# Sustainable Forest Management Plan
# Nassawango Creek Preserve

The Nature Conservancy
Maryland/District of Columbia Chapter

## Prepared by:

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**Updated October 2020**

We acknowledge, with respect, that the land we manage today is the ancestral homeland of the Pocomoke people, who stewarded this land throughout generations.

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|---|---|
| Owner: | The Nature Conservancy |
| Owner Contact: | 425 Barlow Place, Bethesda, MD 20814 |
| | Phone: (301) 897-8570 |
| Forest Location: | Wicomico and Worcester Counties, MD |
| | Latitude 38° 17' 11"N / Longitude 75° 27' 33"W |
| Tract Size: | 9,050 acres |
| Land Manager: | The Nature Conservancy, MD/DC Chapter and GFR Forestry, LLC. |

# Table of Contents

## Statement of Purpose

This forest management plan has been developed to guide the management activities of the Nassawango Creek Preserve property in accordance with the Forest Stewardship Council's standards, The Nature Conservancy's Certified Resource Manager (CRM) program, and the objectives of the landowner, The Nature Conservancy's Maryland/DC Chapter. The Forest Stewardship Council® is an international nongovernmental organization that promotes environmentally appropriate, socially beneficial, and economically viable management of the world's forests. To learn more, visit www.fsc.org. This plan has been written to guide activities on the property for at least the next ten years and will be reviewed and revised every ten years or more often as necessary. This plan is one component of the comprehensive management for this property, which also includes a detailed GIS-based resource inventory and written policies regarding the property's management.

The Nature Conservancy is an international, private, nonprofit organization whose mission is to preserve the lands and waters on which all life depends. To achieve this mission, the Conservancy uses a science-based, non-confrontational and market-based approach.

Nassawango Creek is located on Maryland's Lower Eastern Shore. With headwaters near the Maryland-Delaware border, it winds for 15 miles through extensive upland and bottomland forests before emptying into the Pocomoke River near Snow Hill, MD. Because of its centuries-old bald cypress stands and nearly 90 plant and animal species recorded within the watershed that are rare, threatened or endangered, Nassawango Creek has been a conservation priority for The Nature Conservancy since the founding of the Maryland Chapter in 1978. With nearly 10,000 acres in Conservancy ownership, the Nassawango Preserve is the largest of the Conservancy's 30 preserves in Maryland.

Three natural communities that occur in the watershed - coastal plain ponds, "xeric dunes" (sandy pine/oak uplands), and Atlantic white cedar swamps – are ranked as globally rare in the Maryland Natural Heritage Program's natural community classification. The watershed also harbors a remarkable diversity of native bird species, including 30 forest interior dwelling species (FIDS), 20 warblers, and a half-dozen species considered to be regionally significant.

The Conservancy's early land protection at Nassawango focused on floodplain and bottomland swamp habitats along the main stem of the creek and its major tributaries, as well as on unique wetland communities that harbor multiple rare plant and animal species. In later years the Conservancy expanded its conservation focus to include large areas of undeveloped, unfragmented upland forest in the Nassawango watershed and adjacent areas, with the ultimate goal of protecting and restoring habitat for all native species that still occur in the "Lower Shore" region of Maryland. Now, based on the terrestrial resilience work of Dr. Mark Anderson, the Conservancy also views the Nassawango area as part of a resilient and connected network, in fact the largest resilient area on the Delmarva Peninsula that will not be underwater in 100 years.

To accomplish this forest biodiversity goal, the Conservancy acquired approximately 6,000 acres of upland woods in the watershed, most of which was used in the recent past to grow loblolly pines for commercial timber and pulp production. Most of these lands are still dominated by loblolly plantations, in a variety of age classes. The Conservancy has been working to manage the existing loblolly stands until they reach marketable size, commercially harvest the trees, and use the revenue to carry out a long-term, comprehensive and carefully monitored native forest restoration program. Through carefully planned harvests, and the Forest Stewardship Council's certification, the Conservancy's Maryland/DC Chapter has made the commitment to 'working forest lands' as a critical conservation strategy.

Our ultimate goal is to restore the majority of the loblolly pine plantations to a diversity of habitats that more closely reflect the pre-European settlement forest conditions of the area. This long-term goal includes restoring Atlantic white cedar swamps, sandy xeric dunes, and mixed pine/hardwood forests. While there is no way to accurately set an end-date for restoration, we hope to have most of the planted loblolly pines harvested from the General Management areas by 2070. Our work to restore a native mix of species while controlling invasives is intended not set the clock back to a historical reference point, but to better prepare this important area for species evolution and flow, and resilience of the landscape in the face of climate change.

This plan represents an overview of all the tracts in the Nassawango Creek Preserve. Some individual tracts have had separate forest management plans prepared. The tracts that did not have individual timber management plans are covered in this overview. Most are tracts that are managed as reserves to protect the water quality of Nassawango Creek and its tributaries. Where timber management areas are involved, they are addressed as separate tract plans.

Much of the information in this overview was originally developed in conjunction with the Chesapeake Forest Project by Vision Forestry LLC and the Maryland DNR Forest Service, as the regional and landscape conditions of those properties and the Nassawango Creek Preserve are similar. Activities outlined in this plan were prepared in consultation with Maryland Department of Natural Resources Heritage Program (MD NHP) staff. We continue to consult with these and other relevant experts as we implement and modify this plan over time.

## Forest Certification

Forest certification was established in 2010 and maintained to the present under the Forest Stewardship Council's FSC-US Forest Management Standard (V1.1). As a member of the Certified Resource Management (CRM) Program within the Conservancy, the managers of the Nassawango Creek Preserve comply with the terms outlined in the 2020 MOA between the Group Manager and the MD/DC Chapter of The Nature Conservancy. As a member of this program, this property is FSC certified by NEPCon, Chain of Custody number: NC-FM/CoC-000238. Managers must report any of the following immediately to the CRM Program Director, Josh Parrish, Director, American Forest Carbon Initiative, josh_parrish@tnc.org .

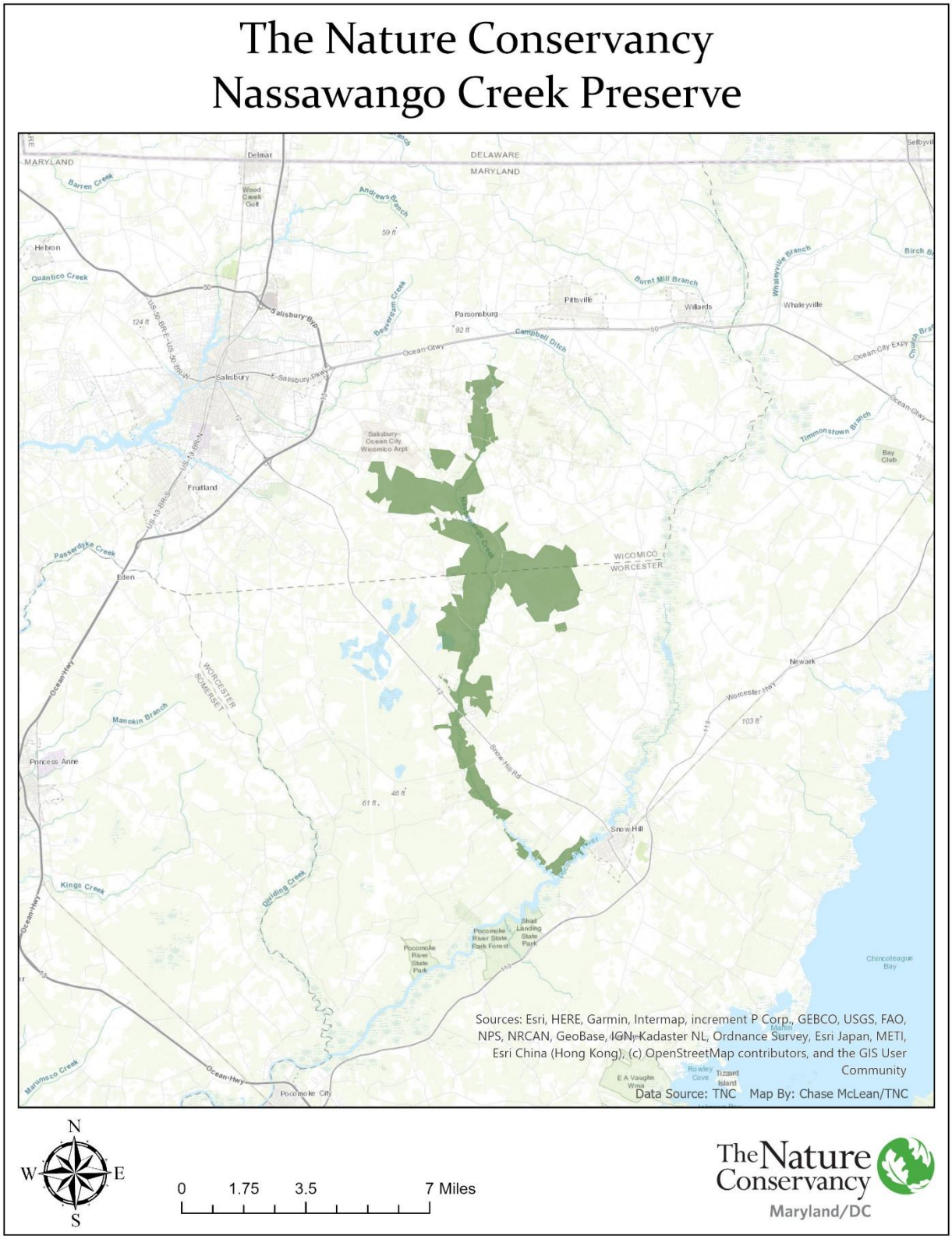
- Any changes in size of the property due to sales or acquisitions
- Any significant changes in staffing or deviations from the management plan
- The use of any plant seed mixture on the property
- The use of any chemical or biocontrol agents on the property.

## Property Description

### Ownership and Land Use

Nassawango Creek is the main tributary of the Pocomoke River and drains a watershed of more than 43,000 acres in the center of Wicomico and Worcester counties on Maryland's Lower Eastern Shore. As the northernmost riverine bald cypress swamp/southern hardwood bottom-land forest along the Atlantic Coast, Nassawango Creek has been recognized as a regionally significant natural area. Over four decades, the Conservancy has acquired nearly 10,000 acres in 63 named tracts to be held in perpetuity in fee simple. The tracts owned by the Conservancy are referred to in this document as the Nassawango Creek Preserve, or "the Preserve." Many of these tracts were formerly owned by private landowners and managed for commercial timber production. On Maryland's Coastal Plain, sub-surface rights are rarely severed from surface rights, because there are virtually no extractable minerals present. Thus, all the Conservancy's fee-interest properties at the Nassawango Creek Preserve include sub-surface rights.

On many tracts, other entities hold partial rights to the Conservancy's land, such as rights-of-way (ROW) for access or utility line maintenance. These interests are tracked on our land management SharePoint site. For the purpose of this plan, we have excised utility ROW's from the Certificate. We do not feel this compromises the Conservancy and FSC standards, as the chemicals used are all listed as acceptable under FSC (they are Garlon – *triclopyr*, Milestone – *aminopyralid*, and Escort - *Metsulfuron Methyl*). However, from an administrative standpoint, it is difficult to accurately track the utility company's management schedule. The acres certified also do not include the recently-acquired Taylor Tract, the site of a large wetland restoration, because an easement held by NRCS prohibits forest harvest on the wooded acreage of the tract.




**Map 1. General location map showing the Nassawango Preserve's boundaries and location southeast of Salisbury, Maryland.**

In addition to the Conservancy's 10,000 acres owned in fee simple, the MD/DC Chapter has assisted in the purchase of approximately 5,400 acres of land adjacent to the Nassawango Creek Preserve on behalf of the State of Maryland. These properties were subsequently transferred to the State as "co-op" or "assist" properties, to become State Forests.

For management purposes, the tracts have been grouped into six geographic complexes (Table 1) and four land use categories (Table 2). These attributes are contained in a Geographic Information System (GIS) that is designed to support both management planning and implementation in the future.

**Table 1. Tracts and Complexes, Nassawango Forests**

| ***Complex*** | Airport | Bear Swamp | Chesapeake | Dickerson | Johnson | Nassawango South | Grand Total |
|---|---|---|---|---|---|---|---|
| ***Tract Name*** | | | | | | | |
| Ace Timberlands Llc | 198.52 | - | - | - | - | - | 198.52 |
| Adkins 1 | - | - | - | - | - | 153.10 | 153.10 |
| Adkins 2 (1 Of 2) | - | - | - | 129.32 | - | - | 129.32 |
| Adkins 2 (2 Of 2) | - | - | - | 18.49 | - | - | 18.49 |
| Adkins 3 (N) | - | - | - | - | 150.46 | - | 150.46 |
| Adkins 3 (S) | - | - | 92.43 | - | - | - | 92.43 |
| Adkins 4 | - | - | - | - | - | 5.13 | 5.13 |
| Adkins 5 | - | - | - | - | 16.84 | - | 16.84 |
| Adkins 6 | 119.76 | - | - | - | - | - | 119.76 |
| Adkins 7 | 19.76 | - | - | - | - | - | 19.76 |
| Adkins 8 | 93.05 | - | - | - | - | - | 93.05 |
| Analytic Process Realty Group Inc | - | - | - | 17.63 | - | - | 17.63 |
| Carney 1 Of 2 | - | - | - | 7.84 | - | - | 7.84 |
| Carney 2 Of 2 | - | - | - | 11.00 | - | - | 11.00 |
| Chesapeake (Somerset) | - | - | 414.19 | - | - | - | 414.19 |
| Chesapeake Corporation | - | - | - | - | 25.59 | - | 25.59 |
| Chesapeake Corporation 2 (Sturges Creek) | - | - | 52.44 | - | - | - | 52.44 |
| Chesapeake Growers | 41.61 | - | - | - | - | - | 41.61 |
| Cordrey 1 | - | 79.91 | - | - | - | - | 79.91 |
| Cordrey 2 | - | 47.75 | - | - | - | - | 47.75 |
| Cubler | - | - | - | - | - | 31.86 | 31.86 |
| Dickerson | - | - | - | - | - | 71.83 | 71.83 |
| Dickerson/Quillen | - | - | - | 261.01 | - | - | 261.01 |
| E. S. Adkins 10 & 11 | - | 2285.80 | - | - | - | - | 2285.80 |
| E. S. Adkins 12 (Laws Road) | - | 47.76 | - | - | - | - | 47.76 |
| E. S. Adkins 13 | - | - | - | 7.67 | - | - | 7.67 |
| E. S. Adkins 14 (Airport Rofr Tract) | 141.95 | - | - | - | - | - | 141.95 |
| E. S. Adkins 9 (Airport) | 1066.42 | - | - | - | - | - | 1066.42 |
| Estate Of David Ward | 45.42 | - | - | - | - | - | 45.42 |
| Etienne | - | - | - | - | 81.39 | - | 81.39 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Ewing | | - | - | 92.25 | - | - | - | 92.25 |
| Foster (N) | | - | - | - | - | - | 469.85 | 469.85 |
| Foster (S) | | - | - | - | - | - | 112.59 | 112.59 |
| Fox | | - | - | - | - | - | 71.25 | 71.25 |
| Fulton 1 Of 2 | | - | - | - | - | - | 22.28 | 22.28 |
| Fulton 2 Of 2 | | - | - | - | - | - | 8.19 | 8.19 |
| Glatfelter 1 | | - | - | - | - | 273.96 | - | 273.96 |
| Glatfelter 2 | | - | - | 11.65 | - | - | - | 11.65 |
| Glatfelter Pulpwood Company | | - | - | 14.57 | - | - | - | 14.57 |
| Jones | | - | - | - | - | - | 3.82 | 3.82 |
| Jones/Lavish | | 88.71 | - | - | - | - | - | 88.71 |
| Moore | | | - | 68.11 | - | - | - | 68.11 |
| N & D Enterprises, Inc. | | 28.56 | - | - | - | - | - | 28.56 |
| Onley Sr 1 | | - | - | - | - | - | 19.55 | 19.55 |
| Onley Sr Ii | | - | - | - | - | - | 113.93 | 113.93 |
| Onley/Hudson 1 Of 2 | | - | - | - | - | - | 110.59 | 110.59 |
| Onley/Hudson 2 Of 2 | | - | - | - | - | - | 2.66 | 2.66 |
| Payne 1 | | - | - | - | - | - | 32.26 | 32.26 |
| Payne 2 | | - | - | - | - | - | 10.04 | 10.04 |
| Pusey (Stephen) 1 (Tnc) 1 Of 2 | | - | - | - | 7.55 | - | - | 7.55 |
| Pusey (Stephen) 1 (Tnc) 2 Of 2 | | - | - | - | 3.11 | - | - | 3.11 |
| Richardson | | - | - | - | - | | 7.85 | 7.85 |
| Salisbury Warehouse | | 37.92 | - | - | - | - | - | 37.92 |
| Surges Creek Llc 2 | | - | - | 9.75 | - | - | - | 9.75 |
| Sustainable Conservation, Inc. East 1 | | - | - | - | - | 177.53 | - | 177.53 |
| Sustainable Conservation, Inc. East 2 | | - | - | - | - | 72.69 | - | 72.69 |
| Sustainable Conservation, Inc. - Parcel 1 | | - | - | - | - | 1174.25 | - | 1174.25 |
| -Sustainable Conservation, Inc. Parcel 2 | | - | - | - | - | 55.44 | - | 55.44 |
| Townsend/Street (Tnc) | | - | - | - | - | - | 238.11 | 238.11 |
| Tyndall/Clark | | - | - | - | 100.37 | - | - | 100.37 |
| Tyson Chicken Inc | | 94.95 | - | - | - | - | - | 94.95 |
| Vessels | | 94.80 | - | - | - | - | - | 94.80 |
| Ward Estate (1985) | | 204.78 | - | - | - | - | - | 204.78 |
| *63 Tracts Total* | *Grand Total* | 2276.21 | 2461.22 | 755.39 | 563.99 | 2028.15 | 1484.89 | **9569.85** |

The property has been divided into four general land use categories (Table 2). Not all tracts are represented, therefore total acreage does not match acreage in Table 1.

**Table 2. Land use categories, Nassawango Forests**

| Complex | Buffer | Cropland | General | Reserve | Total |
|---|---|---|---|---|---|
| | | | *acres* | | |
| Airport | 129.8 | 32.9 | 756.6 | 1,125.1 | ***2,044.4*** |
| Bear Swamp | - | - | 1,300.3 | 1,104.4 | ***2,404.7*** |
| Chesapeake | 41.6 | - | 242.4 | 107.9 | ***391.9*** |
| Dickerson | 136.0 | - | 123.3 | 124.1 | ***383.4*** |
| Johnson | - | - | 951.1 | 538.3 | ***1,489.4*** |
| Nassawango South | 53.9 | - | - | 2,284.4 | ***2,338.3*** |
| ***Grand Total*** | ***361.3*** | ***32.9*** | ***3,373.7*** | ***5,284.2*** | ***9,052.1*** |
| Percent | 4.0% | 0.4% | 37.3% | 58.4% | 100.0% |

## Ownership Context

The Lower Eastern Shore of Maryland contains Wicomico and Worcester counties and is surrounded on two sides by the Atlantic Ocean and the Chesapeake Bay. Part of the Atlantic Coastal Plain, it is a mix of lowland flats, freshwater swamps, salt marshes, forested and non-forested wetlands and uplands. Elevations run from sea level to a maximum of only about 75 feet above sea level, and topography is flat to gently sloping. The climate is temperate, semi-continental and fairly uniform. Summers are hot and humid, with periods of drought common; winters are mild, but can be marked by cold, harsh winds and occasional heavy snowfall. Atlantic hurricanes and associated extreme weather disturbances may impact forest ecosystems, but they are rare. The average growing season ranges from 180 to 232 days per year depending on the area and water availability.

Land use patterns are dominated by water, wetlands, forests and farmland. Taken together, water areas and wetlands make up nearly 35 percent of the area within the boundaries of the region.

**Table 3. Land Cover, Maryland Eastern Shore (Caroline, Dorchester, Kent, Queen Anne's, Somerset, Talbot, Wicomico, Worcester)**

| Land Cover Category | Total Area | Percent |
|---|---|---|
| Open Water | 208,165 | 10.1% |
| Developed Open Space | 94,938 | 4.6% |
| Developed Low Intensity | 37,070 | 1.8% |
| Developed Medium Intensity | 14,407 | 0.7% |
| Developed High Intensity | 5,881 | 0.3% |
| Barren Land | 4,407 | 0.2% |
| Deciduous Forest | 72,418 | 3.5% |

| | | |
|---|---|---|
| Evergreen Forest | 99,123 | 4.8% |
| Mixed Forest | 83,087 | 4% |
| Shrub/Scrub | 10,775 | 0.5% |
| Grassland/Herbaceous | 2,124 | 0.1% |
| Pasture/Hay | 9,877 | 0.5% |
| Cultivated Crops | 786,946 | 38% |
| Woody Wetlands | 481,406 | 23.3% |
| Emergent Herbaceous Wetlands | 157,914 | 7.6% |
| **TOTAL** | **2,067,998** | **100.00%** |

Source: USGS NLCD 2016.

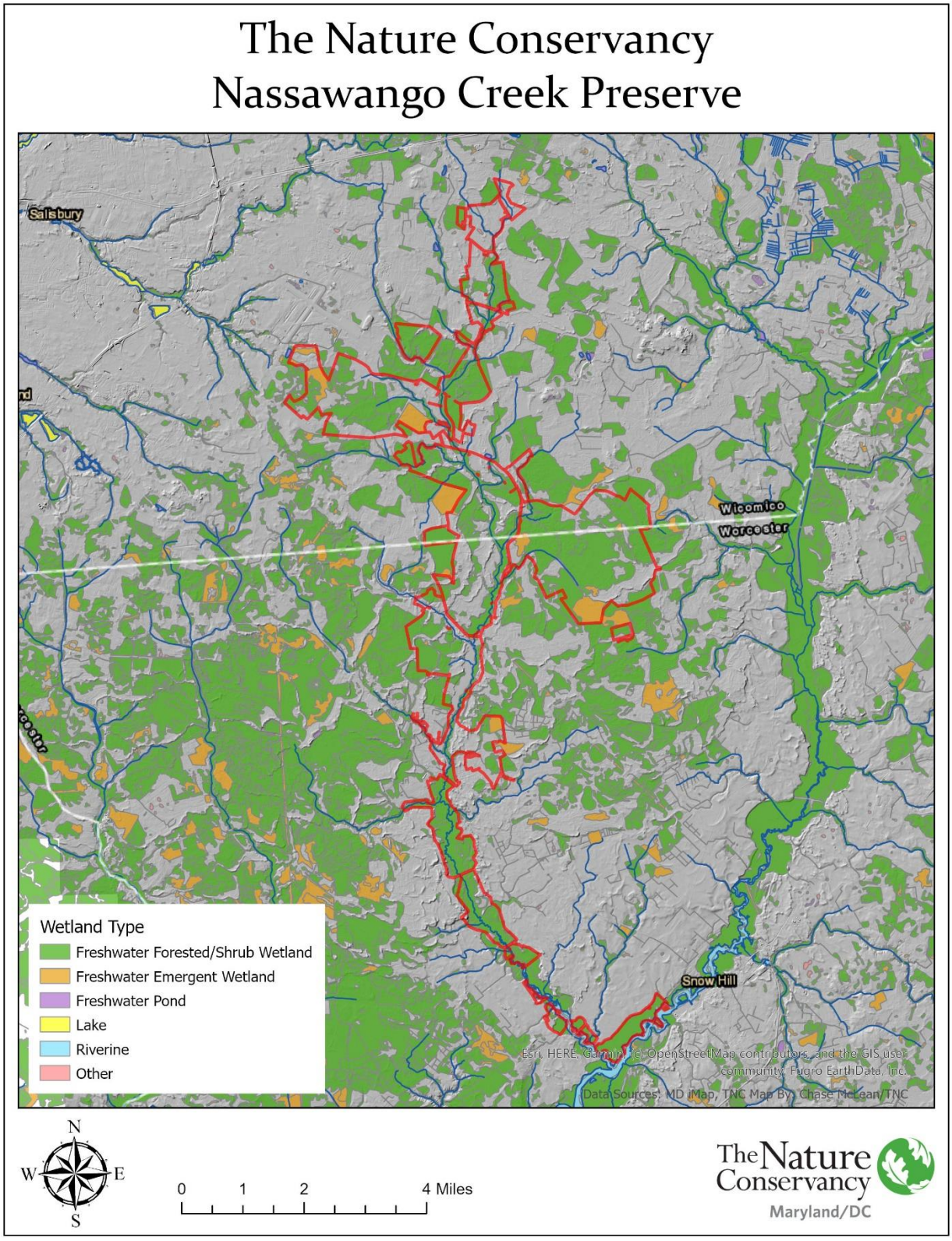
Agriculture and forestry are the most common industries on the Eastern Shore. Farming includes field crops such as soybeans, small grain, corn and vegetables. The main agricultural enterprise is the raising of poultry as broilers, most of which are processed locally before they are shipped to market. Some rearing of livestock is also present but not nearly as common as chickens. Forest products are also a significant source of income. Forested lands are also used for recreational purposes, and hunting leases are a common income generator.

Wet soils dominate the landscape and wetness is a primary factor in determining vegetative cover and management options. Drainage is the most common problem in managing soils, and artificial drainage practices have been common as a means of making soils suitable for agriculture or forestry.

The shores of the Chesapeake Bay and Pocomoke River, and the fields and forests of the adjoining lands are favorable habitat for a variety of wildlife, including game species such as deer and turkey. It is a key portion of the Eastern flyway for migratory waterfowl. Fish and shellfish in the Chesapeake are a major source of economic activity as well as an attraction for sportsmen and outdoor recreation.

Much of the land on the Lower Eastern Shore had been cleared for farming or used as farm woodlots before the establishment of the Nassawango Creek Preserve. When the depression era hit many of the farmers fell on hard times, resulting in the acquisition of large amounts of land by the Federal Government. In the mid to late 1930's the State was purchasing lands for management activities, and in 1954 the Federal Government deeded its holdings to the State. The State continues to purchase inholdings and other ecologically important areas along the Pocomoke River as large forest blocks are valued as contributors to the Maryland State Smart Growth objectives.

Taking adjacent lands into state or conservation ownership is seen as a way to prevent their further loss to development, and the further fragmentation of what remains of the intact blocks of forest in the region. At the same time, sustainable forestry is seen as a way of contributing to the forest-based portion of the region’s economy.




**Map 2. Wetlands map.**

## Management Objectives

The following are overarching goals that drive the management activities on the property. The order in which these goals are presented does not reflect their relative importance.

1. Maintain, restore, and enhance the biological diversity, water quality, and ecological integrity of the Nassawango watershed and the broader landscape context, using long-term, sustainable, forest management practices as a key tool in achieving this goal. Shift from primarily loblolly pine plantations to stands more representative of historic conditions, including shortleaf pine communities, savanna-like xeric dunes, and mixed pine/hardwood forests.
2. Promote age and structural diversity across the forested landscape.
3. Promote species composition of forests that are appropriate for the site characteristics by re-establishing historic fire regimes.
4. Meet the requirements of The Nature Conservancy's organizational objectives in all aspects of land management.
5. Reinvest revenue generated from sustainable production of forest products into the Preserve, as well as fund additional conservation work in Maryland.
6. Foster the sharing of lessons learned and future forest management innovation by establishing the property as an education and research center for ecologically-based land management.
7. Maintain positive, viable collaborations with other landowners to achieve individual and common objectives across the landscape.
8. Contribute to the local economy through forest jobs, forest products, and compatible outdoor recreation opportunities.

### Forest Management Principles

While achieving the management goals on this property, the Conservancy will adhere to the following set of management principles. The principles are grouped by categories.

### Protecting soil and water resources

- Ensure that all activities meet or exceed the State of Maryland's Best Management Practices (BMPs), State (MDE), County and Department of Natural Resources regulations and permitting requirements.

- Assess potential impacts of all management activities on soil and water resources before conducting those activities.

- Ensure that roads do not degrade water quality of wetlands and/or streams or modify sheet flows of water.

- Use the existing road network rather than constructing new roads and close or improve roads that are found to have negative impacts on water resources.

- Maintain culverts and bridges to ensure waterways are unobstructed.

**Promoting forest characteristics**
Silviculture should mimic the natural disturbance patterns of the landscape (such as those patterns caused by windthrow, native disease, and fire) where possible in keeping with current regulations and restrictions.

**Protecting wildlife and natural communities**

- When possible, consult with Maryland Natural Heritage ecologists before conducting activities in areas identified as Element Occurrences (EO's), which are rare species or exemplary natural communities.
- Assess proposed harvest sites for rare species and other wildlife considerations (vernal pools, raptor nests, etc.) before conducting harvests.

**Research**
Partner with academic institutions and other public and private forest land managers to incorporate practical, forest management-related research questions into harvests on the property.

**Property management**

- Identify all property boundaries before beginning any management activity, and consult with the adjacent landowner if a discrepancy is discovered or no existing survey evidence is present.

- Maintain a system of documentation to track all management activities on the property.

- Support local economy directly by hiring local loggers, using local mills, and indirectly by allowing access for activities such as bird watching, canoeing and hunting.

- Encourage use of the property for experimenting with 'low impact' harvesting practices and forest ecology research.

- Be a responsible landowner in the community by developing good working relationships with adjacent landowners, recreational enthusiasts, and community organizations.

## Ecological & Social Considerations

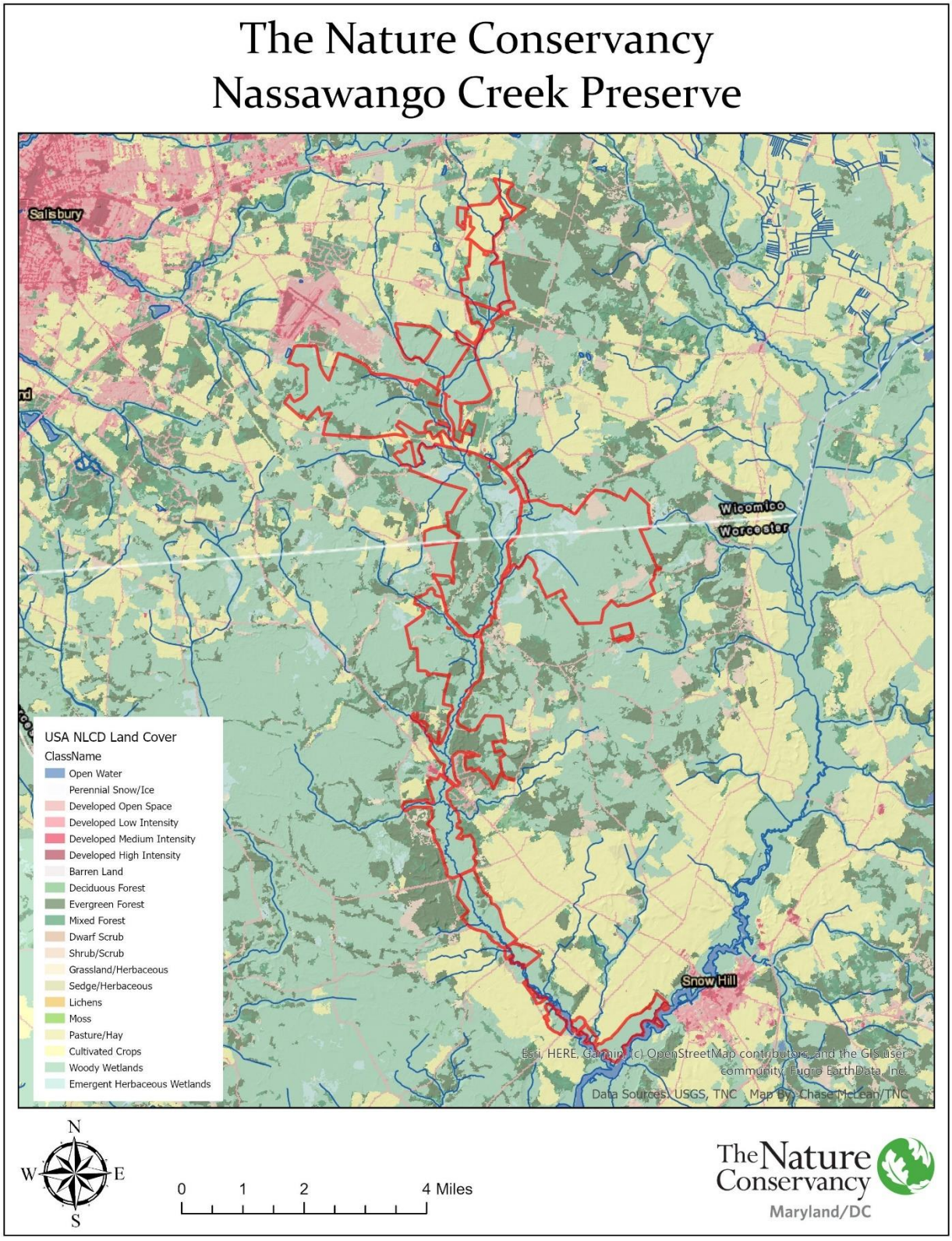
**Historic Forest Composition and Desired Future Condition**
Accurately determining the kind of forests that were present before European settlement is extremely difficult. Nearly all of the upland forests on the Eastern Shore have been logged or cleared several times since the area was first settled in the mid-17th

century. Much of the upland area not cleared for farming was converted to loblolly timber and pulp production in the early 20th century, so regional forest composition has been shifted toward pine and away from hardwoods. Ditching of virtually all stream headwaters has altered both surface and groundwater hydrology, and thus the structure and composition of adjacent forest communities. Also, many animal species, such as bear, red wolf, and cougar, have been extirpated, while the abundance of herbivores such as white-tailed deer has increased substantially (Maloof et al., 2010).

A Salisbury University study was commissioned by the MD/DC chapter of The Nature Conservancy to help piece together the historical composition of our forests using a variety of information sources, including pollen and witness tree records (Maloof et al., 2010). Results of the study indicate that at the time of settlement, pine, oak, and hickory were relatively common, and beech and maple were relatively rare. Maple may be absent from the pollen record because its pollen decomposes quickly, although it is also rare in the witness tree record. There is still ongoing research into the historical forest composition and as we learn more it will be incorporated into future management plans.

Regardless of the limits of our knowledge of historical forest composition, it is clear that very little natural forest remains on the Eastern Shore of Maryland, and that which remains is dramatically oversimplified. Thus, our long-term forest management goal for Nassawango is to eventually shift the forest composition from a loblolly pine-dominated system to one with a larger extent of older fire-maintained forest which more closely reflects historical forest communities. Through careful thinning and final cuts, our ultimate plan is to slowly transition these loblolly pine plantations to an assemblage of diverse, mixed age forest communities.

**Nassawango Creek. Photo by Alan Eckert.**




**Map 3. Forest Cover**

## Management Information

### Forest Management Approach

Our long-term goal for this preserve is to eventually shift the forest composition from a loblolly pine-dominated system to more diverse and resilient forest communities. With this conservation goal in mind, where applicable, Conservancy forestland can also produce valuable forest products including high-quality sawtimber. Harvesting generates income for Conservancy properties, which is reinvested into enhancement and maintenance of the property, and also contributes to the economic health of local communities.

Silvicultural prescriptions for Nassawango preserve are a combination of traditional even- aged forestry practices and progressive uneven-aged management techniques meant to emulate the prevailing natural disturbance patterns of the Coastal Plain.

Silvicultural activities are carried out exclusively on the General Management Area, which is composed of 80% loblolly pine, about 60% of which has been planted by previous owners in stands that are over 75% loblolly. About 40% of the remaining stands are from natural regeneration, and include both pure loblolly and loblolly-hardwood mixed stands.

## Allowable Annual Cut

For these production forests, an average rotation age of 50 years (40-60) is recommended, and harvest levels are calculated accordingly, with about 670 acres in each 10-year age group. That suggests an average harvest of about 67 acres a year, but with the diversity of harvest types that are planned, the average could be a bit higher since the Variable Density Harvests will only remove about 80% of the stand. Yield estimates are for managed areas only; reserves, riparian areas, non-forest, etc. have been left out of all modeling and estimates.

If harvests are conducted at age 50, and are composed mainly of Variable Density Harvests, anticipated yields will be about 10 tons of pulpwood and 86 tons of sawtimber (assuming VDH will harvest about 80% of the total yield) (Table 4). That would produce an annual average allowable cut of around 670 tons of pulpwood and 5,750 tons (960 MBF) of pine sawtimber. This will not include, however, the production from first and second thinnings in the silvicultural system. First thinnings produce around 20-25 tons of pulpwood per acre, but only minor amounts of sawtimber. This would add about 1,300 to 1,500 tons of pulpwood per year on average. Second thinnings produce around 10 tons of pulpwood and 18 (3 MBF) tons of sawtimber per acre, which should add around 650 tons of pulpwood and 1,200 tons of sawtimber to the annual yield. All told, this system should produce something around 2,600 tons of pulpwood and 7,000 tons (1,167 MBF) of pine sawtimber per year once a 50-year rotation is achieved that features two commercial thinnings and a Variable Density Harvest on around 60-70 acres per year each. This is reasonably consistent with the Remsoft model results. Note, however, that this relatively even output level is not possible until the system is more fully established. For the near future, it appears that the AAC should be

closer to 7,500 total tons of wood per year. According to the FIA data, the average annual growth of loblolly pine on the lower Eastern Shore is about 80 cubic feet per acre per year. This calculates out to about 2.34 green tons per acre per year. With 3,367 acres in the General Management area, that comes out to about 7,900 tons per year as an estimate of pine growth, so the 7,500 tons per year as an AAC seems reasonable.

Hardwood yields under this management system, and in this market situation, are considered an "incidental take," since they add almost nothing to the harvest returns and are generally harvested as part of the pine management system (e.g., to clear the site of invading red maple and sweet gums) or left as habitat retention during harvest. The FIA data on hardwoods for the lower Eastern Shore have very high uncertainties, so are not much help in estimating these potential yields.

**Table 4. Estimated yield of loblolly pine by age grouping**

| Loblolly pine (tons/acre) | | |
|---|---|---|
| **Age** | **Pulp** | **Sawlogs** |
| 0 | 0 | 0 |
| 3 | 0 | 0 |
| 7 | 0 | 0 |
| 12 | 0 | 0 |
| 17 | 33 | 8 |
| 22 | 29 | 26 |
| 27 | 25 | 56 |
| 32 | 22 | 71 |
| 37 | 20 | 83 |
| 42 | 14 | 101 |
| 47 | 13 | 107 |
| 65 | 10 | 110 |
| 80 | 10 | 110 |

**Table 5. Tentative 2010 10-year harvest plan by tract (total stand acres shown)**

| Year | Airport (2012) | | Ace (2014) | | Bear Swamp (2011) | | Ches./Som. (2013) | | D/Q - T/C (2010) | | Johnson | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Thin | Final Cut | Thin | Final Cut | Thin | Final Cut | Thin | Final Cut | Thin | Final Cut | Thin | Final Cut |
| **2010** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **2011** | 0 | 0 | 0 | 0 | 111 | 25 | 0 | 0 | 60 | 0 | 0 | 0 |
| **2012** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **2013** | 0 | 0 | 0 | 0 | 30 | 14 | 0 | 0 | 53 | 0 | 0 | 0 |
| **2014** | 0 | 0 | 0 | 25 | 174 | 0 | 192 | 0 | 0 | 0 | 0 | 0 |
| **2015** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 96 | 0 | 0 | 0 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2016** | 97 | 0 | 0 | 0 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0 |
| **2017** | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **2018** | 0 | 0 | 0 | 132 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **2019** | 0 | 0 | 0 | 0 | 255 | 288 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 6. Harvest totals to date, Johnson Tract (for MBF of sawtimber, divide tons by 6)**

| | Tons of Wood | | |
|---|---|---|---|
| **Year** | **Pine pulp** | **Pine Saw** | **Total Income** |
| 2005 | 3,422.8 | 386.14 | $ 34,145.54 |
| 2006 | 4,271.0 | 430.26 | $ 30,264.59 |
| 2007 | 9,478.9 | 184.97 | $ 42,581.80 |
| **Totals** | **17,172.7** | **1,001.4** | **$106,991.93** |

2020 Update:
Annual Allowable Cut for 2020 was calculated using volume control and area control methods. The pine forest methods were verified by growth and yield modeling for adjacent forestland by Vision Forestry and were compared to estimated growth for the states of Maryland and Virginia.

The volume control method was based on the local guideline for growth of 3.3 tons per acre per year, which is based on over 100 plots in the Mid-Atlantic Coastal Plain. The area method used a 40-year rotation for a typical loblolly pine plantation. We used a model developed by Virginia Tech (Ptaeda 4.0).

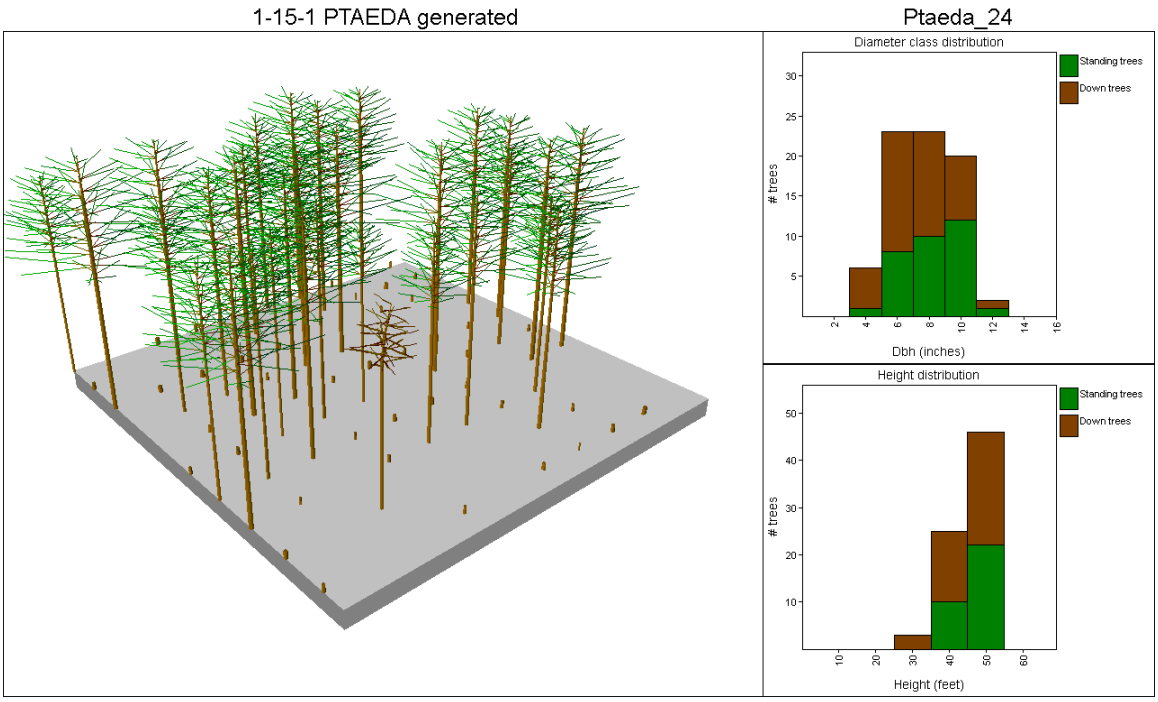



**Figure 1. Simulation using PTaeda software. The stand simulated is 1-15-1 the Airport stand harvested in 2020, cut to 60ft² per acre basal area (using the demo version, we can only use site index 50, our sites are probably site index 60 or 70).**

## Site Class

Since the management of the General Areas is based largely on the age and condition of loblolly pine stands, site class is not used as a distinguishing characteristic guiding the forestry program. These sites will generally run from 85 to 100 (age 50) for loblolly pine on these soils.

## Comprehensive Resource Inventory and Silviculture

A stand resource inventory for all general forest management areas was completed for the initial round of harvest plans. A long-term monitoring system following that of Jenkins et al. (2009) was initiated in 2011 for the entire Nassawango Creek Preserve.

Data collected with this inventory approach provided information on stocking levels and allowed for harvest plan development, while also tracking changes in vegetation cover over time. Attributes on forest stand structure, stand composition, forest regeneration, and wildlife habitat were also recorded. Plots were established for inventory on a ten-year cycle, with a pre- and post-harvest cruise done immediately before and immediately after a harvest.

The estimates of annual allowable cut are based on an area management scheme that calculates the area and age of pine stands and assures that the area harvested does not exceed the planned rotation over a 10-year management cycle.

**Variable Retention Harvests (*VRH*) and Variable Density Thinnings (*VDT*)**
Originating with Jerry Franklin in the Pacific Northwestern United States, Variable Retention Harvests (VRH) and VDT were the driving force behind the disturbance-based silviculture movement. Inherently, they are meant to give forest managers flexibility in distributing harvests or thinning in a non-uniform manner across the stand (Franklin et al. 1997). This approach is combined with the expanding gap and structural complexity units to maximize biological diversity across Nassawango Preserve.

**Traditional Silvicultural Management Approaches**
Loblolly pine-dominated stands occupy a large percentage (~40%) of Nassawango Preserve. As part of a balanced forest management plan, the revenue from the loblolly pine timber harvest is used towards native forest restoration and management across the rest of the Preserve. For those stands deemed inappropriate for inclusion of disturbance-based silviculture, more traditional forest management practices for plantations are employed. These tactics include thinnings in preparation for final harvest, after which the site will be allowed to naturally regenerate.

***Pre-commercial Thinning*** is normally done between ages 5 and 10 by labor crews using backpack saws. The goal is to achieve a well-spaced mixed stand that can be free to grow until the first commercial thinning.

***Commercial Thinning*** is done to prevent over-crowding and stress, while directing growth to desirable species. The first commercial thinning is normally done in loblolly pine stands at around 15 to 20 years of age. Thinning corridors are laid out to conform to the shape of the stand and the landscape, provide good visual appearance, and allow adequate access for the thinning operation. All trees are removed from the corridor, and selected trees (e.g. those that are smaller or less well-formed) are removed from the adjacent areas. Normally, around one-third of the volume in the stand is removed. Basal areas of around 80 square feet per acre are retained.

Second commercial thinnings are normally conducted 8-10 years after the first thinning, and generally remove about one-third of the remaining volume to achieve a basal area of 70-80 square feet per acre. Tree removal is designed to establish the stand density and structural condition desired for the mature forest. Concepts such as variable-density thinning have been utilized in the process of designing thinning projects so as to accelerate the development of structurally complex forest stands as early in the stand life as possible.

**No-Management Approaches**
To effectively measure comparisons between the two prevailing management approaches (traditional even-aged vs. disturbance-based silviculture) there are control stands across the preserve. These have been designated as part of the Reserve Management Area. No silvicultural activity is conducted in these areas. Instead, these

control groups allow us to compare the merits of pursuing forest management approaches. Additionally, a control group provides a benchmark for a "no action" strategy. Finally, this framework provides excellent opportunities for academic institutions and forest researchers to pursue scientific studies. Such research can provide data that will help us adapt our forest management plan and management strategies.

## Other Management Recommendations

***Tree planting*** may be needed if natural regeneration does not result in a diverse, pine/hardwood forest that reflects historic species compositions of Eastern Shore forests. Planting is normally done by hand, with minimal soil disturbance or preparation, and planted with either native deciduous or evergreen tree species, from local sources when possible. In a few cases, particular species are targeted, such as planting Atlantic white cedar in low, wet areas.

***Prescribed fire*** is a management tool that can emulate natural ecosystem processes such as carbon and nutrient recycling, heat pulse on soils and plants, and control of unwanted vegetation. It is thought to have been a prominent historical factor in driving vegetation dynamics, whether from natural events such as lightning strikes, or human-caused, such as fires set by Native Americans. Prescribed fire requires skillful application, and must be implemented in compliance with all permit and regulatory requirements of the Maryland Department of Natural Resources Forest Service. The Conservancy has been re-introducing fire into the Nassawango landscape since 2009, through prescribed burns across the preserve. The results have been very promising, as demonstrated by pre- and post-burn vegetation surveys and bird studies. Prescribed fires continue to be conducted when feasible and appropriate.

***Vegetation control*** may become necessary where undesirable, exotic, or invasive species are involved. A variety of methods, including hand cutting and spot spraying may be appropriate under different situations. Any application involving chemicals is done in accordance with an application plan prepared by a qualified professional. Handling of chemicals and application is conducted by Conservancy staff trained in proper mixing procedures and safety precautions, or qualified contractors. All staff and contractors are required to wear appropriate PPE when handling chemicals. Contractors hired to treat with herbicides must be licensed and insured. Both contractors and staff who carry herbicide in their vehicles are required to have a spill kit and first aid kit appropriate for chemical treatment. When herbicide is used in or around wetland areas, the chemical and surfactant used will be approved for aquatic use.

The Conservancy views weed control as part of an overall site restoration program. The focus is on the desirable species and communities threatened by the invasive species, rather than on simply eliminating certain undesirable plants wherever they occur. Preventative programs keep sites free of species that are not yet established, but which are known to be present elsewhere in the region. Priorities are set for the control or elimination of established invasives on a site, according to their actual and potential

impacts on native species and communities. Action is taken only when careful consideration indicates leaving the invasives unchecked will result in more damage than controlling it with available methods.

The following adaptive management strategy is used: First, goals for a site are established and recorded. Second, species preventing us from reaching these goals are identified and assigned priorities based on the severity of their impacts. Third, control methods are considered, and if necessary, priorities are re-ordered based on likely impacts on target and non-target species. Fourth, weed control plans are developed based on this information, and implemented. These plans emphasize early detection and rapid response for species that threaten our management objectives at the preserve. Fifth, management action results are monitored and evaluated in light of the site goals. Finally, this information is used to modify and improve control priorities, methods and plans, and the cycle is started again. The Nassawango Invasive Species Plan contains more information on invasives control rationale .

***Property management and protection*** includes the periodic re-painting or marking of property boundaries in the forested areas, maintenance of roads, bridges, and gates, and the prevention of trash dumping within the forested areas. Dumping, vandalism, encroachment, and ATV trespass occasionally occur on the preserve. Conservancy staff are very proactive in preventing these problems through boundary posting, gating, and building relationships with neighbors. This is accomplished in part by Conservancy stewardship staff (including one site-based land manager), and a group of volunteers called the Nassawango Stewardship committee, which has primary responsibility for boundary line maintenance. The Committee clears and posts Conservancy signage along 10 to 15 miles of line per year, depending on weather and need.

## Timber Management and Harvesting Recommendations

***Forest Harvests*** are designed to retain important structural complexity and organic legacies, to facilitate effective forest regeneration, and to produce economic value. Harvest areas, riparian buffer zones, and special areas to be protected are marked by a qualified forester prior to tree removal. Retention of forest clumps, important wildlife trees, snags, and other forms of structural diversity are designated during the marking process (see guidelines that follow). Skidding activities and post-harvest treatments are designed to create soil conditions that encourage regeneration of native hardwoods and pines.

***Guidelines for Habitat Retention****:* Habitat retention features are incorporated into all final harvests. The following guidelines in selecting retention areas apply independent of the forest management approach employed. A goal of retaining no less than 2.5% of the harvest area in all final harvests over 20 acres was recommended by Vision Forestry. They used this percentage as a minimum for similar certified forest properties on the Eastern Shore. The Forest Steward Guild Guidelines released in February 2012 by the Forest Guild Biomass Working Group will also be used for final

harvests (Dickinson et. al 2012). This retention is in addition to (or to supplement) the habitat contained in riparian forest buffers.

In selecting the size, shape and location of habitat retention areas, the field forester considers:

- Location in relation to other habitats (connectivity)
- Size in relation to structural stability (large enough to be wind-firm, or to protect some interior shade and vegetative character)
- Shape and visual impact (avoiding straight lines, square areas, etc.)

As areas are selected for retention the following priorities are used to achieve acreage goals:

- Legal habitat protection requirements are met
- Important conservation/habitat areas are identified and protected
- Structural diversity is enhanced
- The acreage target is met

The nature of this management plan already protects and enhances habitat retention, but there are other opportunities for retention areas, such as:

- Delmarva Bays: Most of these seasonal ponds provide high quality habitat for unique plant and animal communities. Where they are not already part of a WSSC or ESA, these should be buffered appropriately, and in some instances used to build a retention area. Where feasible they should be connected to one another.
- Den or Snag Trees: Identify quality den and snag trees and create a no harvest buffer around these trees. Where feasible, they should be connected to riparian areas or other retention features.
- Patches of different species: Whether hardwood or other species in a pine area or pine in a hardwood area retain these areas either as they are, or add no harvest areas if they are very small. Where feasible they should be connected to riparian areas or other retention features.
- Low, wet areas & seeps: These are areas that will either be obvious and can be flagged out before the harvest or won't be recognized until logging equipment begins working the site. Logging contractors are instructed to recognize and alert the supervising forester when they come across these wet areas.
- Ditches: While not being "streams" in the defined sense, these seasonally wet ditches can sometimes provide a useful anchor point for a habitat retention area. They may be particularly useful as corridors that connect other habitat areas.
- Where no natural features are found or available: Where there are no features on the ground from which to build a retention area, consideration should be given to natural regeneration potential. Patches of good seed bearing trees should be left to provide a seed source for natural regeneration. Prevailing winds and shape of the harvest should be a consideration when determining where to place these retention areas. Retention areas should be incorporated into streamside

management zones or connected to adjacent stands creating peninsulas of habitat retention extending from these adjoining stands.

## Harvest Administration Procedures

Timber sales are carefully laid out to protect the important ecological features of the properties, such as vernal pools, xeric dunes, mature shortleaf pine stands, threatened or endangered species or habitats, or water quality into Nassawango Creek. Because most of the harvests are occurring in pine plantations, individual trees or groups of trees are marked for retention, rather than marked for harvest. Before a site is cleared for harvest, an on-site pre-harvest consultation is held between GFR Forestry, Conservancy staff, DNR Heritage, and other interested parties. These pre-harvest meetings cover details on layout and harvest specifications and help to ensure that management activities are compatible with any Element Occurrences on the site. Harvests are not offered for sale or shown to loggers until all parties are satisfied with the details of the proposal.

All harvests begin with an on-site pre-harvest conference. During this pre-harvest conference, particulars of the timber harvest are covered including thinning basal area targets, protection of no-harvest areas, Best Management Practices (BMP) specifications, spill kit requirements, etc. Detailed maps are provided to the logging crew and specific areas needing special attention are inspected and discussed. At this time, the most appropriate equipment for the job is also discussed, such as small equipment for working around sensitive areas, or balloon tires on large equipment if working near wet areas. Although there are some limitations to the range of equipment that is available to us on a particular harvest, due to the small number of operators remaining on the Eastern Shore, we try to obtain the most appropriate machinery available for each situation.

As the sale progresses, the forester conducts and records at least one BMP inspection weekly which includes among other items, road and skid trail conditions, streamside management zones, protection of residual trees, basal area checks where applicable and utilization practices. A final close-out inspection is made at the end of the job to assure that all specifications have been met.

Timber sale agreements or cutting and hauling agreements should require that the logging contractor is a Maryland Master Logger or is a logger who is actively pursuing that recognition status. Appropriate chain-of-custody documentation is provided in timber sale contracts and materials provided to logging and trucking contractors.

## Operations

<u>Logger performance</u>
The forest managers (GFR Forestry) conduct a pre-harvest site visit with the logging contractor to discuss the details of the harvest and performance requirements. During

active harvesting, GFR conducts weekly timber sale site visits to ensure that the logging contractors' activities are meeting the standards expected by the Conservancy.

Expenses and Revenues
GFR Forestry tracks time and expenses as part of a monthly invoicing system. GFR receives individual payments from timber sales and provides summary payments to the Conservancy. On an annual basis GFR compiles a summary of expenses relating to the management of the property as well as a summary of the income generated from timber sales.

Boundaries and Roads
As part of every timber sale, if applicable, property boundaries are identified and marked. Road conditions, including road-stream crossings, are monitored closely during harvest operations and also during general property reconnaissance in order to identify areas of concern or in need of maintenance, or unauthorized use.

In general, the roads in the Nassawango preserve are not heavily used, and erosion is minimal, due to the generally flat topography. In summer 2010, The Conservancy's seasonal field crew inventoried and mapped roads and stream crossings on the preserve. They used GPS units to map roads that are not shown in GIS layers and recorded coordinates of all culverts and bridges. They also photographed water crossings and described their condition so that replacement and repair could be prioritized. The Conservancy has a contractor who regularly maintains roads and water crossings on managed tracts.

## Forest Conditions

In order to track progress toward the development of a diversity of forest characteristics on the actively managed portions of the property, the Conservancy and its partners work together to gather and summarize indicator data on a regular basis. Inventories of the property have been conducted using variable radius points first established in 2013 and last measured in 2015 using a systematic grid with a random start, and more recently using remote sensing. Starting in 2018 the Conservancy has contracted with Silvia Terra to provide information derived from remote sensing. The information provided includes trees per acre, basal area per acre, tree species diversity, and prescribed fire severity (dNBR).

### Birds as Indicators of Forest Condition

Birds have been shown to be good indicators of forested habitat condition. Our ongoing study at Nassawango examines how prescribed fire and timber harvesting impact bird diversity and singing activity using a soundscape analysis. We found a higher quality soundscape as measured by the mean normalized difference soundscape index (NDSI) in the thinned and burned site with lower mean trees per hectare. In addition, the thinned and burned forest had higher mean acoustic complexity and bioacoustic indices (ACI and BI). We also found that since 2005, the population of prairie warbler (*Setophaga discolor*) declined at the unburned (no thin) site as the canopy closed and

became more homogeneous. In contrast, prairie warbler continues to persist in nearby burned and thinned forest of approximately the same age. Prescribed fire combined with targeted timber management can increase the available habitat conditions required by different species of birds of high conservation need at Nassawango.

**Forest Size and Age Class Distribution**
Age classes across the property are typical for the mid-Atlantic region as mostly mid-successional and approximately 20-60 years old. Most stands are comprised of multiple age cohorts including under- and mid-story regeneration of <20 years old, a co-dominant over story of 20 – 80 years old, and a minor component of older trees, greater than 100 years old. Tree cores have been measured for a subset of managed stands as well as reserve areas to confirm ages of pines, Atlantic white cedar, and cypress.

## Current Forest Landscape Types

The forest types now present on these lands have been defined as follows:

***Bottomland hardwoods*** – Hardwood stands composed of southern baldcypress (T*axodium distichum)* mixed with sweetgum (*Liquidambar styraciflua*), swamp shite oak (*Quercus bicolor*), red maple (*Acer rubrum*), and river or water birch (*Betula nigra). These stands contain many large diameter dead and dying trees, as well as downed woody debris, making them excellent habitat for a wide variety of forest birds and other fauna.*

***Mixed Hardwoods*** – Hardwood stands composed of southern red oak (*Quercus falcata*), white oak (*Quercus alba*), sweetgum, black gum (*Nyssa sylvatica),* and red maple. Pine species are mainly loblolly pine (*Pinus taeda*), with some virginia pine (*Pinus virginiana*), shortleaf pine *(pinus echinata),* and pond pine (*Pinus serotina*) also found in the area. Some residual Atlantic white-cedar (*Chamaecyparis thyoides)* can be found. Over most of the area the understory is dominated by holly *(Ilex opaca*), high bush blueberry, and greenbrier in the wetter sites.

***Loblolly pine*** – Stands composed of 75% or more loblolly pine, with the remainder usually mixed hardwoods. Usually plantations established by previous owners, either through planting or natural regeneration after timber harvest.

***Pine hardwood*** – Stands composed of 50-75% loblolly pine, the remainder being mixed hardwoods that include southern red oak, white oak, sweetgum and red maple.

***Hardwood pine*** – Stands composed of 25-50% loblolly pine, with the remainder being mixed hardwoods as above.

***Non forest*** – these lands include open marsh, transmission lines, crop fields, cemeteries and other non-forested lands.

**Table 7. Forest cover types/representative sample areas and land use designations**

| Land use designation | Buffer | Cropland | General | Reserve | Total |
|---|---|---|---|---|---|
| Cover Type | | | *acres* | | |
| Bottomland Hardwoods | 2.4 | | - | 2,406.5 | 2,408.9 |
| Hardwood Pine | 34.2 | | 249.8 | 501.2 | 785.2 |
| Loblolly Pine | 135.8 | | 2,674.1 | 840.1 | 3,650.0 |
| Mixed Hardwoods | 8.4 | | 11.3 | 1,022.1 | 1,041.8 |
| Non Forest | - | 32.9 | 7.9 | 15.5 | 56.3 |
| Pine Hardwood | 180.5 | | 430.6 | 498.8 | 1,109.9 |
| Total | 361.3 | 32.9 | 3,373.7 | 5,284.2 | 9,052.1 |

The General Management areas are used for the management of production forests, where natural regeneration, thinning, longer rotations and variable retention harvests will create a diversity of timber types, vertical structure and ages. The forests in the General area are almost 80 percent loblolly pine, with a well-regulated age structure. Most of the loblolly pine has been planted by prior landowners, but almost all the other forest types have been the result of natural regeneration.

**Table 8. Cover type and age structure, General Management Area**

| Cover Type | HP | L | MH | PH | Total | Percent |
|---|---|---|---|---|---|---|
| Age Range | | | *(acres)* | | | |
| 0 to 10 | 17.1 | 752.7 | - | 97.5 | 867.3 | 25.8% |
| 11 to 20 | - | 796.3 | - | - | 796.3 | 23.7% |
| 20 to 30 | 5.1 | 776.4 | - | 33.4 | 814.9 | 24.2% |
| 30 to 40 | - | 200.2 | - | 51.2 | 251.4 | 7.5% |
| 40 to 60 | 223.2 | 99.2 | 11.3 | 244.0 | 577.7 | 17.2% |
| 60 to75 | 4.4 | 49.3 | - | 4.5 | 58.2 | 1.7% |
| Total | 249.8 | 2,674.1 | 11.3 | 430.6 | 3,365.8 | 100.0% |
| Percent | 7.4% | 79.4% | 0.3% | 12.8% | 100.0% | |

Note: Ages over 40 years are estimates.

**Table 9. Forest cover type and stand origin, General Management Area**

| Cover Type | Natural | Planted | Open | Total | Percent |
|---|---|---|---|---|---|
| Hardwood Pine (HP) | 249.8 | - | | 249.8 | 7.4% |
| Loblolly Pine (L) | 622.5 | 1,935.8 | 115.8 | 2,674.1 | 79.4% |
| Mixed Hardwood MH) | 11.3 | - | | 11.3 | 0.3% |
| Pine Hardwood (PH) | 430.6 | - | | 430.6 | 12.8% |
| Total | 1,314.2 | 1,935.8 | 115.8 | 3,365.8 | 100.0% |
| Percent | 39.0% | 57.5% | 3.4% | 100.0% | |

Reserves are areas that are left untouched unless there are some specific restoration needs, salvage, or other ecological reasons to enter them. Each forest cover type has a significant amount of land set in reserve, with 5,284 acres or about 58% of the total preserve acreage in reserve. The reserve areas contain many of the older High Conservation Value Forests (HCVF) that will continue to develop under the management plan. This also reflects our efforts to assess and protect Representative Sample Areas (RSA) as required by FSC.

**Table 10. Cover type and age structure, Reserve Management Area**

| Cover Type Age Range | HP | L | MH | NF | PH | Total | Percent |
|---|---|---|---|---|---|---|---|
| | | | | *(acres)* | | | |
| 0 to 10 | - | 211.1 | - | 15.5 | - | 226.6 | 4.3% |
| 11 to 20 | - | 47.5 | - | - | - | 47.5 | 0.9% |
| 21 to 30 | 0.2 | 103.5 | - | - | 48.5 | 152.2 | 2.9% |
| 31 to 40 | 25.1 | 130.3 | - | - | 1.3 | 156.7 | 3.0% |
| 40 to 60 | 307.8 | 11.2 | | | | 319.0 | 6.0% |
| 60 to 90 | - | 26.4 | | | 35.8 | 62.2 | 1.2% |
| 90+ | 168.1 | 310.1 | 3,428.6 | - | 413.2 | 4,320.0 | 81.8% |
| Total | 501.2 | 840.1 | 3,428.6 | 15.5 | 498.8 | 5,284.2 | 100.0% |
| Percent | 9.5% | 15.9% | 64.9% | 0.3% | 9.4% | 100.0% | |

Note: ages over 40 years are estimates
Buffers are maintained largely as no-cut areas, except where existing pine plantations need to be thinned to convert the buffer to a mixed hardwood stand. In those instances, high-flotation equipment are carefully used to prevent soil disturbance while removing selected trees and maintaining a 70% or higher canopy cover at all times.

**Table 11. Land Use**

| Land use designation | Buffer | Cropland | General | Reserve | Total |
|---|---|---|---|---|---|
| Cover Type | | | *acres* | | |
| Bottomland Hardwoods | - | - | - | - | - |
| Hardwood Pine | - | - | 20.92 | 726.43 | 747.35 |
| Loblolly Pine | 50.7 | - | 1,355.25 | 704.44 | 2,110.39 |
| Mixed Hardwoods | 2.9 | - | - | 223.43 | 226.33 |
| Non Forest | - | 32.9 | - | - | 32.9 |
| Pine Hardwood | 62.1 | - | 510.36 | 195.2 | 767.66 |
| Total | 115.7 | 32.9 | 1,886.53 | 1,849.5 | 3,884.63 |

**Table 12. General**

| Cover Type | HP | L | MH | PH | Total | Percent |
|---|---|---|---|---|---|---|
| Age Range | | | *(acres)* | | | |
| 0 to 10 | - | - | - | - | - | - |
| 11 to 20 | - | 496.99 | - | - | 496.99 | % |
| 20 to 30 | - | 391.14 | - | - | 391.14 | % |
| 30 to 40 | - | - | - | - | - | % |
| 40 to 60 | 20.92 | 164.98 | - | - | 185.9 | % |
| 60 to75 | - | 32.45 | - | - | 32.45 | % |
| Total | 20.92 | 1,085.56 | - | - | 1,106.48 | 100.0% |
| Percent | % | % | % | % | 100.0% | |

**Table 13. General**

| Cover Type | Natural | Planted | Open | Total | Percent |
|---|---|---|---|---|---|
| Hardwood Pine | 20.92 | - | - | 20.92 | % |
| Loblolly Pine | 261.72 | 1,093.53 | - | 1,355.25 | % |
| Mixed Hardwood | - | - | - | - | % |
| Pine Hardwood | 97.9 | - | - | 97.9 | % |
| Total | 380.54 | 1,093.53 | | 1,474.07 | 100.0% |
| Percent | % | % | % | 100.0% | |

**Table 14. Reserve**

| Cover Type Age Range | HP | L | MH | NF | PH | Total | Percent |
|---|---|---|---|---|---|---|---|
| | | | | *(acres)* | | | |
| 0 to 10 | - | - | - | - | - | - | - |
| 11 to 20 | - | 207.59 | 62.14 | - | - | 269.73 | % |
| 21 to 30 | | 130.6 | - | - | | 130.6 | % |
| 31 to 40 | | | - | - | | | |
| 40 to 60 | 212.54 | 36.71 | | | 28.1 | 330.81 | % |
| 60 to 90 | - | 4.8 | | | | 4.8 | % |
| 90+ | | | | - | | | % |
| Total | 212.54 | 379.7 | 62.14 | | 28.1 | 735.94 | 100.0% |
| Percent | % | % | % | % | % | 100.0% | |

## Disturbance Regimes

Much of this land outside of the most inaccessible swamps has had many timber harvests in the past, and some was probably cleared and used for agriculture in the early 20th century. Insect epidemics such as gypsy moth have affected hardwoods, while pines have been subjected to episodic outbreaks of southern pine beetle. Similar disturbances are likely to occur on a regular basis and maintaining large tracts of intact healthy forests is an important way of minimizing the damage these natural agents can inflict.

Historically, fire was also an important disturbance in these forests. In the case of southern pine beetle, fire-maintained pine forests have been shown to be more resistant. There is some evidence that Native Americans used fire on the Delmarva peninsula and prior to the advent of modern firefighting, lightning strikes were allowed to burn without intervention (Russel 1983; Schneider 1996). The Conservancy and State of Maryland partners are re-introducing fire into the landscape in habitat types that can benefit most from prescribed fire effects. Where appropriate, tracts that have been thinned are burned. However, the use of fire is constrained by nearby agriculture, primarily confined chicken houses, and transportation facilities such as the Salisbury Airport and nearby roads.

## Landscape Level Considerations

The main landscape feature on these lands is Nassawango Creek. Associated with this creek are Wetlands of Special State Concern (WSSC) that require a 100-foot upland buffer adjacent to the wetland and several Ecologically Significant Areas (ESAs) that provide rare early successional habitats associated with streams and bogs. Along with

measures to protect Nassawango Creek's wetlands and water quality, consideration is given in this plan to the sand ridges ("xeric dunes") in the property and the potential for these areas to be restored to an upland pine oak savanna ecosystem.

## Rare Species and Communities

The following descriptions have been developed in conjunction with the Maryland DNR Forest Service as part of the conservation planning work on the nearby Chesapeake Forest Project and the Pocomoke State Forest.

## State Listed Species of Concern on Maryland's Lower Eastern Shore

According to Maryland DNR, there are a number of current and historical rare, threatened and endangered animal species potentially found on or within a mile of the Nassawango Reserve lands.

**Table 15. State listed species likely to be found in the Nassawango vicinity**

| Species | Counties of Occurrence |
|---|---|
| Carpenter frog | Wicomico, Worcester |
| Eastern narrow-mouthed toad | Somerset, Worcester |
| Swainson's warbler | Wicomico, Worcester |
| Palamedes swallowtail | Somerset, Worcester |
| Red-cockaded woodpecker | Worcester |
| Red-bellied water snake | Somerset, Wicomico, |
| Frosted elfin | Worcester |
| Eastern pine barrens tiger | Worcester, Wicomico |
| beetle | Worcester, Wicomico |

**Carpenter frog** (*Lithobates virgatipes*) – According to the Georgia Museum of Natural History, the carpenter frog breeds from March to August in permanent to ephemeral waters. This frog is nocturnal and very secretive. It eats small insects and other small invertebrates and prefers slow-moving or standing water with a great deal of aquatic vegetation. Throughout its range, it is associated with acidic waters of bogs, swamps and backwater rivers. Its color blends well with these waters. This species is listed as In Need of Conservation in Maryland.

**Eastern narrow-mouthed toad** (*Gastrophryne carolinensis*) – According to the Savannah River Ecology Lab, narrow-mouthed toads can be found by flipping over debris in woodland areas near water, or in the wetlands at night during breeding season (summer mostly). Narrow-mouthed toads eat ants. Narrow-mouthed toads require fishless temporary wetlands, like vernal pools, coastal plain ponds, or Delmarva Bays in which to breed.

**Swainson's warbler** (*Limnothlypis swainsonii*) – Mature, rich, damp, deciduous floodplain and swamp forests with deep shade from both canopy and understory cover

are preferred habitats of Swainson's Warbler. On the coastal plain, the species occurs in the shadiest parts of the forest, with dense upper canopy, lower canopy and shrubs, and little herbaceous cover. The shrub stratum is often nearly monospecific stands of giant cane in floodplain forest; sweet pepperbush or fetterbush in swamps at the northern end of range such as the Great Dismal Swamp in Virginia and Pocomoke Swamp in Maryland and Virginia and headwater swamps of the Atlantic Coastal Plain; or scrub palmetto in bottomlands. Although often reported to inhabit canebrakes in the literature, it is clearly not exclusively a cane species; structure of the habitat - both overstory and dense shrub understory canopies characteristic of successional forests - is apparently of primary importance, and a variety of shrubs will do. Since the habitat is successional, rather than climax, management must be aimed at regenerating suitable dense-shrub understory conditions on a temporal and spatial rotation adequate to maintain the warbler in the general area. It has been observed to reoccupy clear-cut stands after a few years in South Carolina coastal plain bottomland hardwood habitat, but this has not been formally studied in the region. Published management recommendations suggest selective cutting of mature trees in warbler territories could be practiced if at least 70% canopy closure were maintained, clear cuts were no larger than 4 ha to minimize habitat disturbance, and contiguous woods should not be cut for 10 to 15 years to allow canopy regeneration in the cut-over area.

**Palamedes swallowtail** (*Papilio palamedes*) – USGS reports that Palamedes swallowtail caterpillar feed on plants of the Laurel family, especially redbay. Adult swallowtails feed on nectar from flowers of sweet pepperbush, thistles, blue flag, and azalea. Habitat includes wet woods near rivers and broadleaf evergreen swamp forests. Range of the Palamedes swallowtail spans the Atlantic coast from southern New Jersey (rare) to Florida and west and south along Gulf Coast to central Mexico.

**Red-bellied water snake** (*Nerodia erythrogaster erythrogaster*) – Maryland's Eastern Shore is the northern extent of this species' North American range. It occurs in forested swamps, freshwater marshes, drainage ditches, and low, wet areas (Mitchell 1994). It feeds on fish, crayfish, frogs, and salamanders. It is named for its characteristic flame-red chin, neck and belly.

**Frosted elfin** *(Callophrys irus)* – The frosted elfin is a small (1" – 1 ¼" wingspan) butterfly in the family of gossamer-wing butterflies known as Lycaenidae. These butterflies are found in open sunny areas of dry woodland glades, savannas, grasslands, and roadsides where its primary host plant, sundial lupine (*Lupinus perennis*) grows. In Maryland, frosted elfins are also known to use false blue indigo (*Baptisia australis*) as a secondary host plant. The adult flight period of the frosted elfin in Maryland is April through May. It lays its eggs singly on the leaves of the lupine. Caterpillars hatch out a few weeks later and feed upon the flowers and fruits of the lupine. Each caterpillar then burrows into the duff or soil and pupates, or forms a chrysalis (a hard-shelled cocoon). The pupa stay in this chrysalid stage for the rest of the year, overwintering in the soil/duff. In this pupal stage, the bodies of the caterpillars break down and reform as adults, ready to break out in the spring and continue their life cycle. Adult frosted elfins, not strong fliers, don't stray too far from their host plant.

**Eastern pine barrens tiger beetle** *(Cicindela abdominalis)* - The eastern pine barrens tiger beetle is a small, 8-11mm, tiger beetle that is found in dry, open and exposed white sand areas within pine/oak barrens and woodlands. These beetles can be locally abundant in good quality habitat. Adult beetles are active in Maryland through July/August. Larvae live in burrows up to 30in deep within the same open sandy habitats where adults are found. The larvae overwinter in these burrows and then pupate in the spring.

## Rare Communities

***Inland sand dunes****:* This natural community is found on late Pleistocene-aged inland dunes and ridges in the Pocomoke River watershed. Inland dunes are best developed on the east sides of rivers and characterized by low-relief and a parabolic shape suggesting formation by northwest winds. Medium- and fine-grained sands of the Parsonsburg Sand Formation and other associated soil types comprise these dunes. Habitats are very dry and support fire-dependent mixed woodlands of pine, oak, ericaceous shrubs, and light-demanding species. Stands are often co-dominated by short-leaf pine (*Pinus echinata*)*,* loblolly pine (*Pinus taeda*)*, s*outhern red oak (*Quercus falcata*), water oak (*Quercus nigra*), and sand hickory (*Carya pallida*) and are classified as a globally rare vegetation type in the U.S. National Vegetation Classification system (USNVC) restricted to the Delmarva Peninsula.

Open areas may be occupied by colonies of tiger beetles, specifically the eastern pine barrens tiger beetle *(Cicindela abdominalis* G3, S1) that requires deep sandy soils with light vegetative cover and minimal human disturbance. The Maryland NHP, together with Conservancy staff, have been monitoring this species on the preserve for numerous years. When it was time for our first harvest along the stretch of road where the beetles occur, NHP and Conservancy staff worked together with Vision Forestry to develop an experimental harvest plan that combined thinning, clear-cuts and buffers to see which benefited the beetle the most. These harvest techniques along with prescribed fire have yielded increases in the beetle population and their distribution at the site. In recent years the beetles have been observed occupying areas off the road and towards the interior of the clear-cut sites, which had not been previously seen.

***Delmarva bays (Carolina bays)***: Delmarva bays are seasonally flooded basin wetlands of nearly flat Coastal Plain uplands with fluctuating, seasonally perched water tables. These can vary from less than one-tenth hectare to four hectares in size and are generally one-half meter to one meter deeper than the surrounding landscape. In some cases Delmarva bays may be bordered by a subtle sand rim. Seasonal fluctuations in groundwater recharge and precipitation cause these wetlands to be irregularly flooded or seasonally inundated -- often void of surface water during very dry seasons or with standing water much reduced to a smaller area at the deepest point within the bay. Vegetation and community structure in a Carolina bay is closely linked to its hydrologic regime. Fluctuations in water levels may vary based on precipitation, evapotranspiration from bay vegetation, and groundwater pumping or depletion (for nearby agricultural purposes). Depth and duration of flooding is also important in influencing the vegetation of a particular community type. Based on water levels during the growing

season, changes in vegetation or community structure are often exhibited as concentric rings around the pond perimeter -- with community changes progressing to the center or lowest point within the interior of the pond. Species characteristic for this community type include warty-panic grass (*Panicum verrucosum*), reticulate nutrush (*Scleria reticularis*), and swamp tupelo (*Nyssa biflora*). All Delmarva Bay vegetation types classified in the USNVC are considered globally rare based on a limited distribution, overall condition, and small patch size.

***Tidal bald cypress forests and woodlands:*** Tidal forests dominated by bald cypress (*Taxodium distichum*) bordering mid to upper portions of the Pocomoke River and associated tributaries. Habitats are predominately freshwater and subject to periodic inundation by diurnal or irregular lunar tides. Stands are best developed on low floodplains forming a corridor between open tidal marshes and non-tidal habitats further inland. On the Pocomoke River, this community primarily forms a large (> 40 hectares) continuous fringing stand. Smaller stands typically form physiognomically distinct pockets and points along tributaries. Microtopographic features include pronounced hummock-and-hollows with numerous protruding cypress knees. Hollows are regularly inundated by tidal water, whereas hummocks are less frequently flooded thus supporting the establishment of trees and mesophytic herbs. Poorly drained and slightly acidic soils consist of variable amounts of silt, clay and fine sands mixed with organic materials. Species characteristic for this community type include bald cypress, swamp tupelo (*Nyssa biflora*), Easton's witch grass (*Dichanthelium spretum*), and creeping rush (*Juncus repens*). Tidal bald cypress swamps are recognized as globally rare natural communities.

***Tidal hardwood swamps*:** Tidal woodlands of regularly or irregularly flooded freshwater systems bordering the upper reaches of Maryland's Coastal Plain rivers and tributaries. Habitats are species rich and structurally complex with open canopies and floristically diverse multiple lower strata. Development and persistence of these habitats is apparently limited downstream by salinity gradients and upstream by the availability of sufficient sediment. Therefore, these habitats are primarily associated with the upper end of the freshwater portion of the salinity gradient. Typically, these woodlands form a distinct zone on low floodplains between dry, gradually sloping uplands and tidal emergent vegetation. Stand size is variable ranging from small patches in to large (>40 hectares), linear stands. Pronounced hummock-and-hollow microtopography is characteristic of this community type. Hollows are regularly inundated by tidal water, whereas hummocks are less frequently flooded thus supporting the establishment of trees and mesophytic herbs. Soils are poorly drained slightly acidic tidal muck consisting of variable amounts of silt or fine sands mixed with partially decomposed organic matter. Species characteristic for this community type include pumpkin ash (*Fraxinus profunda*), swamp tupelo (*Nyssa biflora*), and halberd-leaved tearthumb (*Persicaria arifolia*). Tidal hardwood swamps are considered globally rare and threatened by sea-level rise and non-native invasive species.

***Atlantic white cedar swamps:*** This is a mixed Atlantic white-cedar (*Chaemaecyparis thyoides*), red maple (*Acer rubrum*) swamp. In addition to Atlantic

white-cedar and red maple other canopy associates include sweet bay magnolia (*Magnolia virginiana*), swamp tupelo (*Nyssa biflora*), black gum (*Nyssa sylvatica*), loblolly pine (*Pinus taeda*), and pumpkin ash (*Fraxinus profunda*). The shrub layer is diverse and includes high bush blueberries (*Vaccinium corymbosum* or *Vaccinium formosum*) and laurel-leaved greenbriar (*Smilax laurifolia*). The herbaceous layer may have sparse to moderate cover and includes species such as cinnamon fern (*Osmunda cinnamomea*), partridge pea (*Mitchella repens*), Virginia chainfern (*Woodwardia virginica*) and various species of sedges (*Carex* spp.) growing on hummock of peat mosses. Remaining examples have a limited distribution, small patch size, and are susceptible to sea-level rise. Atlantic white cedar forests are globally rare and now reduced to small remnants of their former distribution by logging and suppression of infrequent catastrophic fire (i.e., stand replacement fires).

***Vernal pools:*** Vernal pools are typically flooded in winter to early spring or after a heavy rainfall but are usually dry during summer. Many vernal pools are filled again in autumn. Substrate is typically dense leaf litter over hydric soils. Vernal pools typically occupy a confined basin (i.e., a standing waterbody without a flowing outlet), but may have an intermittent stream flowing out of it during high water. This community includes a diverse group of invertebrates and amphibians that depend upon temporary pools as breeding habitat. Since vernal pools cannot support fish populations, there is no threat of fish predation on amphibian eggs or invertebrate larvae. Characteristic animals of vernal pools include species of amphibians, reptiles, crustaceans, mollusks, annelids, and insects. Vernal pool species can be categorized as either *obligate* (species that depend upon vernal pool habitat for their survival), or *facultative* (species that are often found in vernal pools but are not dependent on them and can successfully reproduce elsewhere). Obligate vernal pool amphibians include spotted salamander (*Ambystoma maculatum*), marbled salamander (*A. opacum*) and wood frog (*Rana sylvatica*). Fairy shrimp (Anostraca) are obligate vernal pool crustaceans, with *Eubranchipus* spp. being the most common. Facultative vernal pool amphibians include fourtoed salamander (*Hemidactylium scutatum*), red-spotted newt (*Notophthalmus viridescens*), spring peeper (*Pseudacris crucifer*), gray tree frog (*Hyla versicolor*), green frog (*Rana clamitans*), American toad (*Bufo americanus*), and Fowler's toad (*B. woodhousei fowleri*). Facultative vernal pool reptiles include painted turtle (*Chrysemys picta*), spotted turtle (*Clemmys guttata*), and snapping turtle (*Chelydra serpentina*). Facultative vernal pool mollusks include freshwater fingernail clams (*Sphaerium* sp., *Musculium* sp., and *Pisidium* sp.) and aquatic amphibious snails (*Physa* sp., *Lymnaea* sp., and *Helisoma* sp.). Facultative vernal pool insects include predacious diving beetles (Dytiscidae), whirligig beetles (Gyrinidae), dobsonflies (Corydalidae), caddisflies (Trichoptera), dragonflies (Anisoptera), damselflies (Zygoptera), mosquitoes (Cuculidae), springtails (Collembula) and water striders (*Gerris* sp.). Leeches (Hirudinea) are a facultative vernal pool annelid. Plants are predominantly hydrophytic, typically with a combination of obligate and facultative wetland species. Floating and submergent plants may be common, but emergent plants should be sparse or lacking.

***Pond pine woodlands*:** This natural community consists of woodlands or open forests dominated by pond pine *(Pinus serotina)* with a saturated hydrological regime that occupy low swales and fringes of basin wetlands dominated by maple, gum, and hydrophytic oaks. Stands of pond pine are occasionally mixed with Loblolly pine and have sparse to moderate shrub layers of high bush blueberry *(Vaccinium corymbosum)* and sweet pepperbush *(Clethra alnifolia)*. Few remaining examples exist and the ecological dynamics of these wetlands are poorly understood. Additional survey work is needed to identify representative stands, management needs, and threats of these natural communities. In its range (southern NJ, south to FL west to AL) pond pine is associated with globally rare communities susceptible to fragmentation and low viability due to contemporary fire suppression. In Maryland, this community is restricted to the lower Delmarva Peninsula with documented occurrences in Worcester County.

***Coastal plain seepage swales***: This seepage bog is currently known from the inner Coastal Plain from central and southern Maryland to southeastern Virginia. It occurs in saturated swales and headwater streams with extremely acidic, infertile soils, through which a constant supply of groundwater is discharged. Compositionally identical vegetation is more common where artificially maintained powerline rights-of-way intersect small streams and swales. The vegetation is usually a patchy shrubland, although scattered small trees of red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), and loblolly pine (*Pinus taeda*) occur at a few sites. The principal shrubs are smooth alder (*Alnus serrulata*), and sweet bay magnolia (*Magnolia virginiana*). Small to large, graminoid-dominated herbaceous openings occur among the shrubs. Characteristic herbaceous patch-dominants are slender beaksedge (*Rhynchospora gracilenta*), brownish beaksedge (*Rhynchospora capitellata*), *and* broome grass (*Andropogon glomeratus*), Areas of bare mineral soil are frequently carpeted by slender bladderwort (*Utricularia subulata*).

***Bottomland hardwoods*:** A diverse group of seasonally flooded forests that encompass most bottomland sites of the Coastal Plain. Historically, this forest type has experienced heavy harvesting pressure; high quality examples of this community type are scarce. Seasonally flooded swamps are usually dominated by combinations of green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), swamp tupelo (*Nyssa biflora*), willow oak (*Quercus phellos*), and overcup oak (*Quercus lyrata*). Well-drained levees support swamp chestnut oak (*Quercus michauxii*), cherrybark oak (*Quercus pagoda*), American elm (*Ulmus americana*) and river birch (*Betula nigra*) are often abundant in disturbed, cut-over stands. On small stream bottoms, where alluvial landforms and habitat conditions occur at very small scales, trees typical of both levees and swamps may occur in mixed stands. On exceptionally well-drained small stream bottoms, tulip-poplar (*Liriodendron tulipifera*) is often a common associate. Small tree, shrub, and herbaceous composition vary between sites.

## Riparian Areas

This entire property is composed largely of riparian areas, as the preserve itself is positioned around Nassawango Creek. Most riparian areas are contained within reserve areas, so will not be affected by mechanized travel. Where forest management is carried out adjacent to riparian areas, buffers provide water quality protection and undisturbed wildlife corridors. Riparian zones are treated on a site-by-site basis. Most major blue line streams are 300' on either side, intended more as a habitat buffer to provide corridors of mature forest for forest interior dwelling bird species, than as water quality buffer. Smaller old field ditches that may show up as blue lines are buffered according to Maryland BMP's, which is 50'.

## Reserves/Protected Areas

Reserves make up 58% of the Nassawango Creek Preserve and include nearly all lands that are adjacent to the creek itself.

## Non-Timber Forest Products

Currently the only known non-timber forest products being harvested from the property are white-tailed deer and turkey, which are lawfully hunted by private individuals and hunt clubs during the legal hunting seasons. There are other potential non-timber forest products on the property such as wild berries, mushrooms, and holiday greenery. However, the Conservancy has no intention to harvest any non-timber forest products from the property. If it seems desirable in the future to harvest such products, the impacts on the ecosystem would be carefully assessed and an amendment to this management plan would be written before beginning any harvest.

## Cultural Resources

There are eleven known cemeteries on the property. These sites are protected with buffers and located on GIS maps. Any additional cemeteries that are located will be buffered for protection and marked for future reference.

Native American activity on the lower Eastern Shore was all-encompassing, with villages, agriculture, fishing and hunting across the landscape. We work with local archaeological experts to protect sites of historical and cultural significance in the Nassawango watershed, and leaders of local tribes have been notified by mail of our harvest, certification, and restoration plans. If additional Native American sites are discovered on the Nassawango Creek Preserve, the managers will immediately notify state and federal authorities to assure the protection and proper care for the site.

The Conservancy donated its interest in the Visitor Center at Furnace Town to the Furnace Town Living Heritage Museum in 2020. The building was constructed in 1982 with the Conservancy's assistance. The museum houses the Nassawango Iron Furnace, which was constructed in 1829 near Snow Hill, MD. The Village of Nassawango

Hills developed in support of smelting iron. After it was abandoned in the 1850s the town crumbled until all that was left was the large brick furnace. Today, Furnace Town Living Heritage Museum offers a view of the village as it was in the 1800's, and includes programs in archaeology, history, nature, and artisan interpretations to educate the public. Additionally, the property to the north of the site, which is owned by the Conservancy, offers a hiking trail through a bald cypress swamp.

## Scenic Features and Recreational Use

The Nassawango preserve is open to the public. The most scenic vistas of the Nassawango Creek Preserve are viewed from the creek itself, and maintenance of reserve and buffer areas will keep those views intact.
Passive recreation is allowed, and there are seven official trails:

- Paul Leifer Trail behind the Furnace Town Visitor's Center
- Prothonotary Trail (aka Bluebird Trail) on the Payne 1 Tract
- Uhler Trail on the Payne 2 Tract
- Nassawango Joe Trail on the Adkins 1 Tract
- Ridge Trail on the Foster south and Dickerson Tracts
- Old Growth Trail on the Cordrey 2 Tract
- Audio tour trail on the Johnson Tract

The Conservancy has developed three audio tours available for download and use in the field, posted on its public website at nature.org . The Conservancy has placed three geocaches, which seek to attract an outdoor-minded audience to the Conservancy's land. Nature study and documentation of observations through citizen science platforms such as eBird and iNaturalist are encouraged.

There is one public canoe put-in on the Fox tract. As a general rule, ATV use on the preserve is prohibited, although a few exceptions are made for hunters, who can use designated existing ATV roads during deer hunting season.

**Members of the Nassawango Stewardship Committee. Photo by Matt Kane.**

## Neighbor Relations and Partnerships

The Conservancy takes a proactive approach to neighbor and partner communication in the watershed. The Volunteer Nassawango Stewardship Committee and its members have for over 40 years served as a positive presence representing the Conservancy to neighbors, local groups and visitors. Now that we have staff on the lower Shore we are able to provide an even stronger presence through local outreach events.

The Conservancy has worked closely with partner agencies to ensure the protection of Nassawango Creek in areas where ecologically sensitive habitats border or overlap neighboring properties. For example, on the Adkins VI tract, where a powerline right-of-way crosses a sensitive bog, we have asked the power company (Delmarva Power/DPL) to create a "No-Spray Zone," where no herbicides are applied. Our stewardship staff now maintains the ROW manually. On another tract (Foster) with state listed wild lupines (*Lupinus perennis*) along a roadside, we contact the Worcester County roads department annually, asking them to delay mowing until after the lupines have flowered and gone to seed.

On a larger scale, the Conservancy has worked with partners and neighbors to restore Horsebridge Creek, a heavily channelized "tax ditch" which flows directly into Nassawango Creek and is the greatest direct contributor of nutrient and sediment loads to Nassawango. Horsebridge Creek, which was first channelized in the late 1950's to help drain neighboring fields and thus aid farming, is now managed by the Horsebridge Creek Public Ditch Association (PDA), of which the Conservancy (as a neighboring landowner) is a member. Since the berm was established, there had been no seasonal natural flooding of the floodplain to the south of Horsebridge Creek, yet this area, which is dominated by a mix of cypress, black and tupelo gum and red maple, is dependent on cyclical flooding of the bottomland hardwood forest.

The goal of this project has been to restore the seasonal flooding regimen behind a large earthen berm (the now cut-off floodplain) created from the creek/ditch dredge spoils. It has given us the opportunity to work with partner agencies including the Horsebridge Creek PDA (made up largely of farmers and upstream users), the MD Department of Agriculture, the MD Department of Natural Resources (DNR) Chesapeake Forest Lands, DNR Wetlands Division, DNR Heritage, and the MD Department of Environment. Numerous berm cuts were made in the hopes of restoring flow, as well as allowing for the settling out of some nutrients and sediments that had been flowing unabated into the Nassawango. This diversion of floodwater also slows the flow of storm water entering the Nassawango. It is hoped that a total restoration of the creek to a more natural state can be achieved, while maintaining the benefit to the farm community upstream.

The Nassawango Stewardship committee is a volunteer group of preserve neighbors and supporters founded in 1979, two months after the first parcel of land was donated to the Conservancy. The founding members of the Stewardship Committee were advocates for the protection of Nassawango Creek before the Conservancy even became involved. Since then, Committee volunteers have served as our eyes and ears on and around the

property, alerting us to issues such as illegal dumping and ATV use, or notifying us of issues relevant to the preserve, such as proposed developments, or properties that come up for sale. The committee has also devoted many thousands of hours to maintaining property lines, building and maintaining trails and facilities, and promoting and supporting the Conservancy's mission at Nassawango Creek. The Committee remains very active, with quarterly meetings and a current membership of 45, with 12 - 25 volunteers regularly participating in workdays.

Licensed hunters are another important neighbor and partner to the Conservancy. There are over twenty hunt clubs on almost all tracts, totaling 11,959 acres of the Nassawango Creek Preserve. As per their license requirements, hunters ensure our boundaries are clearly posted, help maintain roads and culverts, keep illegal ATV use and dumping in check, and inform us of any issues that require attention. Hunters are also required to submit an annual hunting survey, which allows us to track deer harvest numbers, and track deer population trends on the preserve.

Local stakeholders covered neighbors, hunt clubs, the Nassawango Stewardship Committee, researchers, various State agencies, Conservancy members, and managers of neighboring private and State forests. Stakeholders are notified of our activities through the annual Fall meetings of Nassawango Stewardship Committee, at which the public is welcome, and though posting of this public version of the Sustainable Forest Management Plan on nature.org. The public may contact our staff through our general mailbox at contactmddc@tnc.org or our general office phone at 301-897-8570. Stakeholder response to our program is captured through Conversation Logs on our Land Management SharePoint site.

## Soils

The region features flat topography, near-sea level elevations, and poorly drained soils. Soils are naturally low in fertility, but soil erosion and sediment runoff are seldom a problem, given reasonable management care. Seasonally wet conditions affect the timing and type of management activities. As would be expected, most of these lands are wet, with almost all the area identified as wetlands in the National Wetlands Inventory.

Even though forest operations typically disturb soil far less frequently, and often far less significantly than is common in cultivated land, soil productivity can be damaged by inappropriate timber management activities. Soil characteristics and conditions are important in determining the type and timing of equipment usage, the practices needed to prevent soil erosion and sediment transport to nearby water, and the probable consequences of practices such as fertilization and herbicide usage.

The following soil management groups (SMG's) have been devised to group similar soils from a forest management standpoint on the Eastern Shore, limited to soil series found on Conservancy lands. In addition to helping plan appropriate silvicultural regimes,

soils maps are useful in identifying special wildlife management areas such as xeric dunes and other special features. Table 16 estimates the area of the soil management groups on the property, as follows:

- SMG 1 – Highly productive, wet soils with firm subsoils and perched water tables deeper than 24" that can physically support machines during moderately wet periods.
- SMG 2 – Highly productive, wet soils with shallow (< 24") perched water tables in the winter and non-firm subsoils that cannot support machines when wet.
- SMG 3 - soils that are less wet than either 1 or 2; moderately productive forest sites.
- SMG 4 - very sandy, dry soils that are generally not highly productive forest sites.
- SMG 5 - very wet, low-lying soils; usually too wet for forestry operations.

The Nassawango Creek Preserve is characterized, as typical for the region, by soils that are flat and wet. Almost one quarter of the area is classified as SMG 5, which are soils that are generally too wet for forestry operations. This is consistent with their designation as buffers and reserves. The general forest management areas occur on SMGs 1, 2, and 3. The most common soil, the Mullica-Berryland complex is part of SMG 2, which makes up almost half of the property (Table 17). Some of the interesting and rare communities are found in SMG 4, which contains the sandy soils.

**Table 16. Soil Management Groups**

| SMG | Acres | Percent |
|---|---|---|
| Water | 9 | 0.1 |
| SMG 1 | 1,242 | 13.7 |
| 2 | 4,348 | 48.0 |
| 3 | 219 | 2.4 |
| 4 | 1,158 | 12.8 |
| 5 | 2,097 | 23.1 |
| Total | 9,073 | |

**Dry, open exposed white sand areas found within pine/oak barrens and woodlands and locally known as "sugar sand," with insect tracks. Photo by Deborah Barber.**

**Table 17. Soil series and Soil Management Groups, in acres**

| | Soil Management Group | | | | |
|---|---|---|---|---|---|
| Soil Series | 1 | 2 | 3 | 4 | 5 |
| Askecksy loamy sand | 1,087 | | | | |
| Corsica mucky loam | 155 | | | | |
| Berryland mucky loamy sand | | 176 | | | |
| Falsington loam | | 19 | | | |
| Falsington sandy loam | | 389 | | | |
| Hurlock loamy sand | | 199 | | | |
| Hurlock sandy loam | | 556 | | | |
| Klej loamy sand | | 581 | | | |
| Klej-Galloway complex | | 620 | | | |
| Lenni loam | | 39 | | | |
| Lenni sandy loam | | 183 | | | |
| Mullica-Berryland complex | | 1,586 | | | |
| Fort Mott loamy sand | | | 4 | | |
| Hambrook sandy loam | | | 1 | | |
| Hammonton loamy sand | | | 47 | | |
| Hammonton sandy loam | | | 20 | | |
| Keyport fine sandy loam | | | 10 | | |
| Matapeake fine sandy loam | | | 6 | | |
| Pepperbox-Rockawalkin complex | | | 123 | | |
| Rockawalkin sandy loam | | | 3 | | |
| Sassafras sandy loam | | | 5 | | |
| Cedartown loamy sand | | | | 117 | |
| Evesboro loamy sand | | | | 274 | |
| Galestown loamy sand | | | | 60 | |
| Rosedale sandy loam | | | | 35 | |
| Runclint loamy sand | | | | 405 | |
| Runclint sand | | | | 263 | |
| Udorthents | | | | 4 | |
| Chicone mucky silty loam | | | | | 145 |
| Indiantown silt loam | | | | | 127 |
| Longmarsh and Indiantown | | | | | 150 |
| Manahawkin muck | | | | | 602 |
| Mannington and Nanticoke | | | | | 5 |
| Puckum mucky peat | | | | | 800 |
| Zekiah silt loam | | | | | 268 |
| Total | 1,242 | 4,348 | 219 | 1,158 | 2,097 |
| Percent | 13.7% | 48.0% | 2.4% | 12.8% | 23.1% |

## Geology

## Geology

Nassawango Creek and its watershed lie in the Coastal Plain physiographic region, bounded to the west by the Piedmont plateau and to the east by the Atlantic Ocean. The Coastal Plain is underlain by layered deposits of geologically young, mainly unconsolidated sand and clay, with lesser amounts of gravel, which form a relatively thin mantle above the crystalline rock substrate which extends from the Piedmont region. This wedge of basement rock dips continually southeastward across the Coastal Plain, ranging from 2000 to 5000 feet below the surface. The Coastal Plain Province in Maryland is divided into two topographically distinct subregions, the Eastern and Western Shores. The Nassawango watershed is contained within the Eastern Shore subregion, a generally low, flat plain lacking significant topographic features. Elevations in the watershed range from 5 to 65 feet above sea level.

Most of the surface deposits on the Lower Eastern Shore date to the Quaternary period (Pleistocene and Holocene), reflecting the fact that most of the Delmarva Peninsula was under water several times (probably 3) during the Ice Ages (approximately 125,000 to 15,000 years ago). Almost all of the upland in the Nassawango Creek watershed consists of the Parsonsburg Sand formation at the surface. This formation is mostly medium-grained loose sand (usually quartz), mostly light-colored (yellow, yellow-orange, pale red-brown or white). But the sand may be dark gray-brown where it lies near a basal unit of peaty sand and clayey silt that may be as much as 5 meters thick. Material from the peaty deposits date from about 30,000 years BP (Before Present) to 13-16,000 years BP. No macrofossils have been found in the basal peat layer, but microflora fossils (pollen) show that pine, spruce, and birch, and northern shrubs and herbs were common on the Lower Shore when the peat layer was deposited, indicating that the climate was much cooler and drier at that time.

The depth of the Parsonsburg Sand formation ranges from slightly more than 1 meter to about 6 meters, with an average of about 4 meters. Scattered across the formation are numerous low ridges or knolls of well-drained sandy soil, many of which have a curved or parabolic shape, and which appear to be wind-deposited features. These “ancient dunes” are particularly evident along the east side of major rivers on the Lower Shore (e.g., Nanticoke, Pocomoke) but they also occur throughout the formation in both Worcester and Wicomico counties. The origin of the Parsonsburg Sand formation, however, is complex. Although some areas show evidence of aeolian (i.e., wind-blown) origin, other locations may represent deposits derived from older formations.

Four other types of surface deposits occur in the watershed. First, along the floodplain of the main stem creek and major tributaries are Alluvium deposits of large sand, gravelly sand, and clayey swamp deposits. These sands are light-colored, loosely consolidated, moderately-to-poorly sorted, and fine to coarse grained. These deposits can be up to 2 meters thick but are generally less than 1 meter. Gravel is abundant in many areas. Swamp deposits are dark-colored sandy clays rich in organic matter. Some of the carbonaceous materials in these deposits have been dated to the early Holocene (i.e., 9,000 yrs BP).

Second, surface deposits in the uplands of the lower portion of the watershed, from Furnace Road to the Pocomoke River, are predominately materials from the Kent Island Formation. This formation consists of interstratified clay, silt and sand, and in some places has abundant fine organic matter (one sample dated to 37,000 yrs BP). The Kent Island Formation ranges in thickness from 1 meter to 13 meters, and is most widespread in the Pocomoke River valley, in the upland adjacent to the floodplain Alluvium. The Kent Island Formation appears to be bay or estuary deposit of an ancestral Chesapeake Bay formed during the Middle Wisconsin period, when sea levels and the Bay were much higher. The absence of marine fossils or salt-marsh deposits in the Kent Island Formation indicate that the Bay was freshwater at that time.

Third, surface deposits from the Omar Formation are exposed in narrow bands parallel to the creek and sandwiched between the floodplain Alluvium and the upland Parsonsburg Sand formations, but only between Millville Creek and Sand Road (more or less). This formation is much older than those described above, dating to the Lower Sangamon period, 90,000 to 120,000 years BP. The Omar Formation is the dominant surface deposit east of the Pocomoke River, but west of the river it generally lies below the Parsonsburg Sand layer. Thus, its occurrence along the lower creek is somewhat anomalous. There is also a broad plain of Omar deposits at the surface in the upland area bounded by Nassawango Creek, Dividing Creek, and the Pocomoke River.

Finally, the oldest geologic deposits at Nassawango Creek are those of the Walston Silt formation, which occurs as a broad area east and southeast of Salisbury that barely comes into the extreme western/northwestern edges of the watershed. This formation occupies the highest elevation areas of the Lower Shore, and dates to the Middle or Upper Pliocene. The Walston Silt underlays some of the Parsonsburg Sand formation west of the creek, but in turn it is underlain by the Beaverdam Sand Formation. Beaverdam Sand underlays most of the surface deposits in both Worcester and Wicomico counties and is dated to the late-middle or late Pliocene.

## Modeling Management Activities

Vision Forestry used the Remsoft Spatial Planning System to examine long-term implications of forest management options for The Nature Conservancy. The model constructed for the Nassawango Creek Preserve was a fairly simple one, with thinning and harvest activities limited to the General Management stands on the property. The Reserve and Buffer areas are contained in the model, and inventory estimates can be applied over them, but there are no harvesting operations involved. The model works from the GIS shapefile, so is linked to the management information system.

The model is programmed to carry out a first thinning on the pine stands in the General area at ages between 15 and 25. The model will stop thinning unthinned stands after age 25. Once they are thinned, there are no further activities allowed on these stands for 8 years.

Second thinnings are programmed to occur on land that has been thinned once 8 or more years earlier. These will occur between ages 25 and 35. Again, once a stand has been thinned, no further activities are allowed for 8 years.

Variable Density Harvests are carried out on stands that have been thinned twice once they reach the age of 40 or more. If unthinned stands reach age 45, they are eligible for VDH treatment as well. On a VDH, the stand age is set back to zero, and the regenerated stands will enter the thinning cycle again at age 15. The residual older trees will remain in the stand unless it is determined at that time that some should be removed.

Clearcut harvests are carried out on thinned stands at age 45 or on unthinned stands at age 50. These are designed to create even-aged patches that break up structural uniformity where it exists.

Using these activities and calculating yields and timber values on the basis of nearby Eastern Shore properties such as the Chesapeake Forest Project and The Forestland Group, estimates are made of the amount of activities that will be carried out on an annual basis. The model uses a random selection process to choose activities and seeks to create a regulated age structure within the General Management Area.

The model produces indicators, not specific activity plans. It cannot know when weather will be too wet for field work, or when there is no market or contractor available, so it schedules work on a regular basis. It also is willing to harvest very small areas—something that would be avoided under ongoing management. Despite these limits, the model produces interesting and useful results.

For example, after 20 years of variable harvest volumes, oscillating between pulp and sawtimber, the model finally settles into a pattern of fairly uniform total harvests from the General area, reflecting a high sawlog component as the rotation begins to become effective (Figure 2). The model is constrained so that both sawtimber and pulp harvest can only vary 25% from year to year, which is what produces the “flatter” line than is likely to result.

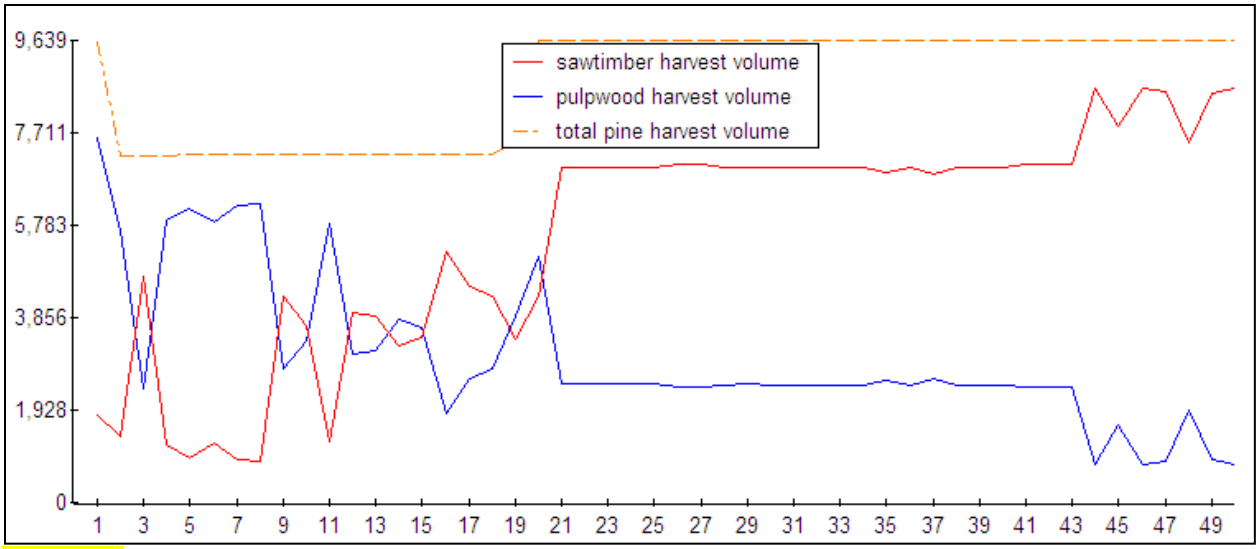



**Figure 2. Estimated pine harvest levels over 50 years**

Removing this much timber from the property each year is the result of an average harvest of about 80 acres a year. The amount of timber harvested from the General Management area is significantly less than the amount of pine eligible for harvest each year (Figure 3), illustrating the conservative nature of the harvest plan, and the wide avoidance of anything approaching an Annual Allowable Cut.

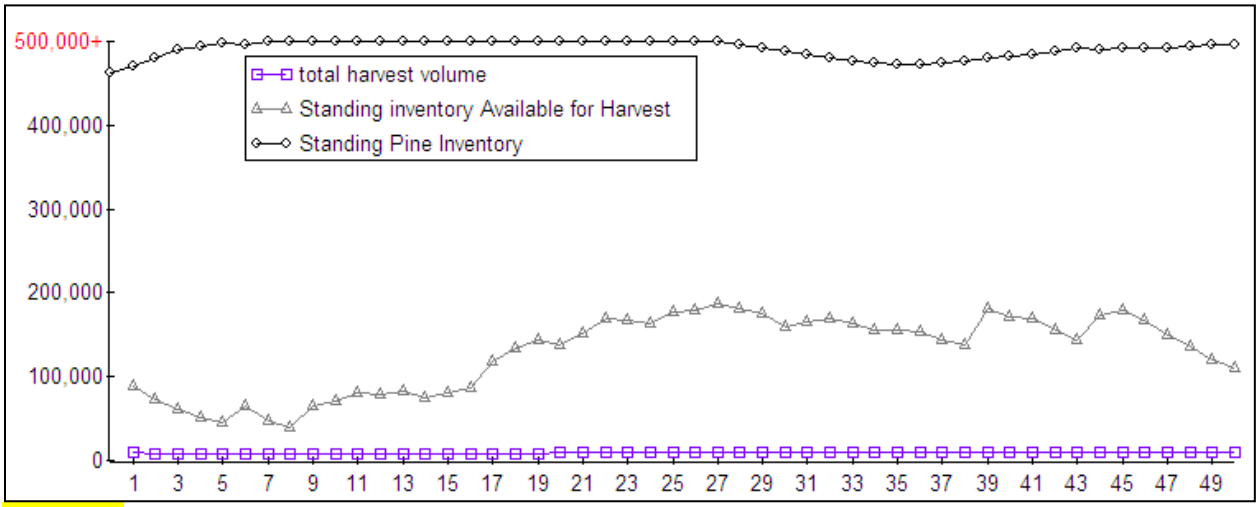



**Figure 3. Annual harvest volume compared to available pine inventory and total pine inventory**

**A prescribed burn on the preserve in March 2020. Photos by Chase McLean.**

## Literature Cited

Bennett, Nick; Perschel, Bob. Forest Guild Biomass Working Group. 2010 Forest Biomass Retention and Harvesting Guidelines for the Northeast. http://www.forestguild.org/publications/research/2010/FG_Biomass_Guidelines_NE.pdf

Maloof, Joan. 2010. A Tree Species Distribution Survey to Guide Restoration. *Maryland Naturalist*.

Russell, Emily W.B. 1983. Indian-set Fires in the Forests of the Northeastern United States *Ecology*, 64(1), pp. 78-88

Schneider, Daniel W. 1996. Effects of European settlement and land use on regional patterns of similarity among Chesapeake forests. *Bulletin of the Torrey Botanical Club*. 123(3) pp. 223-239.