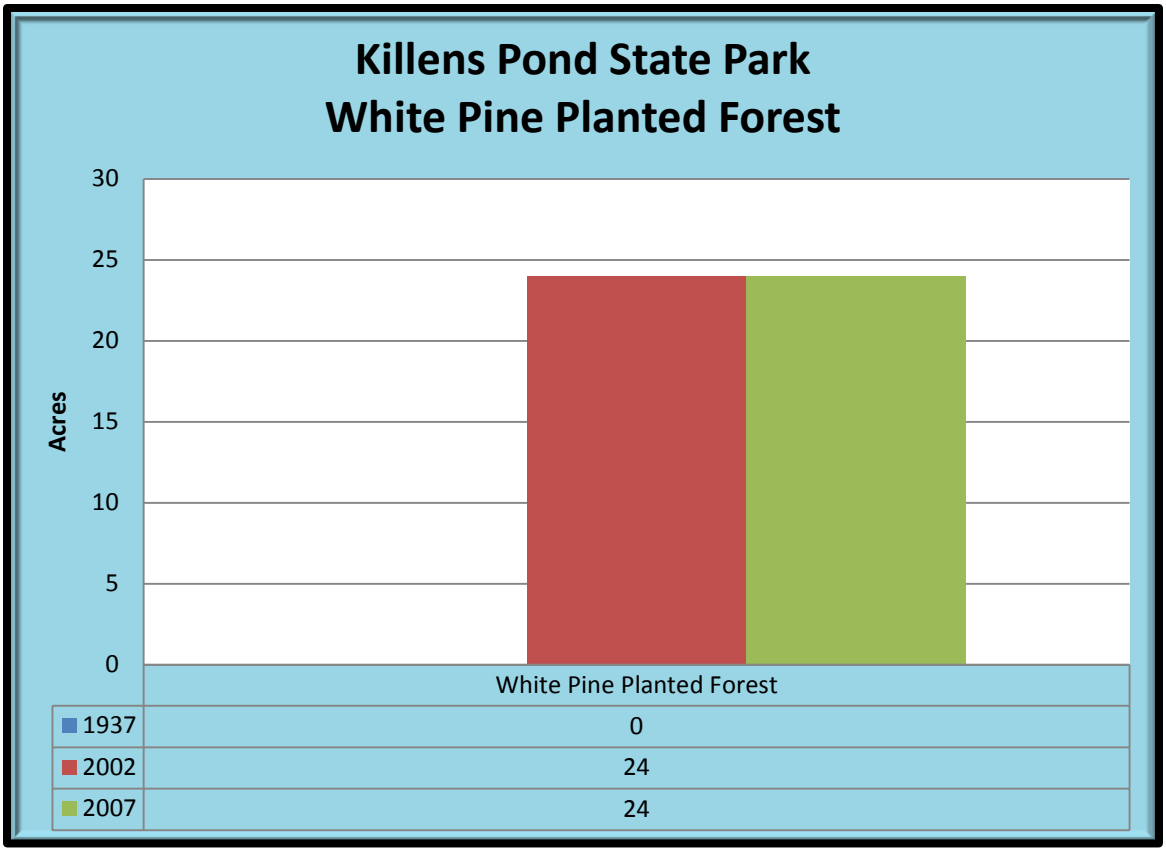

Figure 4.38. White Pine Planted Forest at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 4.42)

Capital of White Pine Planted Forest has increased with its acreage and has resulted in an overall capital gain for the park.

Table 4.42. Natural Capital of White Pine Planted Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$4,538/year
2007	$4,538/year

CHAPTER 5: DESCRIPTIONS AND ANALYSIS OF THE LAND COVERS

Seven land covers were noted during the survey. 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 it effects can also be seen in the impoundments.

The land covers include:

1. Agricultural Field—465 acres
2. Farm Pond/Artificial Pond—1 acre
3. Impervious Surface—30 acres
4. Impoundment—74 acres
5. Modified Land—1 acre
6. Semi-impervious Surface—1 acre
7. Water—2 acres

Agricultural Field **[465 acres (Figure 5.1, Tables 5.1-5.3)] GNA SNA**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

The agricultural fields in Killens Pond State Park are planted in corn, soybeans, or wheat.

Analysis of Condition at Killens Pond State Park

A little more than half of the agricultural field acreage from 1937 was still present in 2007. The rest of the acreage had become 122 acres of cultivated lawn, 58 acres of Mid to Late Successional Loblolly Pine-Sweetgum Forest, 57 acres of Northeastern Old Field, and 43 acres of Early to Mid-Successional Loblolly Pine Forest (Table 5.1). Since 1937 agricultural field has been developed on 3 acres of semi-impervious surface, 2 acres of southern red oak/heath forest, 2 acres of Mid-Atlantic Mesic Mixed Hardwood Forest, and 1 acre of Northeastern Successional Shrubland (Table 5.2).

Table 5.1. What was once Agricultural Field in 1937 has become X or remained in 2007	
X	**Acreage**
Agricultural Field	458 acres
Cultivated Lawn	122 acres
Mid to Late Successional Loblolly Pine-Sweetgum Forest	58 acres
Northeastern Old Field	57 acres
Early to Mid-Successional Loblolly Pine Forest	43 acres
Other vegetation communities/land covers	128 acres

Table 5.2. Agricultural Field has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	458 acres
Semi-impervious Surface	3 acres
Southern Red Oak/Heath Forest	2 acres
Mid-Atlantic Mesic Mixed Hardwood Forest	2 acres
Northeastern Successional Shrubland	1 acre

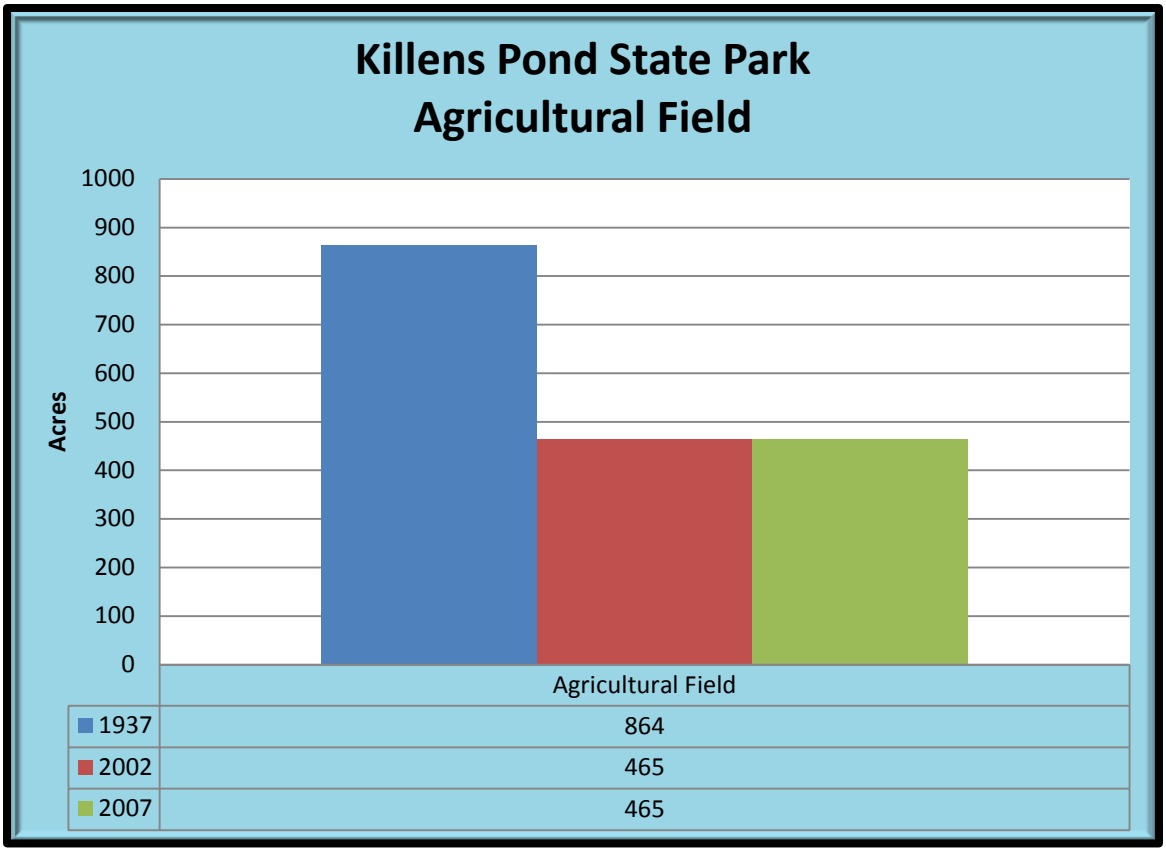

Figure 5.1. Agricultural Field at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 5.3)

Capital of Agricultural Field has decreased along with its acreage. Most of the transfers of capital have resulted in an increase in capital for the park.

Table 5.3. Natural Capital of Agricultural Field	
Year	**Natural Capital (in 2012 dollars)**
1937	$49,765/year
2002	$26,783/year
2007	$26,783/year

Farm Pond/Artificial Pond **[1 acre (Figure 5.2, Tables 5.4-5.5)] GNA SNA**

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 Killens Pond State Park

Ponds have been developed in the park after 1937 in 1 acre of Northeastern Modified Successional Forest and 0.4 acres of agricultural field (Table 5.4).

Table 5.4. Farm Pond/Artificial Pond has migrated into X or remained since 1937	
X	**Acreage**
Northeastern Modified Successional Forest	1 acre
Agricultural Field	0.4 acres

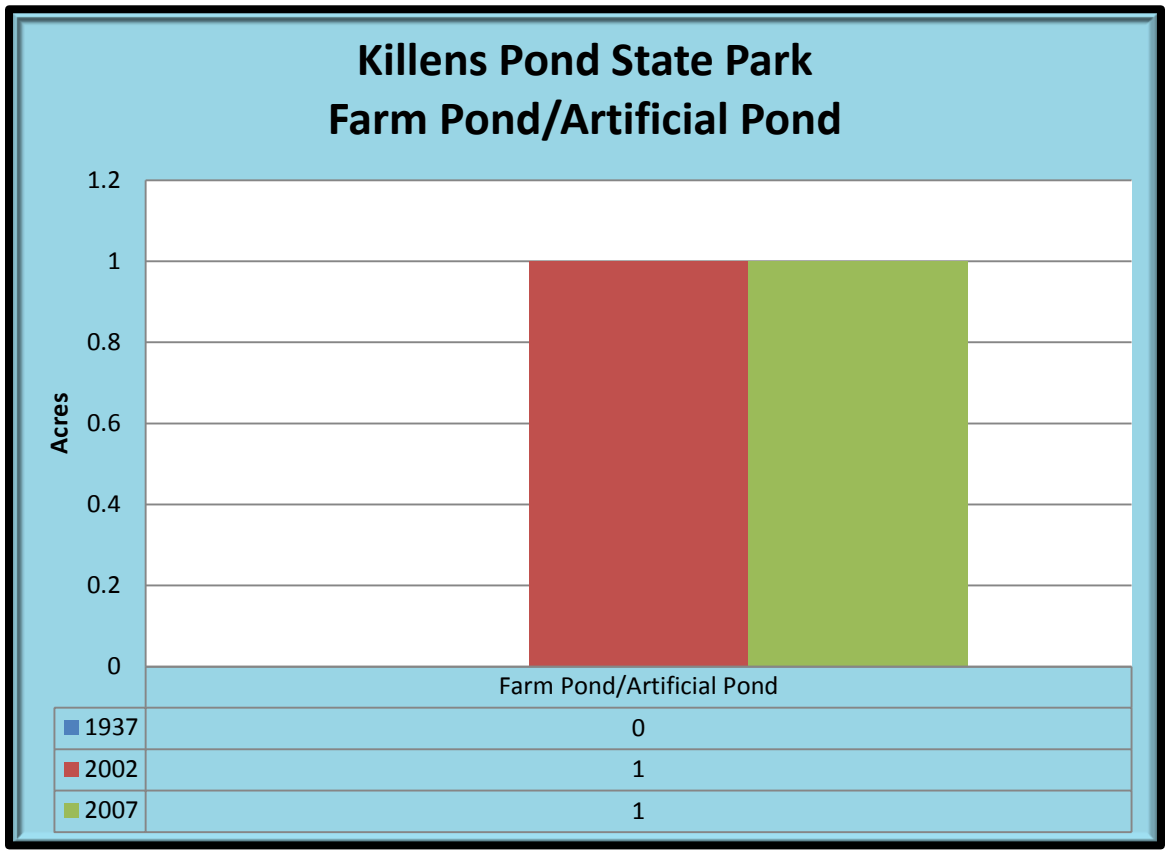

Figure 5.2. Farm Pond/Artificial Pond at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 5.5)

Ponds have been developed in the park since 1937 adding overall capital to the park.

Table 5.5. Natural Capital of Farm Pond/Artificial Pond	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$5,335/year
2007	$5,335/year

Impervious Surface **[30 acres, (Figure 5.3, Tables 5.6-5.7)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

Impervious surfaces in Killens Pond State Park include buildings, roads, and some trails. These areas are impervious to the passage of water.

Analysis of Condition at Killens Pond State Park

About ¼ of the impervious surface present in 1937 was still present in 2007. The rest of the acreage had become 0.3 acres of cultivated lawn and 0.1 acres of White Pine Planted Forest (Table 5.6). Since 1937, impervious surface has been developed in 23 acres of agricultural field, 4 acres of semi-impervious surface (likely through road paving), 2 acres of Mid-Atlantic Mesic Mixed Hardwood Forest, and 0.2 acres of Northeastern Old Field (Table 5.7).

Table 5.6. What was once Impervious Surface in 1937 has become X or remained in 2007	
X	**Acreage**
Cultivated Lawn	0.3 acres
White Pine Planted Forest	0.1 acres
Impervious Surface	0.1 acres

Table 5.7. Impervious Surface has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	23 acres
Semi-impervious Surface	4 acres
Mid-Atlantic Mesic Mixed Hardwood Forest	2 acres
Northeastern Old Field	0.2 acres
Impervious Surface	0.1 acres

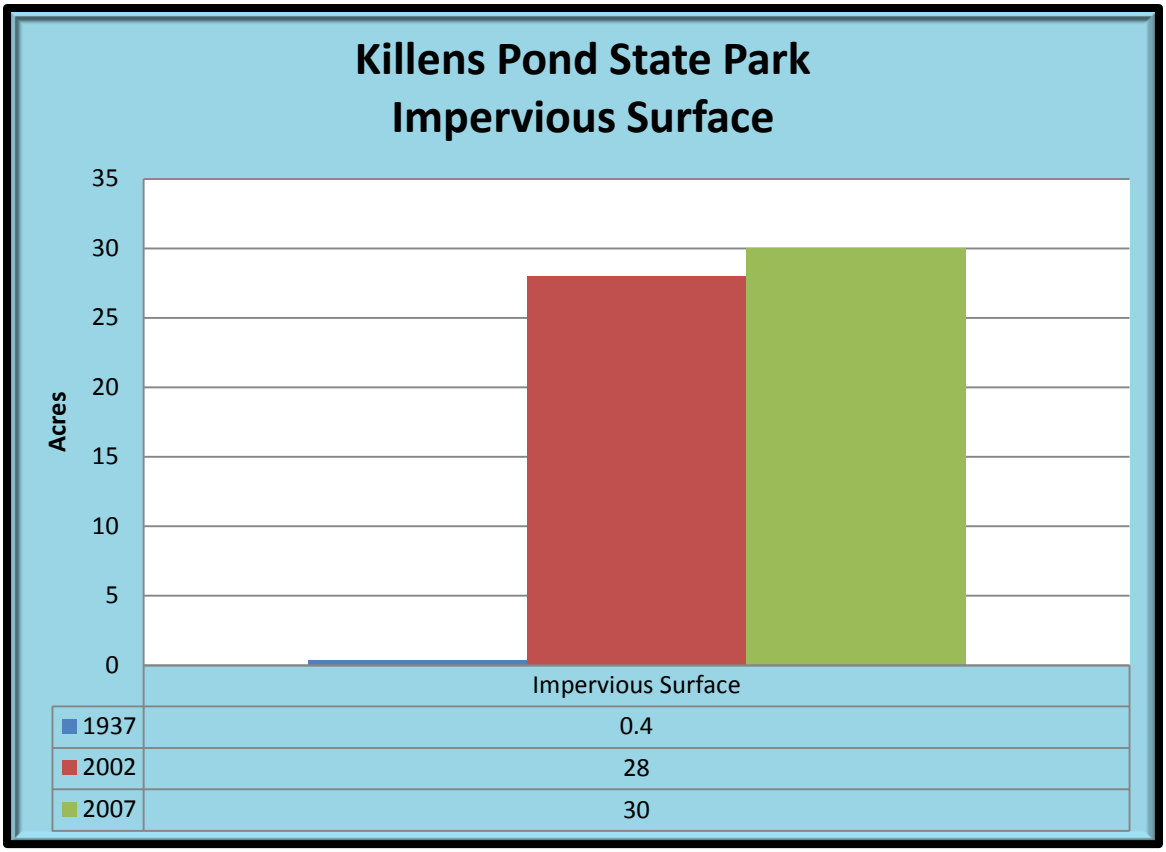

Figure 5.3. Impervious Surface at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital

Impervious surface does not contain any natural capital value.

***Impoundment* [74 acres, (Figure 5.4, Tables 5.8-5.9)]**

DEWAP: Impoundment
NHC: No Equivalent Classification

Description

Impervious surfaces in Killens Pond State Park include buildings, roads, and some trails. These areas are impervious to the passage of water.

Analysis of Condition at Killens Pond State Park

In 1937, what had been Killens Pond and Coursey Pond had been drained. At some point after, the impoundments were re-impounded and from appearances at a higher water level. Most of the area impounded was part of the old millpond (70 acres), but the higher water level also flooded 4 acres of Southern Red Maple-Blackgum Swamp, and 1 acre of Mid-Atlantic Mesic Mixed Hardwood Forest (Table 5.8). The flooding also produced the Lakeside Red Maple Swamp seen on the edges of Killens Pond.

Table 5.8. Impoundment has migrated into X or remained since 1937

X	Acreage
Old Millpond	70 acres
Southern Red Maple-Blackgum Swamp	4 acres
Mid-Atlantic Mesic Mixed Hardwood Forest	1 acre

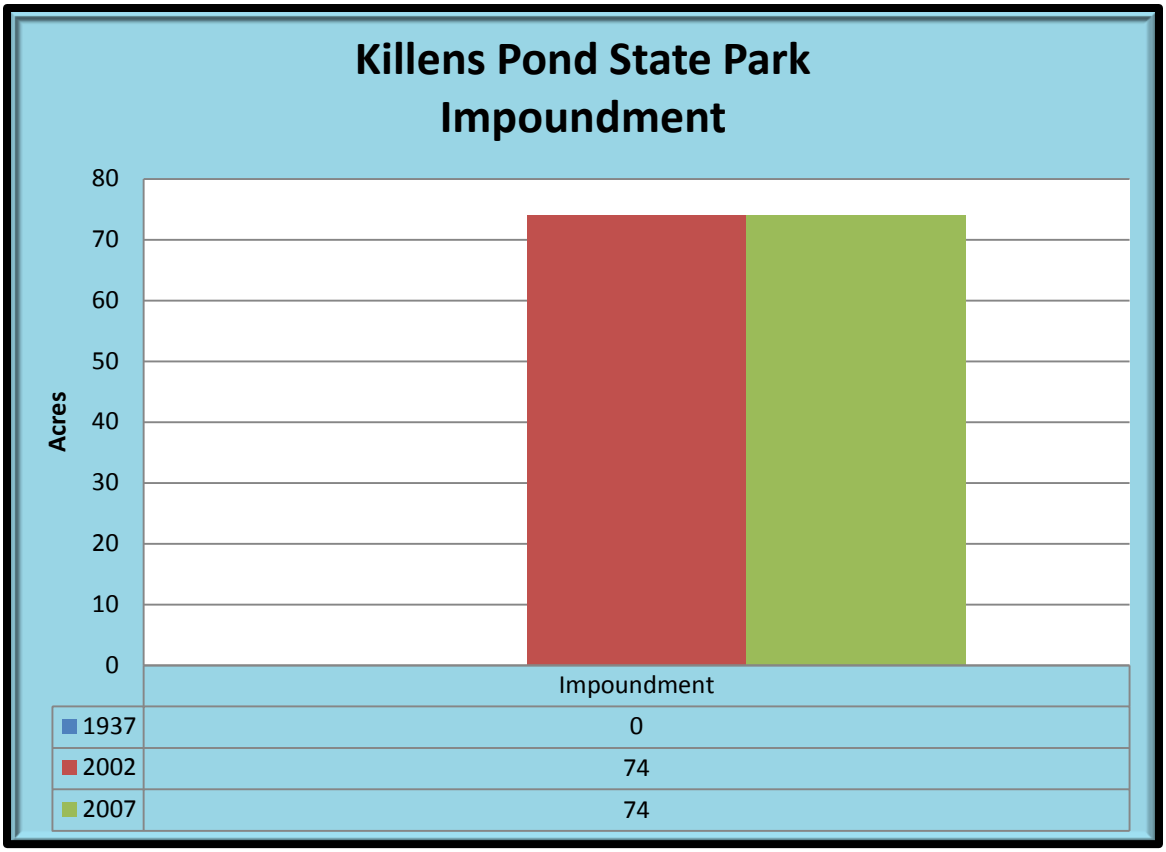

Figure 5.4. Impoundment at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 5.9)

Impoundments have added greatly to the overall natural capital value of the park.

Table 5.9. Natural Capital of Impoundment	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$394,797/year
2007	$394,797/year

Modified Land **[1 acre, (Figure 5.5, Table 5.10)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

Modified land includes those areas that have been stripped of their vegetation; most often for development or industrial activity.

Analysis of Condition at Killens Pond State Park

Most of the modified land at Killens Pond in 2007 came about through the construction of the new Nature Center. In 1937 1 acre of this area was agricultural field and 0.2 was Mid-Atlantic Mesic Mixed Hardwood Forest (Table 5.10).

Table 5.10. Modified Land has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	1 acre
Mid-Atlantic Mesic Mixed Hardwood Forest	0.2 acres

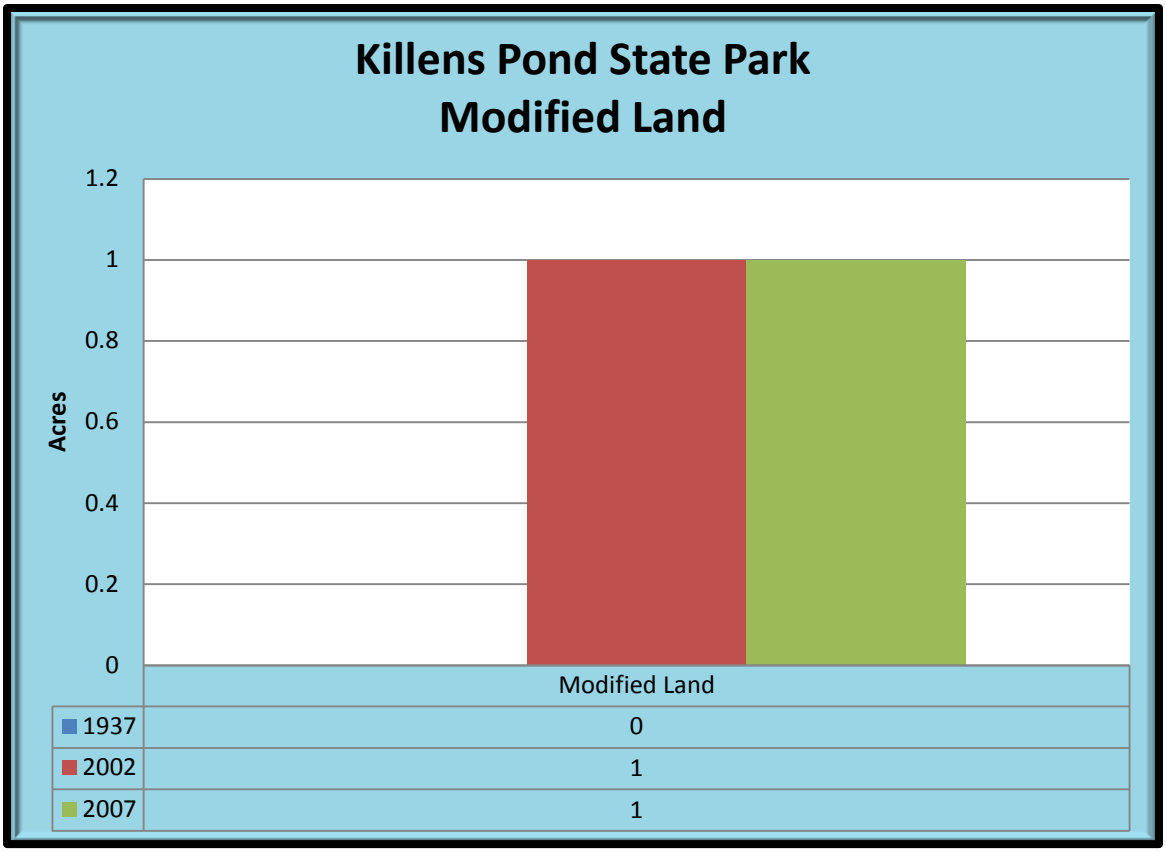

Figure 5.5. Modified Land at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital

Modified Land does not contain any natural capital value.

Old Millpond **[30 acres, (Figure 5.6, Table 5.11)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

Impervious surfaces in Killens Pond State Park include buildings, roads, and some trails. These areas are impervious to the passage of water.

Analysis of Condition at Killens Pond State Park

In 1937 old millpond area was present in what used to be Killens Pond and Coursey Pond. These areas were re-impounded after 1937 with the former old millpond acreage becoming 69 acres of impoundment, 3 acres of Water-lily Aquatic Wetland, 2 acres of Alluvial Alder Swamp, 1 acre of Southern Red Maple-Blackgum Swamp, and 1 acre of Mid-Atlantic Mesic Mixed Hardwood Forest (Table 5.11).

Table 5.11. What was once Old Millpond in 1937 has become X or remained in 2007

X	**Acreage**
Impoundment	69 acres
Water-lily Aquatic Wetland	3 acres
Alluvial Alder Swamp	2 acres
Southern Red Maple-Blackgum Swamp	1 acre
Mid-Atlantic Mesic Mixed Hardwood Forest	1 acre
Other vegetation communities/land covers	0.2 acres

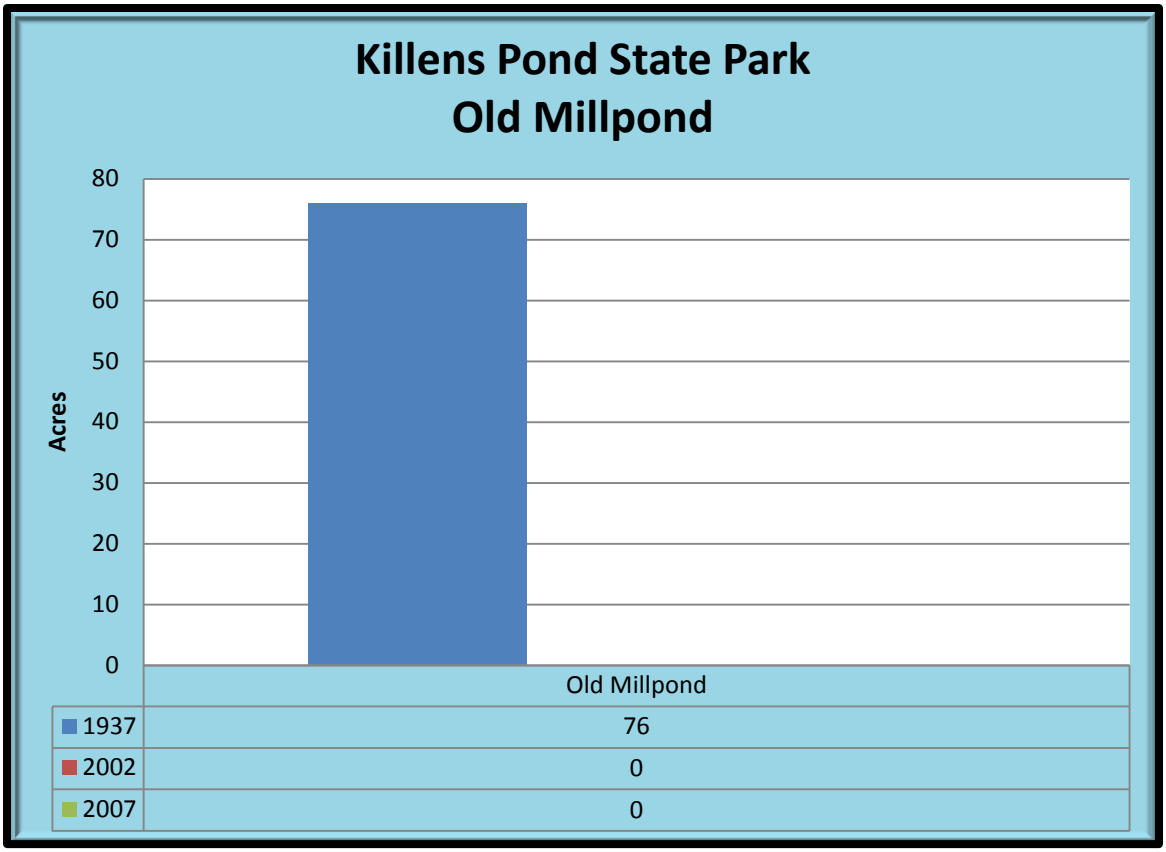

Figure 5.6. Old Millpond at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital

Old Millpond does not contain any natural capital value.

Semi-impervious Surface **[1 acre, (Figure 5.7, Tables 5.12-5.13)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

Impervious surfaces in Killens Pond State Park include buildings, roads, and some trails. These areas are impervious to the passage of water.

Analysis of Condition at Killens Pond State Park

Most of the semi-impervious surface in the park is as dirt roads. In 1937 there were nine acres of dirt roads, but in 2007 there was only one acre. Most of these roads were paved and became 4 acres of impervious surface. Other areas became 3 acres of agricultural field, 1 acre of cultivated lawn, 0.4 acres of Northeastern Modified Successional Forest, and 0.2 acres of Northeastern Successional Shrubland (Table 5.12). Since 1937, 1 acre of agricultural field and 0.1 acres of Mid-Atlantic Mesic Mixed Hardwood Forest have become semi-impervious surface (Table 5.13).

Table 5.12. What was once Semi-impervious Surface in 1937 has become X or remained in 2007	
X	**Acreage**
Impervious Surface	4 acres
Agricultural Field	3 acres
Cultivated Lawn	1 acre
Northeastern Modified Successional Forest	0.4 acres
Northeastern Successional Shrubland	0.2 acres
Other vegetation communities/land covers	0.1 acres

Table 5.13. Semi-impervious Surface has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	1 acre
Northeastern Old Field	0.1 acres
Mid-Atlantic Mesic Mixed Hardwood Forest	0.1 acres

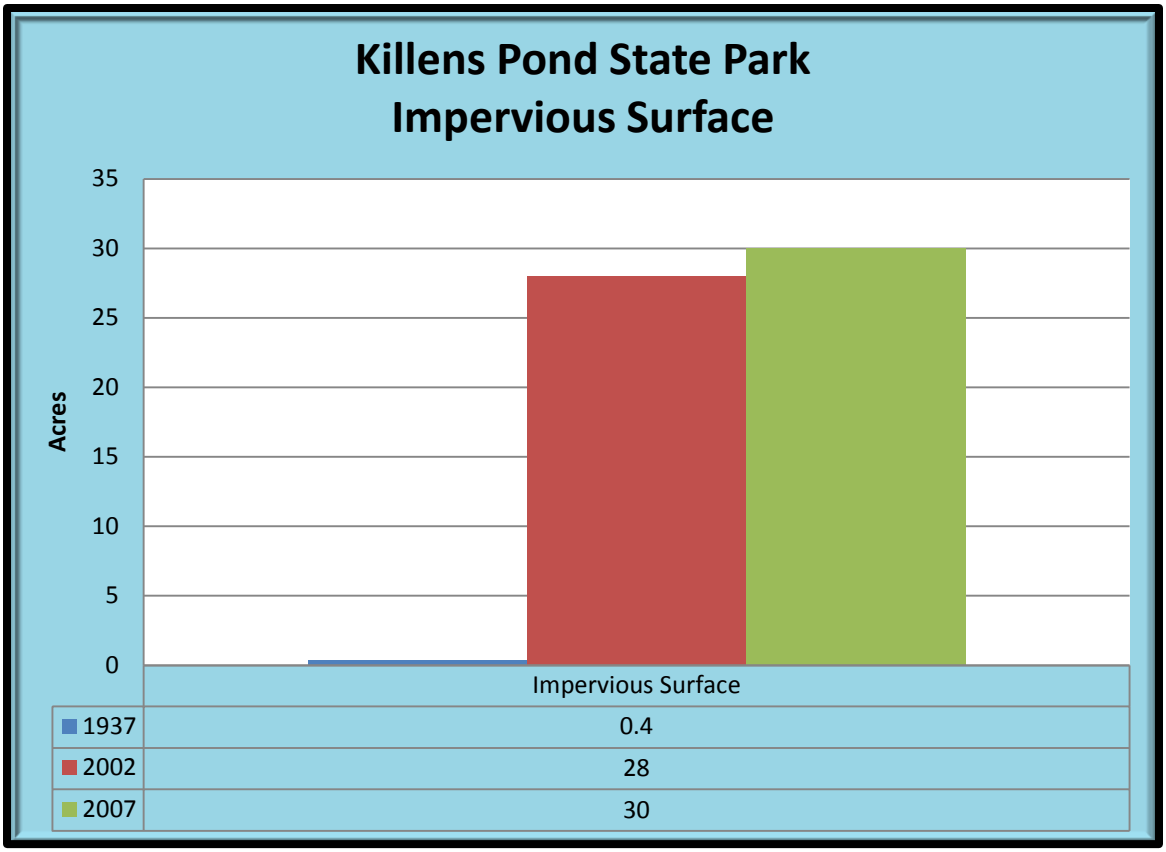

Figure 5.7. Semi-impervious Surface at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital

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

***Water* [1 acre, (Figure 5.8, Tables 5.14-5.16)]**

DEWAP: Non-tidal Coastal Plain Streams
NHC: No Equivalent Classification

Description

Impervious surfaces in Killens Pond State Park include buildings, roads, and some trails. These areas are impervious to the passage of water.

Analysis of Condition at Killens Pond State Park

Only 1 acre of the 2 acres of water present in 1937 was still present in 2007. The rest of the water had become 0.3 acres of Southern Red Maple/Blackgum Swamp, 0.2 acres of Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp, and 0.2 acres of Mid-Atlantic Mesic Mixed Hardwood Forest (Table 5.14). Since 1937, water has eroded new areas including 1 acre of Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp, 0.3 acres of Southern Red Maple-Blackgum Swamp, and 0.1 acres of Old Millpond (Table 5.15).

Table 5.14. What was once Water in 1937 has become X or remained in 2007	
X	**Acreage**
Water	1 acre
Southern Red Maple-Blackgum Swamp	0.3 acres
Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp	0.2 acres
Mid-Atlantic Mesic Mixed Hardwood Forest	0.2 acres

Table 5.15. Water has migrated into X or remained since 1937	
X	**Acreage**
Water	1 acre
Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp	1 acre
Southern Red Maple/Blackgum Swamp	0.3 acres
Old Millpond	0.1 acres

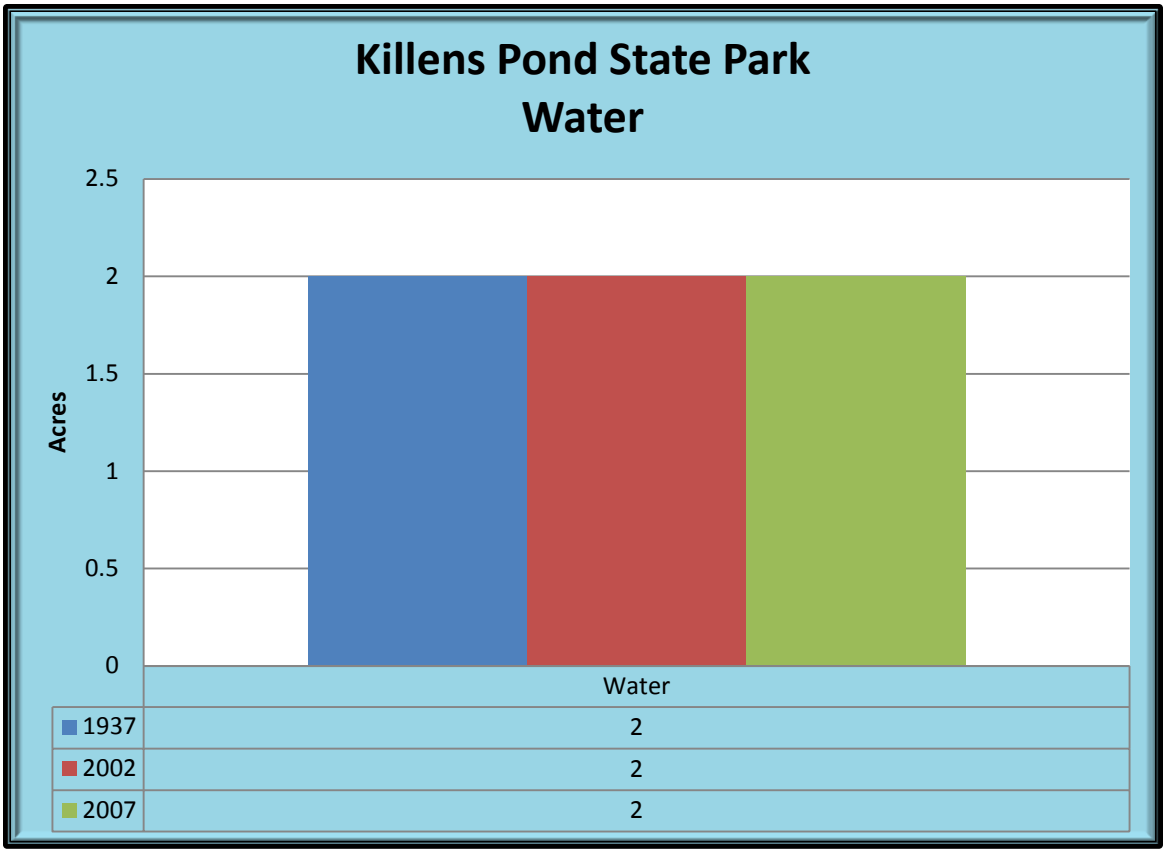

Figure 5.7. Semi-impervious Surface at Killens Pond State Park (1937, 2002, and 2007)

Natural Capital (Table 5.16)

Water has stayed at the same amount throughout the study period.

Table 5.16. Natural Capital of Water	
Year	**Natural Capital (in 2012 dollars)**
1937	$10,670/year
2002	$10,670/year
2007	$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 Coastal Plain Upland Forest			
Species	**Common Name**	**Class**	**Tier**
Cicindela patruela consentanea	Northern barrens tiger beetle	Insect	1
Callophrys irus	frosted elfin	Insect	1
Catocala antinympha	sweetfern underwing	Insect	1
Catocala lacrymosa	tearful underwing	Insect	1
Terrapene carolina	Eastern box turtle	Reptile	1
Eumeces laticeps	broadhead skink	Reptile	1
Cemophora coccinea	scarlet snake	Reptile	1
Elaphe guttata	corn snake	Reptile	1
Lampropeltis triangulum	milk snake	Reptile	1
Haliaeetus leucocephalus	Bald eagle	Bird	1
Accipiter cooperii	Cooper's Hawk	Bird	1
Buteo platypterus	broad-winged hawk	Bird	1
Asio otus	long-eared owl	Bird	1
Melanerpes erythrocephalus	red-headed woodpecker	Bird	1
Certhia americana	brown creeper	Bird	1
Hylocichla mustelina	wood thrush	Bird	1
Wilsonia citrina	hooded warbler	Bird	1
Sciurus niger cinereus	Delmarva fox squirrel	Mammal	1
Discus catskillensis	angular disc	Gastropod	2
Cicindela patruela	Northern barrens tiger beetle	Insect	2
Cicindela unipunctata	one-spotted tiger beetle	Insect	2
Photuris frontalis	a firefly	Insect	2
Erynnis martialis	mottled duskywing	Insect	2
Erynnis baptisiae	wild indigo duskywing	Insect	2
Battus philenor	pipevine swallowtail	Insect	2
Polygonia progone	gray comma	Insect	2
Caripeta aretaria	a geometer moth	Insect	2
Tolype notialis	a lasiocampid moth	Insect	2
Hemileuca maia maia	the buckmoth	Insect	2
Cisthene kentuckiensis	Kentucky lichen moth	Insect	2
Cisthene tenuifascia	a lichen moth	Insect	2
Grammia phyllira	phyllira tiger moth	Insect	2
Zale metata	a noctuid moth	Insect	2
Catocala flebilis	mournful underwing	Insect	2
Catocala residua	residua underwing	Insect	2
Catocala cerogama	Yellow banded underwing	Insect	2
Acronicta exilis	Exiled dagger moth	Insect	2
Acronicta lithospila	Streaked dagger moth	Insect	2
Papaipema araliae	Aralia shoot borer moth	Insect	2
Papaipema baptisiae	Wild indigo borer moth	Insect	2
Lepipolys perscripta	A noctuid moth	Insect	2
Scincella lateralis	Ground skink	Reptile	2
Heterodon platirhinos	Eastern hognose snake	Reptile	2
Lampropeltis getula	Common kingsnake	Reptile	2

Storeria occipitomaculata	Redbelly snake	Reptile	2
Virginia valeriae	Smooth earth snake	Reptile	2
Agkistrodon contortix	Copperhead	Reptile	2
Coragyps atratus	Black vulture	Bird	2
Strix varia	Barred owl	Bird	2
Caprimulgus vociferus	whip-poor-will	Bird	2
Colaptes auratus	Northern flicker	Bird	2
Myiarchus crinitus	Great crested flycatcher	Bird	2
Sitta pusilla	Brown-headed nuthatch	Bird	2
Vireo flavifrons	Yellow-throated vireo	Bird	2
Dendroica dominca	Yellow-throated warbler	Bird	2
Mniotilta varia	Black-and-white warbler	Bird	2
Seiurus motacilla	Louisiana waterthrush	Bird	2
Oporornis formosus	Kentucky warbler	Bird	2
Piranga olivacea	Scarlet tanager	Bird	2
Piplio erythrophthalmus	Eastern towhee	Bird	2
Icterus galbula	Baltimora oriole	Bird	2
Lasionycteris noctivagans	Silver-haired bat	Mammal	2
Lasiurus borealis	Eastern red bat	Mammal	2
Lasiurus cinereus	Hoary bat	Mammal	2
Canis latrans	coyote	Mammal	2

SGCN Species expected in Coastal Plain Forested Floodplains and Riparian Swamps			
Species	**Common Name**	**Class**	**Tier**
Satyrium kingi	King's hairstreak	Insect	1
Clemmys guttata	Spotted turtle	Reptile	1
Terrapene carolina	Eastern box turtle	Reptile	1
Nerodia erythrogaster	Plainbelly water snake	Reptile	1
Nycticorax nyticorax	Black crowned night-heron	Bird	1
Nyctanassa violacea	yellow-crowned night-heron	Bird	1
Buteo platypterus	Broad-winged hawk	Bird	1
Melanerpes erythrocephalus	Red-headed woodpecker	Bird	1
Hylocichla mustelina	Wood thrush	Bird	1
Parula americana	Northern parula	Bird	1
Setophaga ruticella	American redstart	Bird	1
Limnothlypis swainsonii	Swainson's warbler	Bird	1
Amblyscirtes aesculapius	Lace-winged roadside-skipper	Insect	2
Libytheana carinenta	American snout	Insect	2
Anacamptodes pergracilis	Cypress looper	Insect	2
Chloropteryx tepperaria	Angle winged emerald moth	Insect	2
Manduca jasminearum	Ash sphinx	Insect	2
Dolba hyloeus	Black alder or pawpaw sphinx	Insect	2
Haploa colona	A tiger moth	Insect	2
Orgyia detrita	A tussock moth	Insect	2
Catocala unijuga	Once-married underwing	Insect	2
Catocala praeclara	Praeclara underwing	Insect	2
Parapamea buffaloensis	A borer moth	Insect	2
Papaipema stenocelis	Chain fern borer moth	Insect	2

Gomphaeschna antilope	Taper-tailed darner	Insect	2
Gomphaeschna furcillata	Harlequin darner	Insect	2
Sympetrum ambiguum	Blue-faced meadowhawk	Insect	2
Enallagma weewa	Blackwater bluet	Insect	2
Hemidactylum scutatum	Four-toed salamander	Amphibian	2
Pseudotriton montanus montanus	Mud salamander	Amphibian	2
Hyla chrysoscelis	Cope's gray treefrog	Amphibian	2
Rana virgatipes	Carpenter frog	Amphibian	2
Opheodrys aestivus	Rough green snake	Reptile	2
Thamnophis sauritus	Eastern ribbon snake	Reptile	2
Agkistrodon contortix	copperhead	Reptile	2
Ardea herodias	Great blue heron	Bird	2
Casmerodius albus	Great egret	Bird	2
Egretta thula	Snowy egret	Bird	2
Egretta caerulea	Little blue heron	Bird	2
Egretta tricolor	Tricolored heron	Bird	2
Bubulcus ibis	Cattle egret	Bird	2
Plegadis falcinellus	Glossy ibis	Bird	2
Buteo lineatus	Red-shouldered hawk	Bird	2
Strix varia	Barred owl	Bird	2
Vireo flavifrons	Yellow-throated vireo	Bird	2
Protonotaria citrea	Prothonotary warbler	Bird	2
Helmitheros vermivorus	Worm-eating warbler	Bird	2
Oporornis formosus	Kentucky warbler	Bird	2
Piranga olivacea	Scarlet tanager	Bird	2
Icterus galbula	Baltimore oriole	Bird	2
Lasionycteris noctivagans	Silver-haired bat	Mammal	2
Nycticeius humeralis	Evening bat	Mammal	2

SGCN Species expected in Early Successional Upland Habitats			
Species	**Common Name**	**Class**	**Tier**
Nicrophorus americanus	American burying beetle	Insect	1
Callophrys irus	frosted elfin	Insect	1
Papaipema maritima	maritime sunflower borer moth	Insect	1
Terrapene carolina	Eastern box turtle	Reptile	1
Lampropeltis triangulum	milk snake	Reptile	1
Branta canadensis	Canada goose (migratory)	Bird	1
Circus cyaneus	Northern harrier	Bird	1
Bartramia longicauda	upland sandpiper	Bird	1
Scolopax minor	American woodcock	Bird	1
Asio flammeus	short-eared Owl	Bird	1
Chordeiles minor	common nighthawk	Bird	1
Lanius ludovicianus	loggerhead shrike	Bird	1
Dendroica discolor	prairie warbler	Bird	1
Ammodramus henslowii	Henslow's sparrow	Bird	1
Cincindela scutellaris	festive tiger beetle	Insect	2
Atrytonopsis hianna	dusted skipper	Insect	2

Satyrium liparops	striped hairstreak	Insect	2
Satyrium liparops strigosum	stiped hairstreak	Insect	2
Callophrys gryneus	juniper hairstreak	Insect	2
Speyeria aphrodite	aphrodite fritillary	Insect	2
Speyeria idalia	regal fritillary	Insect	2
Boloria bellona	meadow fritillary	Insect	2
Paratrea plebeja	trumpet vine sphinx	Insect	2
Calyptra canadensis	Canadian owlet	Insect	2
Acronicta rubricoma	a dagger moth	Insect	2
Papaipema rigida	rigid sunflower borer moth	Insect	2
Cirrhophanus triangulifer	a noctuid moth	Insect	2
Schina septentrionalis	a noctuid moth	Insect	2
Plegadis falcinellus	glossy ibis	Bird	2
Cygnus columbianus	tundra swan	Bird	2
Coragyps atratus	black vulture	Bird	2
Colinus virginianus	Northern bobwhite	Bird	2
Pluvialis squatarola	black-bellied plover	Bird	2
Coccyzus erythropthalmus	black-billed cuckoo	Bird	2
Chaetura pelagica	chimney swift	Bird	2
Colaptes auratus	Northern flicker	Bird	2
Empidonax minimus	least flycatcher	Bird	2
Tyrannus tyrannus	Eastern kingbird	Bird	2
Toxostoma rufum	Brown thrasher	Bird	2
Dendroica pensylvanica	Chestnut-sided warbler	Bird	2
Icteria virens	Yellow-breasted chat	Bird	2
Piplio erythrophthalmus	Eastern towhee	Bird	2
Spizella pusilla	field sparrow	Bird	2
Pooecetes gramineus	vesper sparrow	Bird	2
Passerculus sandwichensis	savannah sparrow	Bird	2
Ammodramus savannarum	grasshopper sparrow	Bird	2
Dolichonyx oryzivorus	bobolink	Bird	2
Cryptotis parva	least shrew	Bird	2

SGCN Species expected in Impoundments			
Species	**Common Name**	**Class**	**Tier**
Podilymbus podiceps	Pied-billed grebe	Bird	1
Branta canadensis	Canada goose (migratory)	Bird	1
Anas rubripes	American black duck	Bird	1
Pandion haliaetus	osprey	Bird	1
Actitus macularia	Spotted sandpiper	Bird	1
Cygnus columbianus	Tundra swan	Bird	2
Anas platyrhynchos	mallard	Bird	2
Anas clypeata	Northern shoveler	Bird	2
Aythya valisneria	canvasback	Bird	2
Aythya marila	Greater scaup	Bird	2
Aythya affinis	Lesser scaup	Bird	2
Bucephala albeola	bufflehead	Bird	2
Lophodytes cucullatus	Hooded merganser	Bird	2

Pluvialis squatarola	Black-bellied plover	Bird	2
Himantopus mexicanus	Black-necked stilt	Bird	2
Catoptrophorus semipalmatus	willet	Bird	2
Calidris pusilla	Semipalmated sandpiper	Bird	2
Calidris alpina	dunlin	Bird	2

SGCN Species expected in Non-tidal Coastal Plain Streams			
Species	**Common Name**	**Class**	**Tier**
Alasmidonta heterodon	Dwarf wedgemussel	Bivalves	1
Alasmindonta undulata	Triangle floater	Bivalves	1
Lampsilis cariosa	Yellow lampmussel	Bivalves	1
Lampsilis radiata	Eastern lampmussel	Bivalves	1
Leptodea ochracea	Tidewater mucket	Bivalves	1
Ligumia nasuta	Eastern pondmussel	Bivalves	1
Gomphus fraternus	Midland clubtail	Insects	1
Cottus caeruleomentum	Blueridge Sculpin	Fishes	1
Acipenser brevirostrum	Shortnose sturgeon	Fishes	1
Acipenser oxyrinchus	Atlantic sturgeon	Fishes	1
Notropis bifrenatus	Bridle shiner	Fishes	1
Notropis chalybaeus	Ironcolor shiner	Fishes	1
Moxostoma macrolepidotum	Shorthead redhorse	Fishes	1
Ictalurus natalis	Yellow bullhead	Fishes	1
Acantharchus pomotis	Mud sunfish	Fishes	1
Percina peltata	Shield darter	Fishes	1
Actitis macularia	Spotted sandpiper	Birds	1
Anodonta implicata	Alewife floater	Bivalves	2
Elliptio fisheriana	Northern Lance	Bivalves	2
Strophitus undulatus	creeper	Bivalves	2
Photuris pensylvanica	A firefly	Insects	2
Photuris hebes	A firefly	Insects	2
Cordulegaster bilineata	Brown spiketail	Insects	2
Domogomphus spinosus	Black-shouldered spinyleg	Insects	2
Gomphus rogersi	Sable clubtail	Insects	2
Gomphus apomyius	Banner clubtail	Insects	2
Macromia taeniolata	Royal river cruiser	Insects	2
Tetragoneuria costalis	Stripe-winged baskettail	Insects	2
Helocordulia selysii	Sely's sundragon	Insects	2
Somatochlora filosa	Fine-lined emerald	Insects	2
Somatochlora provocans	Treetop emerald	Insects	2
Celithemis ornata	Faded pennant	Insects	2
Enallagma dubium	Burgundy bluet	Insects	2
Enallagma durum	Big bluet	Insects	2
Enallagma pallidum	Pale bluet	Insects	2
Enallagma weewa	Blackwater bluet	Insects	2
Nehalennia integricollis	Southern Sprite	Insects	2
Archilestes grandis	Great spreadwing	Insects	2
Gomphus plagiatus	Russet-tipped clubtail	Insects	2

Gomphus villosipes	Unicorn clubtail	Insects	2
Lampetra aepyptera	Least brook lamprey	Fishes	2
Lampetra appendix	American brook lamprey	Fishes	2
Anguilla rostrata	American eel	Fishes	2
Alosa mediocris	Hickory shad	Fishes	2
Notropis amoenus	Comely shiner	Fishes	2
Noturus insignis	Margined madtom	Fishes	2
Apeltes quadracus	Fourspine stickleback	Fishes	2
Enneacanthus chaetodon	Blackbanded sunfish	Fishes	2
Enneacanthus obesus	Banded sunfish	Fishes	2
Etheostoma vitreum	Glassy darter	Fishes	2
Pseudemys rubriventus	Redbelly turtle	Reptiles	2
Regina septemvitta	Queen snake	Reptiles	2
Anas platyrhynchos	Mallard	Birds	2
Lophodytes cucullatus	Hooded merganser	Birds	2

SGCN Species expected in Riverine Aquatic and Submerged Vegetation			
Species	**Common Name**	**Class**	**Tier**
Ischnura kellicotti	Lilypad forktail	Insect	2